

**Developing a safety risk control protocol to mitigate workarounds
and hazards on construction sites**

by

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Abstract

Construction is one of the most dangerous industries because of the numerous safety hazards that can result in fatalities or major injuries. Workarounds are a contributing factor to construction accidents, yet they receive little attention. To address the problem of accidents in the construction industry, the connection between workarounds and safety hazards on construction sites was investigated in this study. The pragmatic research philosophy used for the study enabled the solving of real-world problems, coupled with data collected using semi-structured interviews and survey questionnaires from case studies in Bloemfontein City, South Africa. The qualitative findings revealed that workarounds often arise because of incompetent or untrained workers, neglect of personal protective equipment, poor communication, and the pressure to prioritise productivity over the health and safety of the construction team. Quantitative analysis further reinforced these findings by demonstrating that poor quality materials, lack of training, and miscommunication contribute significantly to safety risks and, subsequently, compromise the productivity of contractors. The results of the analysis also emphasised the need for a well-defined risk control system, effective planning, and strict enforcement of safety measures by health and safety officers and site management. Furthermore, employees' ignorance of existing risk control systems was identified as a major challenge in ensuring compliance with safety protocols. To address these issues, a well-structured safety risk control protocol was developed based on the findings of the study. The aim of these measures is to mitigate the risks associated with workarounds, to ensure a safer working environment for construction workers.

Keywords: Accidents, Construction industry, Hazards, Safety risks, Workarounds, Risk control systems.

Dedication

I dedicate this research work to my fiancé, Bonelwa Qunta, for her love, encouragement and unwavering support for the past two years.

Secondly, I dedicate this dissertation to my father, Patrick Mona, for his motivation and encouragement whenever I felt discouraged, and always reminding me of all the times I have met obstacles in my academic pursuits and overcome them.

Thirdly, I dedicate this dissertation to my whole family, and I am proud of the fact that I have raised the Mona family's name high, despite difficulties, I have paved the way for those coming after me by being a living example that discipline and perseverance results in success.

Lastly, I dedicate this research to future Master of Construction students at the Central University of Technology. As part of the first cohort of Master students, I quote the words of the late, former president of South Africa, Nelson R Mandela: "It always seems impossible until it is done".

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Definition of Key Terms

Construction Industry: Refers to the industrial branch of manufacturing and trade related to building, repairing, renovating, and maintaining infrastructures.

Hazards: A hazard is defined as a potential source of harm or adverse health for an individual (Vitharan, De Silva & De Silva, 2015).

Health and Safety: Measures taken to prevent injuries, illnesses, and fatalities on construction sites. This involves identifying hazards, implementing control measures, and ensuring all personnel are trained and equipped to work safely.

Safety Management: Safety management is the process of controlling safety policies, practices, and procedures on construction sites (Manzoor & Othman, 2021).

Safety Risks: The projected likelihood and severity of the consequence or outcome from an existing hazard or situation.

Workarounds: Alter (2014: 1042) stated that workarounds are occurrences that transpire when an individual's goal opposes organisational goals, and when people are inspired to take shortcuts or undermine processes stipulated by corporate management, labour agreements, industrial standards, as well as government regulations. Workarounds are a problem that can cause accidents resulting in injuries or fatalities (Beerepoot, 2018: 1).

List of Abbreviations

CDC	Centres for Disease Control
DC	Developing Countries
H&S	Health and Safety
HOS	Occupational Safety and Health
ILO	International Labour Organisation
ISO	International Standards Organisation
JCS	Joint Committee Standards
OHS	Occupational Health and Safety
PPE	Personal Protective Equipment
QFD	Quality Function Deployment
RAM	Risk Assessment Model
RCS	Risk Control System
RCT	Randomised Controlled Trial
SREW	Safety Risk Early Warning System
SRIS	Safety Risk Identification System
WHO	World Health Organisation

Chapter 1: Background of the Study

1.1. Introduction

There is a poor record of health and safety (H&S) performance in the construction industry because of the negative attitude of frontline construction workers towards health and safety in the construction industry (Fang *et al.*, 2020: 104761). Improvement of health and safety is achieved by continual implementation, monitoring and reviewing of on-site H&S measures (Das *et al.*, 2016: 397). Contractors have a habit of focusing exclusively on the execution of a construction project according to the required standards and quality but overlook effective H&S measures to be taken, apart from taking into consideration the safety measures required when executing workarounds during construction processes (Beerepoot *et al.*, 2020:1). This is mainly because they would want to maximize profits and minimize cost relating to processes ensuring that H & S measures to be take.

The construction industry is prone to hazardous activities, and it has a high record of accidents and fatalities compared with other industries (Boadu *et al.*, 2020: 1993). The Health and Safety Executive revealed that the British Construction Industry had the highest level of fatal injuries across all their industries, with a total of 38 fatalities in 2017/2018 (Umeokafor, 2020: 16). Manu *et al.* (2018:188) revealed that the construction industry in developing countries, such as Malaysia and Singapore, recorded the highest number of fatal injuries compared with other industries. This is mainly due to a combination of inherent site hazards and systemic issues such as inadequate safety management, insufficient training, reliance on manual labor, and poor enforcement of regulations. Manu *et al.* (2018: 188) also mentions that developing countries display the worst H&S records. Mamman *et al* (2022: 167) revealed that, in Nigeria, trades, such as carpentry, masonry, iron bending and steel fixing, were recorded as having the highest risk compared with other trades.

Moreover, organisations in construction around the globe must place great importance on the implementation of risk management which includes concepts, such as risk identification and risk analysis, during commencement of construction projects (Okudan, 2021: 114776). It is imperative that the concept of risk management is taken into consideration in the construction industry because there are much more risks, hazard burdens, as well as uncertainties in the construction industry, as opposed to other industries because of the dynamic operations that

occur simultaneously at a rapid pace on construction sites (Moshood, 2020: 100064). In essence, regulation and compliance with H&S standards are among the fundamental pillars for improving and ensuring sustainable H&S in construction. These regulations are enshrined in the **Occupational Health and Safety** (OHS) Act 85 of 1993 is the legislation that seeks to protect the health, safety, and wellbeing of workers in South Africa. This does not only reinforce the significance of this study to developing countries (DCs) but also draws attention to an overlooked fundamental area for improving H&S in the construction industry around the globe both developing and developed countries (*Umeokafor et al, 2022: 1333*).

Emuze (2022: 2) conducted a study in two provinces of South Africa, in which unsafe work procedures and safety violations on construction sites were investigated. Unsafe procedures are a result of pressures from work, wanting to increase productively, inadequate supervision, miscommunication, deviation from safety rules, and unwillingness to follow safety procedures at work (Emuze, 2022: 2). It is known that health and safety measures adopted on construction sites will differ according to the nature and complexity of construction projects. Health and safety measures should be established after the nature of the project to be undertaken has been taken into consideration, as well as the risks pertaining to the execution of workarounds during construction operations have been considered (Guo & Zhang, 2022: 104256). Alter (2014: 1042) stated that workarounds are occurrences that transpire when an individual's goal opposes organisational goals, and when people are inspired to take shortcuts or undermine processes stipulated by corporate management, labour agreements, industrial standards, as well as government regulations.

Development of a safety risk protocol against workarounds and hazards, using an effective risk control system, must be implemented and deployed on construction sites to combat the hazard burden borne by executing workarounds which can threaten the health and safety of frontline construction workers (Beerepoot *et al.*, 2020: 1). Effective risk control systems entail various steps to be followed to achieve desired risk control against workarounds. These steps include policy, organising, planning and implementation, measuring, performance, as well as auditing and reviewing the risk control system to ensure an effective health and safety management system on construction sites (Khalid, 2021: 105402).

Given these issues, there is an urgent need to create effective practices to control safety risk

that, not only improve hazard mitigation, but also address the fundamental causes of workarounds on construction sites. The aim of this study was to identify factors that drive workarounds, assess their influence on site safety, and provide a systematic approach to risk management and compliance with safety standards to improve safety on construction sites. Therefore, by combining risk management concepts, behavioural safety methods, and technical solutions, the aim of the suggested framework is to improve construction site safety and limit the occurrence of workarounds that result in dangerous conditions in the South African Construction Industry (Ericson, 2015).

1.2. Research Problem

The construction industry environment is dangerous, with numerous activities taking place simultaneously at a rapid pace. These construction operations occur under pressure as there is always limited time because of fast-tracking of construction programmes and a rush to complete the overall project in time, thus workarounds become inevitable (Alter, 2014: 1042). When workarounds are executed on construction sites, the focus is mostly on how quickly they can be completed and is rarely on how safely they are conducted to eliminate all risks, as well as to maintain H&S of frontline construction workers (Beerepoot *et al.*, 2020:1). This is not because construction workers are indifferent to their lives; rather, the emphasis is often on rapid project completion and cost minimisation—such as meeting tight deadlines on publicly funded housing or road infrastructure projects in South Africa—where pressure to avoid delays and additional costs can result in the reprioritisation of processes required to ensure compliance with health and safety (H&S) standards.

The South African Construction Industry is like the construction industries of other developing countries, as there is a high rate of poor H&S procedures because of non-compliance with H&S regulations (Malomane *et al.*, 2022: 846). Emuze (2022: 1) emphasised that work pressures on construction sites influence frontline workers to deviate from safe work procedures and this has the potential to result in fatalities in the South African Construction Industry. According to statistics about construction accidents released by the Federated Employer's Mutual Assurance Company (FEM) for the year 2022, a clear indication is displayed that the South African Construction Industry has an urgent need for increased H&S measures and protocols to control safety risk. The FEM (2023: 2) statistics show that there has been a total number of 6157 accidents that occurred on construction sites, of which 48 were fatal accidents, and 605

accidents left frontline construction workers permanently disabled. FEM recorded a massive number of 69,079 lost days where the frontline construction workers were absent from work because of injuries, as well as occupational sicknesses because of the on-site activities, during the period of January to December 2020 (FEM, 2023: 2). It can be noted that everyone cares about their lives however, they overlook certain things as it will directly affect productively, cost implementations and completion of the projects

The statistics mentioned above-support the notion that construction operations are under strain because of the increased construction schedules and the need to finish projects on time (Malomane, 2022: 1). A procedure commonly implemented to alleviate work pressure is a workaround. Workarounds are implemented often on construction sites, but more attention must be devoted to how they can be managed to reduce hazards on construction sites (Beerepoot, 2018: 1). Workarounds are a problem that can cause accidents that result in injuries or fatalities (Beerepoot, 2018: 1).

Therefore, development of a protocol that will mitigate the occurrence of workarounds and hazards, using a safety risk control system in construction is necessary to combat safety risks associated with the execution of workarounds on construction sites. This is imperative for the following reasons: occurrence of workarounds is an under-studied phenomenon in the construction industry and, particularly, the development of an effective protocol to control safety risk that will mitigate workarounds and hazards on construction sites is an unexplored phenomenon (Alter, 2014: 1042). This poses a threat to the lives of the employees which mainly relates to the health and safety of the employees.

Secondly, the FEM statistics -mentioned above depict the number of accidents that transpired, including the number of fatalities that occurred, in the previous year and first six months of 2023, giving a clear indication that the South African Construction Industry has an H&S crisis (FEM, 2023: 1-2). The issue of frontline construction workers deliberately bypassing safety rules and performing life threatening workarounds in construction suggests the need for the development of an effective protocol to control safety risk that will mitigate the occurrence of workarounds and hazards present on construction sites (Alter, 2014: 1042).

1.3. Research Question and Sub-questions

The main research question of this study was: How would a protocol to control safety risk mitigate workarounds to reduce hazards on construction sites? Thus, the sub-questions were formulated as follows:

- What are the hazards linked to workarounds on construction sites?
- What are the risks linked to workarounds on construction sites?
- How do workarounds turn hazards into risks on construction sites?
- How would the development of a protocol to control safety risk mitigate workarounds and hazards on construction sites?

1.4. Research Aim and Objectives

The aim of this study was to develop a protocol to control safety risk that will mitigate workarounds to reduce hazards on construction sites. Thus, the research objectives were as follows:

- To identify hazards linked to workarounds on construction sites.
- To determine safety risks linked to workarounds on construction sites.
- To outline how workarounds turn hazards into safety risks on construction sites.
- To develop a protocol to control safety risk that will mitigate workarounds and hazards on construction sites.

1.5. Delimitations of the Study

- The development of a protocol to control safety risk that will mitigate the occurrence of workarounds and hazards on construction sites is the main contribution of the study.
- Case study projects were adopted for the collection of data for this study.
- Protocols to control safety risk to mitigate hazards are associated with workarounds.

1.6. Limitations of the Study

The primary data of this study were collected from frontline construction workers as well as construction professionals from different case studies in Bloemfontein City, South Africa. In addition, implementation of the newly proposed protocol to control safety risk to mitigate

workarounds and hazards might not be monitored easily, as workarounds are a random occurrence on construction sites.

1.7. Research Assumptions

Accidents, injuries and fatalities experienced in the construction industry affect the industry negatively. As a result, the causes of hazards in the construction industry can be prevented to mitigate accidents. Workarounds are connected to the hazards and are preventable, hence a safety protocol to mitigate workarounds and hazards on construction sites was developed in this study.

1.8. Research Design and Methodology Summary

1.8.1. Design

An exploratory research design was utilised for this study. An exploratory research design assisted the researcher to probe an understudied phenomenon in the construction industry in depth (Roberts *et al.*, 2023: 300). The research strategy used in this study was based on case studies, which made it possible to examine a phenomenon in a real-life context (Fernando & Bandara, 2020: 196). The types of case study selected for this research were multiple case studies, because three construction projects were used for data collection. Case 1 Started in November 2023 - December 2024, case 2 started in August 2023-April 2025 and case 3 started in September 2024-February 2025

(Isak, 2014: 29).

1.8.2. Sampling

The researcher selected a mixed-methods approach which therefore meant that two sampling methods were used. Thus, one method was suitable for qualitative research, and the second method was suitable for quantitative research. A purposive sampling technique was used for the qualitative data, as it enabled the researcher to choose a focus group deliberately based on the participants' experience in construction (Claessens *et al.*, 2022). A stratified, random sampling technique was adopted for the collection of quantitative data and was used for best representation of the population (Rahman *et al.*, 2023).

1.8.3. Instrument Design and Data Collection

In addition, the methodological choice for this study was mixed methods, which enabled the researcher to conduct investigations using both qualitative and quantitative methods (Almeida, 2018: 1). Mixed methods entail collecting data in a persuasive and rigorous manner, using both qualitative and quantitative methods. According to Remler and van Ryzin (2021: 57), qualitative methods include non-numerical data such as interviewing and observations. For quantitative methods, researchers analyse numerical data, using statistics, simple graphs and tables (Remler & van Ryzin, 2021: 58).

1.8.4. Data Analysis

The qualitative data were analysed using thematic data analysis. Conclusions based on case studies were grouped into codes, which were broken down into themes, then used to write a precise and logical analysis of the collected data (Braun & Clark, 2021). Quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS) (v2024, 30.0.0), to provide descriptive statistics which included mean score and standard deviation (Okagbue *et al.*, 2021).

1.9. Importance of the Study

The development of an effective protocol to control safety risk to mitigate workarounds and hazards remains an action that has not been implemented in-depth in the construction industry. The reason is that workarounds are regarded as being a means of achieving an end goal even though they might conflict with health and safety protocols on construction sites (Alter, 2014: 1042). Since the construction industry is one of the most dangerous industries in the world, there is a need for the development of effective guidelines to minimise the hazard burden and injuries of frontline construction workers during execution of workarounds, irrespective of the pressures of rushing to meet practical completion on construction sites (Azmat, 2020: 1). Injuries and fatalities that occur in the construction industry are because of the lack of incorporation of sound health and safety management systems on site, and ineffective protocols to control risk, which fail to control or eliminate hazard burdens which arise during the execution of workarounds on construction sites. Ineffective implementation of health and safety management systems can be attributed to senior management of organisations who regularly impose pressure of completion dates on construction teams, causing panic and anxieties among frontline workers that results in their overlooking H&S regulations, as they

are the main drivers of productivity on construction sites (Emuze, 2019: 497).

Thus, the aim of this study was to develop a protocol to control safety risk to mitigate the occurrence of workarounds and hazards on construction sites. As a result, the proposed protocol to control safety risk will encourage senior management on construction sites to deploy effective health and safety management systems to mitigate all risks and uncontrolled hazards during the execution of workarounds on construction sites.

1.10. Social Impact

The intention of this study was to address United Nations Sustainability Goals such as:

SDG 3: Good health and well-being

The proposed protocol will respond to SDG3 by promoting the health and safety of construction personnel when workarounds are executed on construction sites (Ebekoziem, 2023).

SDG 8: Decent Work and Economic Growth

A safer construction site not only will enhance the health and safety of workers on site but also will increase the economic growth of the contractor, since more money will be made from construction activities. As a result, less money will be spent seeking medical care for workers on site but, rather, the profits made will assist the contractor to grow, purchase newer plant machinery and be able to undertake more construction projects (Kronenberg & Fuchs, 2021).

1.11. Chapter Outlines

- Chapter 1: Introduction. In this chapter, the purpose of the study and emphasis on developing a protocol to control safety risk to mitigate workarounds and hazards on construction sites are described. The condensed study is then used to develop a problem statement. In this section, the premise of the study, research aims, scope, and significance are summarised. A well-planned research strategy can test the hypothesis and meet the objectives of the study. Important assumptions, an ethical statement, an overview, and a chapter summary are provided.
- Chapter 2: Relevant Literature Review. In this chapter, the literature about developing a protocol to control safety risk to mitigate workarounds and hazards on construction sites is evaluated.

- Chapter 3: Research Methods. Details about the research methods used for this study are provided. In this chapter, dependability, validity, sample methods, and data collection technology are considered.
- Chapter 4: Analysis and Interpretation of the Qualitative Results: The development of a protocol to control safety risk to mitigate workarounds and hazards on construction sites is discussed. The aims and essential results of the study are explained in this chapter.
- Chapter 5: Analysis and Interpretation of the Quantitative Results: The development of a protocol to control safety risk to mitigate workarounds and hazards on construction sites is discussed. The aims and essential results of the study are explained in this chapter.
- Chapter 6: Discussions of Findings: In this chapter, the findings pertaining to the development of a protocol to control safety risk to mitigate workarounds and hazards on construction sites are discussed.
- Chapter 7: Recommendations and Conclusions: This chapter contains the findings and recommendations.

1.12. Chapter Summary

In this chapter, the background of the study, the central question, sub-questions, statement of the problem, and the aim and objectives of the study were introduced. The key terminology used in the study is defined for clarity and understanding. The hypothesis was defined clearly and the delimitations, limitations and the importance of the study are mentioned.

Chapter 2: Literature Review

2.1. Introduction

In this chapter, the main areas of interest of this study are introduced, and the already existing literature pertaining to the research problem is discussed. The researcher identifies knowledge gaps in existing literature and seeks to discover more knowledge about developing an effective protocol to control safe risk to mitigate workarounds and hazards on construction sites. Thus, the purpose of study was to find strategies would contribute to the Safety risk control protocol to mitigate workarounds and hazards on construction sites.

2.2. Safety Rules and Safety Risk Control

According to Alsaadi and Norhayatizakuan (2021: 2), the construction industry is a pillar of success of modern countries because of the rapid economic development that has increased the demand for the construction of infrastructure and facilities around the globe. Alaloul (2021: 5012) mentioned that the construction industry accounts for at least R30 trillion worldwide and contributes immensely to a country's economy and gross domestic product (GDP). However, these construction projects face different types of risks during project execution, thus these risks should be identified, evaluated and carefully managed based on the expertise and knowledge possessed by health and safety officers, safety managers as well as other construction professionals (Alaloul, 2021:2).

This expertise is also known as risk control which is translated to safety rules or life-saving rules as purported by (Selleck *et al*, 2022: 1). Obondi (2022: 1) argued that a risk is an uncertain event that can affect project goals, such as cost, quality, scope, and time, negatively or positively. Obondi (2022: 1) explained further that project risk monitoring and control is a process of tracking identified risks, identifying and analysing new risks, monitoring the implementation of risk response plans, and assessing the effectiveness of risk management processes throughout a project.

Risk control is described as a suitable measure to mitigate or eliminate all risks present in a workplace (Osei-Kyei *et al.*, 2022:1). Risk control is also applicable to health and safety risks in any workplace, including construction. When risks have been identified, analysed and

assessed, then decisions about risk control measures to be taken should align with health and safety regulations pertaining to risk mitigation and control (Ershadi, 2020: 78). According to the Health and Safety Executive (HSE, 2019), many statutory provisions are qualified by words such as “so far as is reasonably practical” or “so far as is practicable”. These refer to assessments of the cost factor, the effectiveness and reliability of different control measures available.

Establishing and maintaining control is imperative to all management functions. The most effective way of achieving risk control in construction operations is by obtaining commitment to health and safety objectives from all the construction personnel on site (HSE, 2019). It begins with site management taking responsibility for factors that harm health and safety which ultimately result in injuries and accidents (Idoga, 2020: 1350). Co-ordination of the leadership on site and appointing experienced personnel as health and safety officers to ensure adequate co-ordination of safety measures, as well as inspecting implementation of the safety standards results in effective control of safety risk on construction sites (Salguero-Capparos, *et al.*, 2020:27).

Health and safety officers are usually the professionals on construction sites who are responsible for risk control, risk analysis, risk assessments, and setting the relevant health and safety standards which are appropriate for a particular project (Obuobi-Donkor, *et al.*, 2023:2). When managers on site create a positive working environment, this ultimately creates a positive health and safety culture among the overall construction team and ultimately creates a safer construction project (Othman *et al.*, 2020: 5). To achieve effective control of safety risk, emphasis on team effort and commitment is highly recommended in developing and maintaining systems to prevent the occurrence of unforeseen events long before they transpire (Shaikh *et al.*, 2023: 2). The main functions for successful health and safety management are grouped into three categories, namely: formulating and developing policies, planning and measuring, and effective implementation (HSE, 2019).

Risk management systems are a project management technique that includes identifying the risks in a project, determining their impact on the project, determining the measures that should be taken after the necessary arrangements are made, as well as considering uncertainties and potential hazards (Bayraktar, 2020: 237). Critical controls (CCs) are specific safety barriers, which: (i) directly prevent the unplanned release of energy, which causes major accident

events; (ii) directly prevent the escalation of consequences of events; or (iii) are unique controls within an event pathway (Selleck *et al*, 2022: 2). Risk control systems (RCSs) are the systems that are implemented to ensure that effective workplace precautions are controlled and maintained. RCSs vary according to the nature of potential hazards to which workers are exposed in the workplace. For instance, organisations in construction which are exposed to hazardous materials will require safe storage which would ensure that all flammables and toxins are safely stored away to minimise falling and exposure to elements of weather (Ostad Ali Askari, 2022: 64).

2.2.1. Compliance Communication and Information

According to Kim and Kim (2017), effective communication and information management are critical components in guaranteeing safety compliance on construction sites, but some obstacles remain. Also, Lambrinouidakis (2013) stated that the introduction of technological tools for hazard reporting and real-time warnings has increased the speed and accuracy of safety communications, allowing for instant risk reduction. Furthermore, safety reporting systems and real-time danger communication, such as wearable technologies, have demonstrated efficacy in improving compliance and averting accidents (Kim & Kim, 2017). However, substantial challenges exist, such as language and literacy issues that impede knowledge of safety protocols, particularly among workers from diverse backgrounds (Pereira & Werlang, 2022). Furthermore, the fragmented structure of communication networks between sub-contractors and teams results in inconsistent safety procedures, whereas a top-down communication approach frequently fails to involve workers effectively in safety conversations (Kim & Kim, 2017).

According to Pereira and Werlang (2022), to address these problems, firms must implement culturally appropriate communication methods and ensure that communication systems are integrated throughout all project teams, to support uniform safety practices. Furthermore, worker participation in decision-making processes regarding safety is crucial for increasing compliance and building a safety culture (Sapfirova, Volkova & Petrushkina, 2019). Through these techniques, construction companies can improve communication, which leads to improved compliance and, eventually, a safer working environment (Kim & Kim, 2017).

2.3. Control of Safety Risk in Construction

It is noted in the literature that the construction sector that employing 7% of the global workforce (Nyaruai, Kinyua & Gathu, 2016), faces significant challenges in health and safety (H&S). Ajayi (2021: 1) stated that the construction industry remains one of the most dangerous industries in the world, as it continues to record high rates of accidents and fatalities. The industry, known for its hazards (Babalola *et al.*, 2015), poses one of the highest risks to workers (Elsebaei *et al.*, 2022), with traumatic injuries and fatalities being more prevalent among construction workers (Mersha, Mereta & Dube, 2017; Manu *et al.*, 2021). The “fatal four” – falls, being struck by an object, electrocution, and being caught in or between objects – are leading causes of fatal occupational injuries (Kinteh & Bass, 2023). The Health and Safety Executive revealed that the British Construction Industry had the highest level of fatal injuries across all their industries, with a total of 38 fatalities in 2017/2018 (Umeokafor, 2020: 16). Manu *et al.* (2018:188) revealed that the construction industry in developing countries, such as Malaysia and Singapore, recorded the highest number of fatal injuries compared with other industries. Manu *et al.* (2018: 188) also mentions that developing countries display the worst H&S records. Mamman *et al* (2022: 167) revealed that, in Nigeria, trades, such as carpentry, masonry, iron bending and steel fixing, were recorded as having the highest risk compared with other trades. Therefore, this requires or prompts safety and risk control measures to be established to ensure that there are protocols to control safety risk to mitigate workarounds and hazards on construction site.

It is crucial that safety and risks cannot be discussed without understanding hazards and risks within the construction industry. Hazards and risks in construction can be presented in two layers of causes comprising immediate (human and construction-site elements), and underlying causes (management and external elements). All the causes can be related to each other in producing occupational illnesses and accidents (Guo *et al.*, 2022). Underlying causes can increase the probability of the immediate causes occurring, which ultimately results in the occurrence of accidents. Inadequate or lack of safety training has been identified as an important contributing factor to the high accident rates in the construction industry (Guo *et al.*, 2022). Furthermore, it can be noted also that there are proximal factors and characteristics of events, including inadequate construction planning, incorrect construction operations, inappropriate site conditions, and unacceptably noisy and crowded sites that result in accidents

(Famakin *et al.*, 2013). While these factors are inevitable within the construction industry, it is the duty and role of various stakeholders to have protocols which will mitigate these challenges and chances of these hazards and risks occurring. Thus, they should ensure that H & S is prioritized this also includes all signage's which are required at the construction site as well as all processes being following regarding H & S.

In addition, it can be noted that a hazard is an unsafe act or an unsafe condition that has the potential to cause injuries, fatalities or environmental contamination (Famakin *et al.*, 2023). In construction, hazards include, but are not limited to, working at heights, in excavations, working in confined spaces, being exposed to loud noises, being exposed to toxic chemicals, electric cables and connections, as well as working with plant and equipment (Mir & Khan 2021: 1). Hazards can be defined as potential situations that can cause harm, unintentional injuries, loss of life, damage or loss of an item or belongings, which arise during occupational work. They are also known as the counterpart of safety (Shrestha, 2021: 17). Frontline construction workers are at a greater risk of developing certain occupational health disorders and sickness than workers in other industries. They are exposed to multiple physical, chemical and biological agents which make them vulnerable to various health problems that include injuries, respiratory problems, dermatitis, Musculo-skeletal disorders and gastro-intestinal diseases (Mir & Khan 2021: 1). Therefore, all these conditions and circumstances require protocols which will ensure that there is safety and risk management.

2.4. Workarounds in Construction

2.4.1. Concept of workarounds

The notion of workarounds has been used widely in literature to refer to a variety of behaviour. Workarounds entail bypassing established safety rules, deviation from organisational processes, mishaps and/or any combination thereof (Soffer *et al.*, 2022: 3). Workarounds also are said to be adaptations to an unexpected situation, improvisation or alternative methods from the usual, pre-determined work system, which are executed with intentions of bypassing, minimising and even overcoming obstacles, mishaps, abnormalities, or established regulations that defer organisations from achieving their desired outcome (Soffer *et al.*, 2022: 1). The Theory of Workarounds (Alter, 2014) is one of the existing theories which illuminates the phenomenon of workarounds. Other existing theories that portray workarounds are

institutionalised workarounds, activity theory, network theory, and adaptive structural theory (Wibisono *et al.*, 2019: 188). Therefore, it is important to note that workarounds can be responses to unidentified risks or passively accepted risks. Unidentified risks are risks that have not been anticipated by the project managers and stakeholders. For instance, termination of contract by suppliers, unexpected archaeological finds, unique geological faults, or contaminated soil; a sudden, mid-project change in environmental laws or building codes that forces a major redesign or use of new, expensive materials, which was not foreseeable during the planning phase. In addition, these risks can also be Natural disasters/Extreme weather events; Geopolitical events; New technology failure. While the passively accepted risks are Minor weather delays; Minor material price fluctuations; Supplier delivery times; Minor scope clarifications. On the other hand, it can be noted also that workarounds can pose unintended risks. Hence, the basis of this study is mitigating the risks pertaining to execution of workarounds by mitigating them through an effective protocol to control safety risk on construction sites.

2.4.2. Plans Available to Manage Workarounds

Safety management plans are essential in construction projects to prevent the occurrence of different types of hazards and accidents on construction sites. There are different stages of safety management, including the major parameters of safety management which would assist in managing workarounds (Khan & Rajshekhar, 2020: 17). Workarounds are adaptive processes that occur in the environment of a centralised system. As adaptations, they expose organisations to potential data issues, for example, data availability, data accuracy, and data leak. Hence, organisations must manage workarounds. One way to achieve this is to classify them (Wibisono *et al.*, 2022: 1). It can be noted also that an Occupational Health and Safety Management Plan, Site and Camp Management, Worker Safety and Work Site Management Plan, and Labour Environmental Management Plan are also essential for the management of risks and hazards which might occur in construction (Khan & Raishekhar, 2020: 17).

2.4.3. Factors that Influence Workarounds

Psychological distress is related to workarounds, as Alter (2014: 4) referred to workarounds as instances when workers feel motivated to bypass existing work regulations with intentions of taking shortcuts. Dennerlein *et al.*, (2021: 3) mentioned that work pressures strongly influence safety performance on a construction site, especially when there is work overload and pressure to meet very close deadlines, and this has a negative impact on frontline construction workers

who experience psychological distress as they will most likely make mistakes that will result in accidents. The underlying causes of the violations include intoxication, fatigue, negligence, work pressures and the refusal to adhere to Safe Work Procedures. (SWPs) It was apparent that work pressures influence the occurrence of safety violations that drive the drift into failure (Emuze 2019: 497).

Workarounds seemingly occur when construction personnel feel inspired to take shortcuts or undermine processes that are stipulated for best practices by labour agreements, industrial standards and government regulations (Alter, 2014). Workarounds can be seen also as being unremarkable in everyday operations. They are viewed also as being questionable, hazardous and even unethical and illegal, as they violate procedures. According to Dallasega *et al.* (2021), personnel on construction sites tend to execute workarounds when faced with challenges of productivity on site and use them to meet deadlines. Emuze (2019; 497) argued that the most cited cause of not implementing Safe Work Procedures (SWP) was work pressures that required operatives to increase productivity at the expense of safety. However, execution of these workarounds has been found to decrease efficiency on projects, to increase the risk rate of work execution because of accelerating tasks, as well as to increase the rate of errors and, ultimately, cause delays in a construction project (Dallasega *et al.*, 2021).

Weinzierl *et al.*, (2022: 2) also confirmed that workarounds are executed with intentions of bypassing procedures and standards to increase the level of productivity on sites. This often results in poor workmanship, increased errors, as well as increased injuries and accidents that pose a risk to the construction workers who are executing these workarounds. Kassem *et al.*, (2021) stated that workarounds in construction often will be a regular occurrence and this is the result of shortenings in communication channels where construction workers are motivated to have informal ways to communicate information amongst themselves, thus causing miscommunication in the long run. Vast amounts of information have been lost and misunderstood because of these informal communication channels, ultimately causing a negative impact on the overall construction project (Kassem *et al.*, 2021).

2.4.4. Mitigating Factors for Workarounds

Based on the assertion that workarounds result in risks and accidents because of the frontline construction workers and site management not ensuring that safe work procedures (SWPs) are followed makes it paramount that there are certain steps to be followed to mitigate the effects.

Emuze (2019: 502) stated that interviewees suggested that, to curb these accidents, wearing the required personal protective equipment (PPE), maintaining a high standard of housekeeping, and monitoring construction activities should not be compromised. Furthermore, the interviewees suggested that site operatives should not compromise the purpose of toolbox talks and early warning signs. A few interviewees also mentioned increased awareness and training. In addition, regarding interventions that should be implemented to ensure that artisans abide by safety rules, the interviewees perceived that supervisors should ensure that SWP training is conducted to reinforce the implementation of method statements for every activity on site. Also, considering that, sometimes, accidents are caused by fatigue amongst the workers, this requires daily safe task instruction (DSTI) to be issued to support compliance-based safety. Management to ensure that employees are not working fatigued they should implement balanced work schedules with adequate breaks, limit excessive overtime, provide training on sleep hygiene, encourage reporting, and foster a culture that supports health, rest, and work-life balance through ergonomic design and adequate staffing, ensuring clear policies and open communication about fatigue risks.

2.5. Effects of Workarounds

According to Wibisono *et al.*, (2019: 188) adaptation through workarounds can produce either positive or negative results for organisations. On the positive side, it could provide a timely response to hindrances, expectations, and misadventure. Similarly, it promotes both creativity and improvisation to address organisation dynamics. It should be acknowledged that the magnitude of the outcome of each workaround is heterogeneous for different organisations. Some types of workarounds are harmless, but others are catastrophic in nature (Wibisono *et al.*, 2019: 188).

Based on the assertion that workarounds are nothing but adaptations to an unexpected situation, improvisation or alternative methods from the usual pre-determined work system, which are executed with intentions of bypassing, minimising and even overcoming obstacles, mishaps, abnormalities, established regulations that defer organisations from achieving their desired outcome (Soffer *et al.*, 2022:1), workarounds tend to ensure progress and success in construction by bypassing the unidentified and unpredicted challenges which might affect process negatively. For instance, systemic instability and operational risk; compliance and regulatory breaches; erosion of standard processes and inefficiency; hidden costs and resource

drain among other negative effects. Thus, it can be noted also that there are risks and safety issues associated with workarounds that are not entirely negative but also enable innovation which will result in the success of construction projects. Thus, workarounds can also trigger a second order or re-design of business processes that affects the performance of an organisation positively or negatively. On an organisational level, workarounds can trigger negative effects (Beerepoot *et al.*, 2018). However, there is a need for effective methods for predicting and managing process change proactively (Weinzierl *et al.*, 2022: 2).

While, on the other hand, it can be noted that unsafe behaviours can affect employees negatively as they will be exposed to risks which can translate into lack of safety and life-threatening situations (Selleck *et al.*, 2022: 1). Wibisono *et al.* (2019: 188) also mentioned that workarounds lead to negative ordeals, such as reducing quality of information and promoting strategic misalignment in an organisation. Weinzierl *et al.* (2022:2) mentioned that, while employees implement workarounds based on risk-benefit analysis with positive intentions, their implementation might unintentionally and unprecedentedly have adverse consequences on an individual and organisational level (Alter, 2014).

2.6. Protocols for Enhancing Effective Control of Safety Risk on Construction Sites

2.6.1. Concept of Protocols

A protocol is a set of pre-determined rules or guidelines which outline steps to be followed to perform a specific task (Flechsig, 2022). Occupational Health and Safety Administration (OSHA) is an agency which sets a framework of safety protocols that must be adhered to in various industries such as construction, healthcare and manufacturing (Ko & Abdul Majeed, 2022: 10). This agency enforces safety protocols for the use of PPE such as gloves, respirators, safety goggles, as well as workplace safety hazard protocols to ensure that all risks pertaining to chemical hazards, electrical safety, and ergonomics are eliminated (DiGiandomenico *et al.*, 2020). The United Kingdom and South Africa do try to hold clients liable for H&S through organisations such as construction designers and management regulators (Boadu *et al.*, 2023: 1612). Construction Regulations 2014 for South Africa (Malindi & Smallwood, 2018: 138) are regulations which govern the health and safety performance of the construction industry. In the Occupational Health and Safety Act No. 85 of 1993, provisions of duties of employers to their

employees were made also. These are provisions for the maintenance of plant and machinery to ensure effective health and safety measures in the workplace (Mhlophe, 2022).

The National Building Regulations and Standards (NBRS) Act No. 62 of 1977, addresses safety during demolition to ensure that the process is conducted in a safe manner and prohibits any dangerous demolition methods. The NBRS also addresses issues that affect public safety, controls of noise, dust, unstable soils, underground infrastructure, and that housekeeping on site after demolition is completed (Mazibuko, 2016). Under the Labour Relations Act No. 66 of 1995, s protocols are implemented where employers are required to provide sufficiently secured work environments to ensure effective health and safety of employees. Any breach of these protocols is regarded as being unfair labour practice (RSA, 1995).

The Basic Conditions of Employment Act No. 75 of 1997 requires employers to train their employees about possible health and safety hazards (Lukhele *et al.*, 2022: 2050). This Act also mandates employers to take employees for medical examinations when they have been exposed to hazards in the workplace (Lukhele *et al.*, 2022: 2050). Construction Regulations 2014 enforce main contractors to submit a coherent risk identification, risk management, health and safety plan in which all health and safety specifications are documented to ensure H&S of the proposed construction project (Malindi & Smallwood, 2018).

2.6.2. Concept of Protocols in the Construction Industry

There are vast numbers of studies which are intended to improve preventative and proactive H&S measures in construction. These include building designs for H&S enhancement, planning as well as construction to reduce injuries, accidents and fatalities whilst increasing productivity on construction sites (Getuli *et al.*, 2021).

2.6.3. Existing Protocols in the Construction Industry and their Purpose

Knowledge-based systems have been introduced in the construction industry as systems which will take previous data into account as well as past experiences from completed projects to enhance risk assessment of new, proposed projects. Architects utilise this system to develop designs in a way that will enhance H&S during construction processes (Qi *et al.*, 2011). Automatic rule checking is a computerised protocol used to assess compliance of designs with H&S regulations with a view to planning for safety and prevention of hazards by utilising specific algorithms and BIM platforms (Getuli *et al.*, 2021). Digitalisation of construction sites not only enables virtual inspections and information-based analysis of construction processes

but also allows for semi-automatic reviewing of design compliance which will improve accuracy and reliability of the validation process (Akinlolu *et al.*, 2022: 2699).

There is also a safety design protocol, namely: clash detection which is used in planning and management of construction workspace. This protocol is utilised as a means of clash detection. This IT- based safety system can provide virtual simulation to assist in identification of safety risk and safety planning (Getuli *et al.*, 2021).

In addition, the nature of risks on construction sites is known to be different because of some construction sites having unique features such as difficult construction process, temporary organisational structures, changing work locations, unmanageable work environment, and behaviour of the workers (Ajith *et al.*, 2021: 175). To ensure that there is safety, there are effective measures to control risk, which are in line with the Health and Safety Executive (HSE). These measures are guided by the process illustrated in Figure 2.1.

The protocol in Figure 2.1 is categorised using four methods: input, process, output, and outcomes (Health & Safety Executive, 2025). "Input" refers to the monitoring of issues such as uncontrolled hazards. In this case, the risks are created by the operations of the organisation. The term "process" describes the programmes to promote a positive health and safety culture as well as the continuous assessment of the creation, implementation, operation, and efficacy, of the health and safety management system. The term "output" refers to an organisation's attentive monitoring of the identified hazards. Outcomes include accidents that could cause injury, illness, or loss, as well as reactive monitoring of adverse outputs that result in these outcomes.

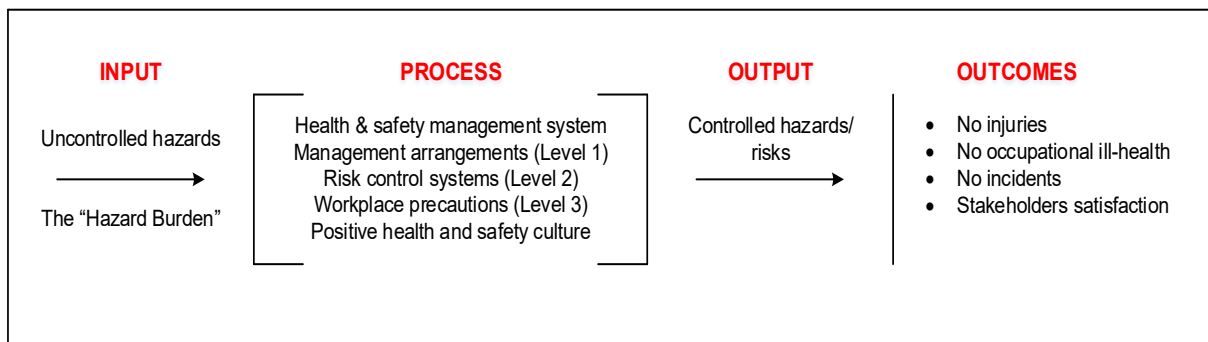


Figure 2.2.1; Effective risk control

Source: Adapted from Health and Safety Executive (HSE), 2025)

2.7. Risk Control Systems

A risk control system is a system which is set to manage risk, mitigate risk and ensure that consequences are minimal (Kitsios, 2020: 1269). This system can be referred to as a risk management system. Risk management in a construction project includes identifying, analysing, and responding to various risks to achieve the project objectives (Pawade *et al.*, 2022: 1). Hence, the risk is considered as being negative on construction projects. In theory, the risk is usually defined as a positive or negative deviation of a variable from its expected value. In general, the risk is understood only as a loss. Risk management constitutes a strategy to avoid losses and to use risks or available chances potentially arising from risks. However, regarding workarounds, it can be noted that, sometimes, the risk has not been identified which, therefore, would make it a challenge to implement a risk control system.

A risk management or risk control system is used to identify, assess, and control threats to an organisation's capital and earnings. These risks stem from various sources, including financial uncertainties, legal liabilities, technological issues, strategic management errors, accidents, and natural disasters. A typical risk management process includes the following key steps: risk identification, risk assessment, risk mitigation, risk monitoring (Pawade *et al.* 2022: 2). Selleck *et al.* (2022: 3) also mentioned the reliability of risk-control, which is a factor of the availability and use of the control when required (i.e. control is implemented) and the effectiveness of the control to eliminate or minimise exposure to a threat and mitigate the severity of consequences. When measuring reliability of risk controls, quantitative, semi-quantitative and qualitative processes can be applied, depending on the control to be measured, whether the events where a control was challenged in the normal environment can be tracked, or whether the control can be tested under controlled conditions (Selleck *et al.*, 2022: 3; Grattan, 2018).

There is also a need to assess the reliability of control barriers. These barriers are influenced by organisational psychological mechanisms, such as confirmation bias, normalisation of warnings, consensus mode decision-making and group ideas, which occur within work teams and across organisations (Selleck *et al.*, 2022: 2). The reliability of barriers is affected also by human factors (e.g. competence and human actions) in the detection of threats or changes in barrier functionality, diagnosing what action is required and then acting (Nnaji & Karakhan, 2020). Causation analysis of construction accidents identified actions of frontline construction workers as being influenced heavily by supervision and risk management through planning and risk control at different levels across an organisation. This emphasises the need for a holistic

approach to managing fatal risks and the use of barriers (Winge *et al.*, 2018, cited by Selleck *et al.*, 2022: 2). Selleck *et al.* (2022: 2) noted further that, for construction organisations to invest in the development and implementation of a safety barrier approach, such as Critical Control Risk Management (CCRM), organisational leaders must be accountable for fatality prevention as well as assurance that the controls being defined will prevent fatalities (are they the necessary controls?) and how will the reliability of the controls be measured?

2.8. Chapter Summary

In this chapter, literature related to the phenomenon examined in the study was discussed, which relates to safety, risks and hazards, safety work procedures, and workarounds in the context of construction. Also mentioned are the effects of workarounds, protocols for enhancing effective safety, and risk control systems. Based on these discussions, it can be noted that workarounds are inevitable, but measures must be established to mitigate the risk, accidents and effects which might transpire. As a result, this will ensure effective control of safety risk during project implementation while, also, mitigating the effects of workarounds and hazards on frontline workers on construction sites. This is essential also, as some of the effects are a serious threat to the lives and health of frontline construction workers.

Chapter 3: Research Methodology

3.1. Introduction

In this chapter, the selected research methodology that guides the data collection and data analysis explained. The selection of research approach was guided by the research problem being investigated in this study. Mixed methods used for data collection and analysis were influenced by the exploratory research design employed for this study. The approaches that were used to test the validity and reliability of the data are discussed also in this chapter.

3.2. Research Design

Research design is a system that outlines the overall structure of a study and offers a foundation for the entire research activity. This form of paradigm helps the researcher to collect data that will address the subject being studied (Pawar, 2020). The nine types of research design that also are possible include: descriptive design, exploratory design, experimental design, longitudinal design, cross-sectional design, casual design, action research design, cohort research design, and case study design. Descriptive, explanatory, and exploratory research designs are the three main categories of research designs.

An exploratory research design is used in this study to develop a protocol to control safety risk to mitigate hazards and workarounds on construction sites. An exploratory design was chosen for this study because causes and reasons were emphasised, and evidence either to confirm or deny an explanation or prediction was offered. Furthermore, exploratory research is appropriate in situations when a phenomenon is poorly understood, the issue is not well defined (Saunders *et al.*, 2023). Thus, using an exploratory research design, the researcher was able to investigate the causes of hazards and workarounds on construction sites. The findings were then used to develop a proposed protocol to control safety risk. For this study, both qualitative and quantitative data were collected. For instance, semi-structured interviews were used to collect qualitative data from case-study projects, and survey questionnaires were used for collecting quantitative data from construction personnel on projects in South Africa's Free State Province.

3.3. Application of the Research Onion Framework

The Research Onion is a useful tool used to break down the different methodologies to enable a researcher to investigate a research problem thoroughly. Included in the Research Onion is

the research philosophy which addresses positivism, realism, interpretivism and pragmatism. Research approaches address deductive and inductive approaches. Research strategies available include experiment, survey, case study, action research, grounded theory, ethnography and archival research (Saunders *et al.*, 2023).

Research choices include different methodological choices such as mono method, mixed methods and multi method, also including cross-sectional and longitudinal time horizons. Included in the Research Onion are research techniques and procedures which include data collection and data analysis (Saunders *et al.*, 2023).

Therefore, all six levels of the Research Onion have been assessed to conclude this research project effectively. Table 3.1 shows a list of each of the six layers that were used to make the topic under investigation a reality.

Table 3.1: Research onion layers adopted

Research Layer	Selection
Research philosophy	Pragmatism
Approach to theory development	Abductive
Methodological choice	Mixed Methods
Research strategy	Case Study
Research time horizon	Cross-Sectional
Research techniques and procedures	Semi-Structured Interviews and Survey Questionnaires

Source: Researcher's construct adapted from (Saunders *et al.*, 2023)

3.4. Research Philosophy

There are various research philosophies which include positivism, interpretivism, pragmatism, post-modernism, and critical realism (Saunders *et al.*, 2019). The suitable research philosophy for this study was pragmatism. Pragmatism is readily conceived of as being a philosophical stance for doing instead of theorising *per se* (Clarke & Visser, 2018). The philosophy is not a conjoining of opinions and ideas about a certain concept but guiding principles for delivering action. Pragmatism is concerned with the belief or way in which individuals should execute business when engaged in certain forms of inquiry (Cara, 2017). Thus, this philosophy enabled constructivism and objectivism, which enabled the judgement of a topic based on its impact on

the social world by either one or both points of view. Pragmatism is used also to discover a solution to a problem (Orth, 2021: 741). Pragmatism is a flexible approach focusing on "what works" to solve real-world problems, prioritizing practical outcomes over adherence to strict philosophical stances like positivism or interpretivism, and often utilizing. In this research, pragmatic philosophy assisted in developing a protocol to control safety risk to mitigate workarounds and hazards on construction sites.

In addition, since data were collected from site management and general workers, this supported the aim of pragmatic philosophy, the aim of which is to unveil practical knowledge. This is the knowledge that is presumed to work in a particular situation. The knowledge gained is evaluated in terms of its ability to be used to solve problems in everyday life rather than its universal applicability. The knowledge of interest should have immediate and practical utility such that it explicates people and society from oppressive and debilitating circumstances. This renders pragmatism a useful tool for individuals and groups that conduct some form of action research (Dube, Nkomo & Apadile-Thokweng, 2024).

3.5. Research Approach

For this study, since the chosen research philosophy was pragmatism, both deductive and inductive approaches (abduction) were used in the research (Dempsey, 2022: 15). Deductive research entails a study that has a theory that can be tested by empirical observation. The deductive method can be explained broadly as moving from a general approach to a particular approach. The main objective of using this method is to find answers to the research questions (Dempsey, 2022: 15). Inductive research entails conducting research based on observation of empirical reality, so researchers create their own theory as opposed to focusing on existing theory. Therefore, inductive research has a process that extends from the research question to observation, description and data analysis, then researchers derive their own theories as the conclusion (Dempsey, 2022: 15).

3.6. Methodological Choice

A mixed-methods approach was applied in this study to integrate both qualitative and quantitative data. As a result, a sequential, exploratory mixed-methods strategy was used in this investigation (Saunders *et al.*, 2023). The exploratory sequential mixed methods design begins with a qualitative phase to explore a phenomenon in depth and identify key themes or

variables. These qualitative findings then guide the development of quantitative instruments such as surveys (Saunders *et al.*, 2023). The subsequent quantitative phase measures the patterns and relationships identified in the qualitative stage on a larger scale. This approach is useful when little is known about a topic, and researchers need to first explore before confirming and generalizing findings.

In addition, the exploratory sequential mixed methods design helped the researcher to start collecting and analysing qualitative data from the case-study projects in Bloemfontein City, South Africa. Quantitative data were then collected from construction personnel in the Free State Province to validate the results of the qualitative data. Thus, mixed-methods data (qualitative and quantitative) produces several types of data. For instance, while the qualitative data offer open-ended information obtained from interviewees involved in case-study projects, the quantitative data offer closed-ended information from participants working on construction projects. As a result, the mixed-methods data were collected and analysed independently (Saunders *et al.*, 2023).

3.7. Research Strategy

A case study is a systematic investigation of an individual, group, community or any other unit in which the researcher examines in-depth data relating to several variables (Heale & Twycross, 2017). The reason to choose a case study as a research strategy is that it is conducted on a real-life project and can be used for monitoring projects, activities, or assignments. Based on the data collection, statistical analysis can be carried out. Thus, in this study, the case study enabled the researcher to narrow down a broad topic into manageable research questions. The researcher purposefully selected the case studies which are relevant for the phenomenon under study also the proximity to which the study has been carried out. In this study, three case studies were used. As a result, a multiple case-study design was adopted for this study, since three construction site projects were selected for data collection in Bloemfontein, South Africa. In multi-case studies, data are collected from multiple cases for analysis to enable the researcher to draw conclusions from the study (Ishak, 2014). Table 3.2 shows the case-study projects which helped the researcher to collect the data.

Table 3.2: Multiple case-study projects

Case-study projects	Construction project description	Nature of works
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Case 1	Construction of student residential projects	General building works of a residential building
Case 2	Construction of lecture block project	General building works of a lecture-hall building
Case 3	Refurbishment of a university building	Maintenance of the facility and refurbishments

Source: Created by the researcher

3.8. Time Horizon

There are basically two types of time horizons, namely: cross-sectional and longitudinal (De-Keijzer, 2020). In this study a cross-sectional time horizon was used to conduct the research. It took approximately 24 months to complete this study. A cross-sectional method was used because the method can be used for both qualitative and quantitative research and was most suitable for this study, using mixed methods as the methodology. Cross-sectional methods assist a researcher when observing a certain group of people in a particular setting and are utilised also for observation of individuals at a certain point in time (Orth *et al*, 2021: 741). In a cross-sectional study, data are collected from a population over a single period, as was the case in this study.

3.9. Data Collection

3.9.1. Primary and Secondary Data are the Two Main Categories of Data

The subsequent sub-sections contain an explanation of the data collection methods.

- **Primary Data**

The aim of this research was to develop a protocol to control safety risk to mitigate hazards and workarounds on construction sites. This goal was achieved by using an exploratory research design, as suggested by Pawar (2020), and data were collected using a mix-methods research approach (qualitative and quantitative methods). To collect qualitative data from case-study projects, for example, semi-structured interviews with the selected case studies were used. To collect quantitative data from individuals working on construction projects, closed-ended survey questions were used.

3.9.2. Qualitative Data Collection: Case Studies

The case-study research strategy was used to collect the qualitative data. The case study

followed a multiple case-study research design. This was because three case studies helped the researcher to collect the qualitative data as shown in Table 3.2 above. The case studies were divided into three categories: general construction of a residential building (Case 1), lecture-hall construction (Case 2), and facility maintenance and refurbishment (Case 3).

Qualitative data were collected from each case study, and interviews were limited to people working on the case study. Therefore, the interviews were open-ended and semi-structured to enable the participants to express their thoughts regarding their work experience in relation to the project on which they were working.

3.9.3. Quantitative Data Collection: Survey

To assess the variables that contribute to hazards and workarounds on construction sites, quantitative data were collected, using survey questionnaires. The survey questionnaires contained closed-ended questions, and a Likert Scale, with a range of 1 to 5, was used to evaluate the variables of hazards and workarounds. The researcher printed the survey questionnaires and delivered hard copies to construction sites so that personnel could complete them. Thus, participants included engineers, site managers, project managers, health and safety officers, foremen, craftspeople, and general labourers. It is noted that only personnel who were working on the approved construction projects in Bloemfontein City received and completed the survey questionnaires.

- **Secondary Data**

In addition, the researcher collected secondary data, mostly through the consultation of academic sources such as the library, electronic books, published and unpublished theses and dissertations, journal articles, conference papers, presentations, and reports. The secondary data were selected after the abstract and title were examined to determine whether they fitted the objectives of this study, which included mitigating hazards and workarounds to develop a protocol to control safety risk.

3.10. Research Samples

3.10.1. Research Sampling: Qualitative Data

To collect the qualitative data multiple case-study projects were adopted for this study, as

explained in Section 3.7. In each case study, the data were collected using open-ended, semi-structured interviews. Since a case study was adopted for this study, the researcher only interviewed people who were working at each construction site. This enabled the researcher to respond to the research question based on the experiences and challenges that the participants had on the construction site project towards hazards and workarounds. There are various sampling methods which can be used which include non-probability or purposive sampling (Raman 2023). As a result, the researcher adopted non-probability sampling, using a purposive sampling technique to select interviewees from each case project. Also, the three case studies were selected purposively because the researcher focused on construction projects which hired professionals, artisans and general workers to investigate the phenomenon being studied in detail. The target population was construction workers within Bloemfontein, this population comprise of construction managers, quantity surveyors, safety managers, safety officers, artisans (bricklayers and scaffold erector), project managers and foremen. The interviews for the three case studies comprised thirty (30) construction personnel. For example, for Case-Study Project 1, ten (10) construction personnel were interviewed, for Case-Study Project 2, ten (10) construction personnel were interviewed and, for Case-Study Project 3, ten (10) construction personnel were interviewed, as shown in Table 3.3. As a result, the researcher adopted non-probability sampling, using a purposive sampling technique to select interviewees from each case project. Also, the three case studies were selected purposive because the researcher focused on construction projects which hired professionals, artisans and general workers to investigate the phenomenon being studied in detail. The research population was made up of thirty (30) construction personnel from three case-study projects in Bloemfontein City, South Africa. The construction personnel included: construction managers, quantity surveyors, safety managers, safety officers, artisans (bricklayers and scaffold erector), project managers and foremen, as shown in Table 3.3.

Table 3.3 shows the research sample of the interviewees, focusing on the designation, years of experience, professional registration and qualifications.

Table 3.3: Research samples for qualitative data

Code	Age	Professional Registration	Qualifications	Position
Case 1: Construction of student residential projects				

P1	20-29	Candidate ECSA	BSc Honours in CM	Assistant site agent
P2	30-39	SACQSP	Post-Graduate Diploma in Property Development	Quantity surveyor
P3	30-39	SACPCMP	Post-Graduate Diploma in Project Management	Safety manager
P4	40-49	SACQSP	Post-Graduate Diploma in Property Development	Quantity surveyor
P5	30-39	SACPCMP	Property Development and Management	Quantity surveyor
P6	20-29	Candidate SACPCMP	Bachelor' s degree in construction health and safety management	Junior safety officer
P7	40-49	Not registered	Certificates	Foreman
P8	30-39	Not registered	Grade 12	Scaffold installer
P9	30-39	Not registered	Honours Degree in Public Management	Project manager
P10	50+	Not registered	Grade 12	Bricklayer
Case 2: Construction of lecture block project				
R1	30-39	ECSA	B-Tech Electrical Engineering	Project manager
R2	40-49	None	Matric	Site foremen
R3	30-39	SACPCMP	Post-Graduate Diploma in Project Management	Junior project manager
R4	30-39	SACQSP	BSc Honours Degree	Project manager
R5	30-39	None	B. Tech Electrical Engineering	Electrical engineer intern
Code	Age	Professional Registration	Qualifications	Position
R6	20-29	None	Bachelor' s in electrical engineering	Electrical working inspector
R7	30-39	Not registered	Diploma Civil Engineering	General foremen
R8	20-29	Candidate ECSA	Post-Graduate Diploma in Project Management	Electrical engineering intern
R9	20-29	Not registered	Advanced Project Management	Site agent
R10	30-39	Not registered	Post-Graduate Diploma in Construction Management	Quantity surveyor
Case 3: Refurbishment of a university building				
I1	20-29	None	Certificates Occupational Health, Safety and Environment	SHE representatives
I2	40-49	SACQSP	Post-Graduate Diploma in Property Development and Management	Quantity surveyor

I3	30-39	SACPCMP	Post-Graduate Diploma in Construction Management	Project manager
I4	30-39	Candidate SACQSP	Advanced Diploma in Quantity Surveying	Junior quantity surveyor
I5	50+	None	Grade 12	Site manager
I6	30-39	ECSA	Post-Graduate Diploma in Project Management	Mechanical engineer
I7	20-29	ECSA	Bachelor' s in computer and electrical engineering	Electrical electronics and computing union
I8	30-39	Candidate ECSA	Post-Graduate Diploma in Project Management	Mechanical engineer
I9	40-49	ECSA	Bachelor' s degree in architecture	Project manager
I10	30-39	Not registered	Master' s degree in communication sciences	Project administrator

Source: Case study data

3.10.2. Research Sampling: Quantitative Data

The research population for the quantitative data consisted of construction personnel in the construction industry of the Free State Province of South Africa. The researcher distributed the survey questionnaires to one hundred and twenty (120) individuals, and ninety-four (94) of those who worked in the Free State Construction Industry responded which was 78% response rate. Participants included quantity surveyors, safety officials, civil engineers, construction managers, project managers, artisans, and general workers. A probability sampling strategy, employing a simple random sample methodology was utilised to obtain the quantitative data. This was because the construction personnel were selected randomly and were provided with printed survey questionnaires to complete. Table 3.4 shows a summary of the quantitative data research samples. The research samples describe the participants' demographic profile, which includes their age, gender, and positions.

Table 3.4: Research sample for quantitative data

Item	Frequency (N)	%
Participants gender		
Male	68	72.3
Female	26	27.7
Years of work experience		
< 5	33	35.1
5-10	24	25.5
10-15	17	18.1
15-20	16	17.0
>20	4	4.3
Occupation		
Project Manager	21	22,3
Engineer	30	31,9
Construction Manager	7	7,4
Safety Officer	11	11,7
Quantity Surveyor	4	4,3
Artisan	19	20,2
General Worker	2	2,1
Total	94	100%

3.11. Administration of Instruments

The data were collected using a mix-methods research technique that included both qualitative and quantitative data methods. The research instrument employed for the qualitative data was a semi-structured, open-ended interview. There were two sections to the research instrument. Closed-ended questions about the interviewees' backgrounds were asked in the first section. In the second section, questions were asked in line with the research objectives of the study. Interviewees were asked to answer questions about their work experience, particularly the construction project in which they were involved, to respond to the open-ended research question.

The quantitative data instrument was designed using a closed-ended survey questionnaire. The survey consisted of two sections. The first section established the backgrounds of the participants, and the second section evaluated variables that attempted to address the research objectives of the study. A Likert Scale with a range of 1 to 5 was used to answer each question

to evaluate the variables associated with hazards and workarounds on construction sites. The instruments are attached in appendix B and D.

3.12. Data Analysis

3.12.1. Qualitative Data Analysis

The qualitative data collected from the multiple case studies were analysed using thematic analysis, as recommended by Kiger and Varpio (2020). The researcher used thematic analysis to examine the similarities and differences in the data collected from multiple case studies to respond to the research questions. The researcher began to analyse the collected qualitative data to determine the answers to the sub-questions that addressed the objectives of the study. In addition, the interviews were coded to facilitate the categorisation of the participants' responses. After the coding procedure was finished, themes were identified and arranged in line with the research sub-questions. Then, quotes from the respondents were used to support each theme. However, responses that failed to answer a research sub-question were excluded.

3.12.2. Quantitative Data Analysis

The quantitative data were supplied by ninety-four (94) individuals in the construction industry. The survey was designed with a Likert Scale, ranging from 1 to 5. Thus, the quantitative data were analysed using software from Statistical Product and Service Solutions (SPSS). With the help of SPSS, the researcher used descriptive analysis to analyse the data, as recommended by Cresswell (2022). By arranging and condensing the characteristics of a data collection, descriptive analysis provides insights into its distribution, central tendency, and variability (Cresswell, 2022). To respond to the sub-questions of the study that were centred on the mean score and standard deviation, the researcher employed descriptive analysis. In addition, using the mean score, a dataset of the stated study objectives was used to assess the central tendency of the variables.

3.13. Reliability and Validity

Reliability in research refers to how consistently a research procedure measures the phenomenon of the study (Abideen *et al.*, 2022: 1). In addition, a study that is reliable should produce similar results if repeated under the same conditions. Thus, mixed methods were used for this research for data collection. It was found that the data collected using qualitative methods produced similar results to the data collected using quantitative methods, as presented

in Chapters 4 and 5.

The qualitative data were collected from multiple case studies using semi-structured interviews. The data from the three case-study projects were analysed using thematic analysis and the results from the three case studies were similar. Therefore, it can be concluded that the qualitative results of this study are reliable since the data collected from three case studies using semi-structured interviews produced similar results, as highlighted in Chapter 4.

While, for quantitative results, the data were collected from construction personnel who were working in the construction industry in Free State. The reliability of the quantitative data was tested using Cronbach's alpha (α), as recommended by Cresswell, (2022). Cronbach's alpha was used because it integrates or sums items in Likert Scales. As a result, each individual item in the scale is used to measure a phenomenon on an underlying, quantitative measurement continuum. In addition, Cronbach's alpha ranges from 0.00 to 1.00, but a negative alpha value can occur when the items are not correlated positively among themselves (Cresswell, 2022). For this study, as presented in Chapter 5, the Cronbach's alphas of the tested objectives were higher than 0.70, which are acceptable.

3.14. Ethical Consideration

All the participants from the selected construction sites were given an opportunity to read the introductory statement as a means of assuring that the study was for research purposes only and their identities would be withheld for confidentiality purposes. The interviews were conducted in a manner that made participants comfortable to express their views on this study freely. The survey questionnaires were structured in a way that did not reveal respondents' identities as well, maintaining their anonymity for the research. Core to ethical consideration in research is to maintain and ensure the integrity, validity and reliability of research (Pietila, 2020: 49). The researcher also applied for ethical clearance from the university ethics committee, which was granted, and the ethical clearance number is FRIC 2024-02-02 (Appendix F). This also granted participants to participate voluntarily and freely in the interviews and respond to the questionnaires.

3.15. Chapter Summary

In this chapter research philosophy, approach, strategy, timeframe, data collection, and analysis

of the study, related to the development of a protocol to control safety risk to mitigate workarounds and hazards on construction sites, were explained. The process and justification for data collection and analysis of primary and secondary data were provided. The research approach which encompassed the sample population, sampling process and sample size, was presented in this chapter. The research findings are presented and discussed in the subsequent chapters.

Chapter 4: Results and discussions of the Qualitative Data Analysis

4.1. Introduction

In this chapter, results collected from the three case-study projects in Bloemfontein City, South Africa are presented. The qualitative data from the multiple case studies were collected using semi-structured interviews, and only people who worked on each case-study project were interviewed. The multiple case studies included: Case 1: Construction of student residential projects, Case 2: Construction of lecture block project, and Case 3: Refurbishment of a university building.

4.2. Case 1: Construction of student residential projects

Case 1 was a construction of student residential projects in Bloemfontein, South Africa. This project included construction of double-storey residential buildings that will house 211 students. In addition, the projects comprised three blocks, namely, Block A, B and C. This project was selected because of the nature of the construction works which exposed management, general workers and stakeholders to numerous safety hazards and risks that had the potential to cause accidents if not mitigated. In Case 1, the researcher interviewed ten (10) construction personnel (management and workers) using semi-structured interviews. Table 3.3 in the previous chapter shows the background and coding of the construction personnel interviewed in this case study.

4.2.1. The Connection between Hazard and Workarounds

To answer the first research sub-question that asked: What are the hazards linked to workarounds on construction sites? the qualitative data collected in this case were analysed thematically using two themes: (1) establishing the causes of construction hazards, and (2) understanding the concept of workarounds in construction.

4.2.1.1. *Establish the Causes of Construction Hazards*

The construction workforce contributes significantly to hazardous activities. Workers contribute to unsafe working habits that cause hazards on site. It can be noted that workers tend to ignore rules by trying to take shortcuts in their duties on site by finding “simpler” ways of doing things. Furthermore, lack of effective communication affects safety measures on

construction sites. Poor communication in construction projects compromises health and safety, resulting in accidents, injuries, and non-compliance with safety standards. Misunderstandings during task assignments, language barriers in a diversified workforce, and insufficient safety briefings are all common contributors to such dangers. P1 stated that:

Lack of communication and poor team participation of the middle management and engagement with the workers also failing to explain the importance of safety on-site.

The hazards present on construction sites are poor handling of small tools and use of plant machinery by unauthorised operators. Also, workers choose to hold smoke breaks near places designated as being highly flammable. In addition, hazards on construction sites often lead to workarounds of safety rules when workers prioritise productivity and meeting deadlines over complying with regulations. On the other hand, poor housekeeping in construction is the major cause of hazards on construction sites. P6 also mentioned that hazards are present on construction sites because site foremen do not listen and do not regard housekeeping as being a priority on site. They will leave boards lying down and say they will tidy them up at the end of the business day and, when that time comes, they rush to knock off. Bricklayers also contribute to hazards because they say that they cannot be expected to clean when their job creates a mess. They enjoy walking around, but they clean up at the end of the shift or the following day.

P2 stated that:

In most cases, they likely leave stuff lying around after they have completed a particular task. So, they don't do housekeeping, and that can be one of the causes of the hazards.

The participants highlighted the need for the management team to take responsibility.

P2 stated that:

The managers themselves sometimes issue prompt instructions without the proper planning, such as when a particular task needs to be done but was not planned or scheduled for that day. Preparations of conducting that task might contribute to a certain hazard because it was not properly planned and it's a rush job, leaving many details unattended or

not paying enough details in terms of the preparation of the task that needs to be undertaken.

P3 suggested that:

Some workers do not have the appropriate equipment to execute the job, resulting in them not being able to execute their expected tasks. For example, those who were plastering will be told to start with paintwork without completing what the task they were doing, they are not prepared to do another task, they have not done sufficient planning, they don't have the right PPE, they don't have specific tasks to do, they are jumping into everything.

P7 stated that they were working without safety gloves which resulted in them cutting themselves while they were working with gases. Fortunately, it was inflammable gases, but it caused frost bites when the scarred finger came into close contact with the gas. According to P6, about lack of knowledge, lack of understanding, ignorance of safety regulations and procedures and taking unqualified, random workers to execute duties of artisans, construction managers will just "okay" because there is a department for safety, and they will not worry about compliance but will only accelerate production. With that mentality, they contribute to hazards.

4.2.1.2. Understanding the Concept of Workarounds in Construction

The concept of workarounds contributes to the hazards because they are unplanned – they are Plan B – meaning they are improvisations of what was initially planned. Factors such as time and costs also contribute as drivers of these hazards. This is mainly because the contractors would like to minimise the cost and execute tasks expeditiously and, in so doing, they tend to overlook safety precautions that must be adhered to when executing a particular task. For instance, in a task that requires scaffolding, they will use a step ladder that is not securely balanced; or a boom lift is needed, but a step ladder is rather used instead. Other factors are to improvise which, basically, is not doing what was planned initially, which contributes to the hazards because corners are being cut which is dangerous.

For example, workers might not use personal protective equipment (PPE) when handling hazardous materials, which results in exposure to toxic substances or injuries. Similarly, shortcuts such as faulty scaffolding assembly or overloading equipment can increase the risk of falls, structural collapses, or machinery-related accidents. P5 stated that workarounds on

construction sites are linked frequently to hazards such as unstable structures, unguarded machinery, and inadequate fall protection. P5 added that these shortcuts often arise from pressure to meet deadlines, lack of adequate equipment, or insufficient safety oversight. P5 stressed that contractors who ignore the established protocols usually expose their workers to heightened risks of accidents and injuries.

P6 stated that:

People tend to say that they have experience to execute many tasks on construction, but they are only competent to do what they are tasked to do at that time. Due to scarcity of work at that time, they will want to take any work that is available at the time, which they know very well they are incompetent on for the sake of making money for themselves.

If an activity in construction is not planned, it exposes risks of safety hazards and inadequate equipment as there will be a compromise on the tools and machinery being used, for the sake of progress.

Signage on construction sites is compulsory. It is necessary to know something before it happens. For example, when a person enters a building, and there is construction, there must be a sign so that, at least, the person knows. P9 concluded that, when a person goes on site, it is not necessary to rush. Activities must be planned. Inspection and training are not done but, before a person goes on site, induction is necessary. Every construction site has possible risks, yet inspection, supervision and training are lacking. P10 revealed that one of the biggest hazards occurs when workers are working on scaffolding and do not use safety harnesses to protect themselves.

4.2.2. The Connection between Safety Risks and Workarounds

To answer the second research sub-question that asked: What are the risks linked to workarounds on construction sites? the qualitative data collected in this case was thematically analysed using one theme: comprehending construction safety risks and workarounds.

4.2.2.1. *Comprehending Construction Safety Risks and Workarounds*

Concerning safety risks, P1 noted that all risks are the product of hazards. In addition, P1 stated that:

Poor construction team can lead the whole project to jeopardy. Not sharing information and skill to workers will cause hazards. Therefore, failure to share information on construction sites is a risk that might cause hazards.

For instance, P2 described an incident in which a TLB driver was operating a vehicle when he collided with an electrical pole. After the truck struck the pole, a brief electrical explosion occurred, giving the on-site experience the feeling of an action thriller. Fortunately, nobody was hurt, but how loud the transformer would have sounded when the truck struck the electrical cable can only be imagined.

In addition, P1 showed that road construction projects have a markedly higher risk, especially when they are constructed in neighbourhoods. The implementation of a project necessitates careful consideration of many factors that are not directly related to the project but have an impact on the daily lives of the people living in the nearby neighbourhoods.

P8 stated that sometimes while working on heights, there is something wrong with the scaffolding. Most of the workers do not have a valid licence to erect the scaffolder and are not competent to do so. In most cases, when working, it is necessary to make sure that everything is according to the procedure.

P9 stated that, sometimes, when working on heights, workers forget their helmets. This is a problem because a worker cannot go upstairs without a helmet, and there are certain things a worker cannot use without the necessary PPE. Even the project manager or the owner can be seen going to the site wearing shorts, sneakers and t-shirt but are going to direct those who are working. P9 revealed that construction personnel do not pay attention to carelessness. The only thing they focus on is money; they do not focus on most of the things. When something happens, that is when they start paying attention to it, but they find out that it is already too late.

P9 stated further that, by not wearing a mask, a worker might contract TB. On top of that, when

contractors arrive and hire people, they do not test them or, maybe they test only those who are going to work on heights but those who are inhaling the dust are not working on heights.

4.2.3. Workarounds that Turn Hazards into Safety Risks

To answer the third research sub-question that asked: How do workarounds turn hazards into risks on construction sites? the qualitative data collected in this case were analysed thematically using one theme: the connection between hazards and safety risks.

4.2.3.1. *The Connection between Workarounds and Safety Risks*

It can be noted that there is a connection between workarounds and safety risks within construction sites (Mahmood, Misra, Sun, Luqman, and Papa, 2025). based on the finding participants also shared the same assertion, thus, P4 revealed that safety risks linked to workarounds on construction sites include increased exposure to falls, electrocution, and machinery-related injuries because of protective measures that are bypassed. In addition, P4 argued that workers often neglect safety barriers or correct use of equipment, leading to unstable work conditions and preventable accidents. According to P5, risks that are taken normally on sites that contribute to these hazards are: the lack of appropriate PPE, the lack of enforcement of the law in general, and managers not instructing subordinates, particularly about health and safety. P5 also noted that the risk of working on a roof is that, normally, people do not wear their safety harnesses and sometimes, even if they do wear them, they are not hooked to something that prevent them from falling. P5 stated that:

General workers don't put sufficient scaffolding whereby you need to have proper scaffolding, but they decide to have two strips of scaffolding so they will put one.

In addition, P1 outlined that repetitive task can cause workers to think that they understand the work but do not realise that every day there are new challenges, and this can affect their mentality. According to P1, excellent use of systems can minimise safety risk hazards and accidents on site. P2 revealed that not much time or effort is put into ensuring that the health and safety aspect is established so, automatically, it will lead to hazards that will likely cause accidents at a later stage. P2 stated that:

Workarounds blank, unplanned to rush work, it means that no sufficient work planned so they must do as they owe.

P3 stated that they are not informed, so anything can happen. People might fall depending on the task that they are short-cutting. P3 revealed that shortcuts create high chances of causing risks because of lack of planning. P3 noted that at the site on which he was working, they just monitor, and they are done. According to P4, workarounds turn hazards into safety risks on construction sites by bypassing established safety protocols that are designed to mitigate those hazards. For example, P4 stated that,

When workers skip using fall protection systems to save time, they expose themselves directly to the risk of falling from heights.

P10 revealed that, to provide an injury-free working environment, it is necessary to make sure that workarounds are executed correctly to prevent risks and hazards.

4.3. Case 2: Construction of lecture block

Case 2 was about the construction of a new lecture-hall block in Bloemfontein City, South Africa. The project included the construction of a new lecture hall which was single-storey, and the alteration of an existing lecture hall. In this case study, the researcher interviewed only people who were working on this project, using semi-structured interviews. This was because the researcher wanted people who had experience and exposure to the phenomenon being investigated regarding safety risk, hazards and workarounds in Case 2. Case 2 involved a general building works in which workers were exposed to hazards that had the potential to cause accidents. Table 3.3 in the previous chapter shows the background and coding of the construction personnel interviewed in this case study.

4.3.1. The Connection between Hazard and Workarounds

To answer the first research sub-question that asked: What are the hazards associated with workarounds on construction sites? the qualitative data collected in this case were analysed thematically using two themes: (1) establish the causes of construction hazards, and (2) understand the concept of workarounds in construction.

4.3.1.1. *Establish the Causes of Construction Hazards*

The first interview concerning the identification of hazards on construction sites was conducted with R1. The interviewee stated that sometimes they worked under pressure because maybe

the product really was needed urgently. Then they would forget about safety so they would just work without PPE. For example, if it was electrical work or activity, they would just work on live cables without protective gloves. Then they would suffer an electric shock because they would assume that it was not important. R2 believed were so negligent. When somebody saw something, they would jump over it, but someone else might not see it, which was a sign of negligence. R2 stated that:

When doing bricks cutting, they just throw it around and they leave shovels lying around, that is negligence. That is what we are fighting for most often.

The interview conducted with R4 revealed that there were many different factors. Where the workers were on site, 90% of the time the factor was cleanliness. With objects lying around, they could not go around because they dumped there or the dumping overflowed to other sites, or general cleanliness. In addition, R1 noted that working at the university where student was still moving up and down, it was really to ensure that the work sites were always barricaded with signs that the building or site was under construction to avoid anybody going through and falling over objects. They worked on heights, so sometimes the ceiling was not fitted properly, so they had to be careful about that.

R2 also highlighted that cutting corners was not even allowed because, like loading, they wanted to load bricks and mortar on top of the scaffolding and there was a certain amount to load. Just because people wanted to chase productivity, they would want to load everything because they wanted to cut corners.

R3 noted that, if there was paint work that had to be done, maybe instead of using the correct ladder or scaffolding, they would try to be quick based on the timeline that they had, because most of the contractors wanted to complete the job as soon as possible. Furthermore, R3 stated that someone could not be on a step ladder with someone else holding it. That was turning a blind eye just to complete the job. R3 stated that:

People scraping or painting, working without wearing masks can get hurt because some other paints have chemicals.

R4 noted improper planning, improper tools provided to workers, improper training provided

to workers in how to use a set of tools, improper management of the teams, mismanagement from the foreman's site, incorrect areas, and health and safety which is everyone's responsibility. Also, R4 stated that one of the hazards most unspoken about was the electrical cable running from a temporary power point all the way to the building. R4 noted further not being vigilant and not following the correct procedure and training in health and safety.

4.3.1.2. *Understand the Concept of Workarounds in Construction*

The interview conducted with R5 revealed that there were situations whereby there was not enough material (material shortage) on sites, and this might contribute to workarounds.

R5 stated that:

In some cases when we are at work, there is no one who are about material shortage. It is a matter of getting things done, even when they know that there is material shortage or rather there are certain process which should be done. All they just want to get the job done.

The interview conducted with R7 revealed that, if workers were doing plastering and brickwork in one area, the workers who were doing would disturb those were doing brickwork and vice versa, so it was a hazard. According to R9, the biggest hazard for the workers working on site was if they did not use the correct tool and PPE for the job.

Also, R5 revealed that when someone was doing workarounds, they were making a temporary solution. Another workaround might involve workers working on stairs or scaffolds without using PPE. For example, often workers walked on scaffolds without wearing helmets, holding them in their hands instead. R6 stated further that:

Project managers: you tell them that we need wire strippers and other tools, but they don't deliver them on time, and they are going to push you to work and want certain tasks completed in certain time, but they forget that they have not given you the tools to do your job.

R7 said that, if there is material lying around, they must clean so that it is clear. Moreover, regarding housekeeping, R7 revealed that, if the workers were working and using shutter bolts, they would leave those cuts.

R9 added working on heights because they did not wear the harnesses when necessary and that was very dangerous because they could fall off the scaffold.

The interview conducted with R10 revealed that construction workers contributed to hazards by not wearing appropriate PPE, by working in an area where housekeeping was not done and this was detrimental to other workers because, if housekeeping was not done, there was a risk of tripping and falling. R10 commented that site management contributed to hazards by allowing construction teams to execute work during adverse weather conditions, and they allowed the workers to execute work in dangerous areas without appropriate PPE or sufficient plug machinery and expertise. Moreover, R10 stated that:

Hazards of working in a place that does not have adequate housekeeping and hazards of working on roofs without the correct PPE.

4.3.2. The Connection between Safety Risks and Workarounds

To answer the second research sub-question that asked: What are the risks associated with workarounds on construction sites? the qualitative data collected in this case were analysed thematically using one theme: comprehend construction safety risks and workarounds.

4.3.2.1. *Comprehend Construction Safety Risks and Workarounds*

Regarding safety risks, R1 believed that there were risks discovered from the hazards. R1 revealed that there were risks because they had been trained within their skills whether they were a carpenter, electrician, or whatever, they all went through training. They knew that, before they attended to any task, they had to do risk assessment, and they knew what to do regarding the safety associated with those activities. R2 substantiated this by stating that sometimes they wanted them to use safety harnesses, but they do not use them. They do not clamp them, they just wear it, so they take a risk. Also, R2 believed that sometimes contractors chase productivity. While in the process of chasing productivity, the chance of being careful might be compromised, which might rebound to affect the project. This is mainly because there will be more money needed to fix mistakes which also will be more costly compared with ensuring that the job has been done correctly in the first place.

Also, R1 noted that:

Basically at the moment we just generalise because I have got a number of projects, I have got one that is working at heights, I'm dealing with roof sheeting and the ceilings and the eaves and all that, so first of all we have to make sure that scaffolding is erected and approved, which was done and safety filed talking to the scaffolding, not only the project on its own because it is an external supplier who supplied the scaffolding.

R2 believed that there were risks discovered from the hazards, caused by construction teams. R2 noted that working with cranes and columns on construction sites, they lifted heavy objects and the contractor worked with sharp objects, so the risk was high. R2 stated that:

There are times when one will wonder how their behaviour or rather action did not cause an accident and wonder how they have also survived certain incidents which put their lives at risk. Working in construction daily exposes one to death risks and hazardous environment. One will only keep praying for God's protection as the accidents and death incidents happen when one is less expectant.

R3, on the other side, revealed that the first cause is injuries on site, which can slow down productivity because they allowed manpower downtime and some of them can be so serious that they end up in hospital. R3 stated that if the contractor did not have risk management and was not following the risk management plan on site, it would result in even more dangerous hazards to the workers. Moreover, R1 stated that the management really must not rush into the product. They must let the process take its course. They must not pressurise the team, because they know better that the consequences if any danger or any harm or any risk happens, they are the people that will have to answer.

Moreover, R3 revealed that they needed to pre-plan and sort out their risks, because they were working in an environment whereby there was constant movement. So, for instance, if they barricaded, they could control the movement of people on their site. R3 believed that they could not obtain a job on a construction site and just start working, without trying to determine what the risks were and trying to mitigate them as far as possible, and it was important to have their regular toolbox meeting before they started so that the employees on site were aware of the risk

factors and not make mistakes that might cost them the project. According to R7, to see that this area is wrong, they are not supposed to work there but they force themselves to work there, is also a risk. R8 stated that:

On site we are using a crane, to load the material from up to down, so the risk is, the load that the crane is carrying, it passes on top of the people who are working on heights, like on a scaffolding, so if that object can fall to the guys, then it will be a problem.

According to R4, financial risk occurs when something goes wrong, budget stops, cash flow, and so forth on the site of the contractor or the investigation goes wrong. Also, R4 stressed that who is responsible for commercial risk? Did the contractor train the effectively, was the person inducted onto the site appropriately, who did this person come through, was it through a client or engineers? R5 added that construction companies do not conduct matters in a quality way. They want you to call them again because it is business and they are concerned about making profit. So, they usually do low quality work so that you call them again for the same jobs, according to R5. Moreover, R5 stated that most contractors like cheap work; they do not want to spend money and, sometimes it involves doing favours for certain companies, even if they know that they do not deliver. R5 argued further that working on live circuits because they must be very careful because people make mistakes and they are shocked when the current is not switched off.

The interview conducted with R6 revealed that the construction workforce worked without safety boots, and the hazard is that if there is an electrical shock, it might harm them and their health, and the other concern is that it could damage the danger box/transformers, which is a risk also, not only to themselves but to the environment in which they were working. R6 revealed that, most of the time, when working in the industry, especially when working with electrical equipment, the first job they might have is to install a light bulb which will require them to be on an elevated height, so they find out that most of the time the scaffolding is not stable, so they might fall. Also, the workers do not have helmets and most of the time they do not use safety harnesses.

R9 revealed that, if the workers are not using the correct tools for a job, not wearing the PPE, and doing something without planning, all these actions can cause risks for them because they

are not sure what they must do. R9 noted that management teams sometimes just turn a blind eye to those actions because they want productivity to continue, so they will see a person is not using the correct tool and will just turn a blind eye because they want to push productivity.

R10 stated that:

Using faulty tools, like a grinder having wires exposed, and it is not securely grounded for electricity, not properly earthed and may shock the worker or the next person, so there are risks involved if using inadequate tools deliberately even if they are not in a good standard to be used.

Also, R10 revealed that construction workers were always keen to push productivity and they might want to use the cranes even when the conditions are not conducive, for the sake of pushing the productivity. R10 noted that risk arise because of workers working without sufficient PPE.

4.3.3. Workarounds Turn Hazards into Safety Risks

To answer the third research sub-question that asked: How do workarounds turn hazards into risks on construction sites? the qualitative data collected in this case were analysed thematically using one theme: the connection between hazards and safety risks.

4.3.3.1. *The Connection between Workarounds and Safety Risks*

The first interview conducted with P1 revealed that the result is damage. They would have accidents, injuries or even death. Moreover, according to R1, workarounds were a risk their own, because they were taking a shortcut and not doing the work appropriately or doing the work the correct way, so workarounds and risks were linked because, if they were not doing work in the correct manner, it would end up as a safety risk. R1 stated that:

It's a damage, it causes either death, like we said on property or human being. It can, like I said it, take life and can be costly. Remember that damage can be in health format, like you're sick, there's damage to the building and it' going to be costly to the company to repair that.

The interview conducted with R4 highlighted that a workaround itself is a risk, so it is already a risky situation especially during erection, and a construction site is a risky area because

anything can go wrong, even things that are unforeseen such as, maybe, stones collapse when people are underneath, which is already risky, but what they could do is that they say the gravel must be at least 3 metres away from the trenches. R4 added that there is a relationship between workarounds, hazards and safety risks but, considering it in isolation, trying to relate it to everything else just adds more risk. R4 argued that workarounds increase the chance of something going wrong. R6 revealed that workarounds cause hazards because, for instance, workers need to have safety boots but, instead, they wear sneaker shoes, so it is a hazard. Also, R6 contended that, if workers climb on a ladder without a safety helmet, there is chance that they might fall.

R2 believed that should not take shortcuts because they will be short of something, so that is going to cause the hazard for them. They are going to leave objects lying around and say, “No, I’ll come back,” and they want to take a shortcut. They do not do the housekeeping on the site and because of those actions, they will course more hazards. R2 outlined that hazard is a risk, and a risk is caused by hazard; it is one thing because everybody who takes shortcuts will end up being injured. R2 added that it might not be today, but it will happen – they are waiting for that day to come – they were preparing the way. According to R3, scaffolding must be checked and labelled to say that is safe to use. Most of the time, not all contractors take their employees to training about scaffolding, but not everybody can just climb on scaffolding and start working. R3 added further that probably there would be loss of life and loss of time on the project as well loss of money towards the project and the contactor on the project.

R5 stated that:

So, the hazard will be shocking or burning the whole DB. Workarounds lead to hazards, and hazards are connected to safety; it means, they’re all linked.

In addition, R6 revealed that workarounds lead to hazards which lead to risks, because if they want to do something that has never been tested or done by experts, it is going to cause a shock or risk, meaning that people might contract health problems or it might start a fire.

R7 believed that workarounds and safety risks are connected because workers are going to use Plan B, which is not safe, but they are still going to use it. Also, R7 believed these both

contribute to risks, because workers are going to use the wrong material in a wrong area. According to R8, it will depend on the people who are working on that project. If they have the necessary tools and equipment for that workaround, it is fine but, if they do not have the necessary equipment, it is going to be a problem. Moreover, R8 suggested that workarounds and safety risks link if workers do not have appropriate equipment for the workaround that they are about to perform but, if they do, there is no risk. R8 believed there is a connection because every work always involves a hazard, whatever the project might be. The solution is to identify the hazards and develop ways to mitigate them. There are always hazards; it is just necessary to develop ways to prevent them. R9 noted that workarounds increase the hazards. R9 revealed that, when not following a protocol, workers need to, so it does increase the hazards. According to R9, when workarounds and hazards are managed as if they were trenches and they are barricaded to make sure that workers cannot go near there and work near them, then they become a risk, but they can manage those risks in that way. R9 stated that:

For sure, because you do a workaround because you want to get it done now, and you are not following the 100% protocol, so you increase your hazards and your risks, so it also goes with managing that, so that workaround don't injure somebody.

According to R10, if sufficient guidelines are established and safety procedures are followed, then the risk can be minimised. With sufficient inspection and supervision by site management there can be control the risks can be minimised and could be eliminated. R10 revealed that workarounds are temporary solutions and bypass safety rules. Therefore, bypassing safety rules that are established causes hazards because the safety rules are developed specifically to mitigate accidents and any fatalities that might occur on construction sites.

4.4. Case 3: Refurbishment a University Building

Case 3 was about the refurbishment of an old university building in Bloemfontein City, South Africa. This project included the internal demolition of existing walls, demolition of a concrete slab, removal of old carpets, and removal of wooden, suspended ceilings. This project was selected because of the safety risks, hazards and workarounds that were experienced during the demolition and installation of lateral support which often results in accidents if not mitigated. Table 3.3 in the previous chapter shows the background and coding of the construction personnel interviewed in this case study.

4.4.1. The Connection between Hazard and Workarounds

To answer the first research sub-question that asked: What are the hazards associated with workarounds on construction sites? the qualitative data collected in this case were analysed thematically using two themes: (1) establish the causes of construction hazards, and (2) understand the concept of workarounds in construction.

4.4.1.1. *Establish the Causes of Construction Hazards*

According to I1, everyone knows the importance of safety regulation on construction sites. For example, PPE is always worn by workers. However, the interviewees highlighted that, despite workers knowing the safety regulations, the challenges remain in understanding the consequences of not adhering to these safety regulations. For example, it was explained by I4 that, by not providing the appropriate PPE required for a job and giving people jobs that they are not trained for, such as operating a machine, often result in accidents which can be traced to poor safety management.

In addition, I1 stressed that falling of waste materials, such as bricks, causes dust, and it is hazardous, which is recorded often by contractors. According to I2, the material or equipment lying around that is not being used at that time for construction, workers mostly attend to that only after, or closer to, the time to knock off, and it becomes dangerous when they do that. I2 stated that the managers themselves sometimes issued prompt instructions without effective planning. Furthermore, I2 revealed that objects that are not fully fixed to the building and the rubble lie around on the floor or construction site without appropriate storage. The third interview in Case Study 3 was conducted with the project manager referred to as I3 in this study. The project manager revealed poor housekeeping, horseplay, incorrect PPE, working under the influence (intoxication). The project manager added further that the industry was confronted by a lack of supervision of workers, inadequate project scheduling and co-ordination, not providing sufficient tools and plant machinery for workers, not providing adequate lighting for workers to execute work, and working the construction team for long hours. Moreover, the project manager revealed working on heights with inadequate safety harnesses and fall protection and using faulty or improper tools without the correct PPE.

The interview with I4 revealed that skilled and unskilled construction workers both contributed to hazards on construction sites. Skilled workers can introduce risks if they lack expertise, while unskilled workers might inadvertently contribute to hazards because of a lack of experience. Furthermore, I4 suggested that, if safety protocols and organisation are not enforced effectively, this can lead to unsafe working conditions. I4 said that it was essential to adhere rigorously to safety practices and provide vigilant oversight to mitigate these risks effectively. I4 summarised that hazards on construction sites often occur when safety rules are ignored.

4.4.1.2. *Understand the Concept of Workarounds in Construction*

According to I5, running on site (horseplay) is the most common occurrence where they arrive on site and might be connected to workarounds. For example, a worker can use a tool that is sharp, such as a blade grinder to cut wood or plastic, and such activity might result in a worker cutting himself, as a blade grinder is not meant for cutting plastic. I5 stressed drinking on duty and using drugs on duty. The site manager revealed that contractors are running their business on progress and productivity, and they do not care about the safety regulations. I5 said further that working without thinking of another person nearby was a big challenge in the construction industry. I6 highlighted that pressure on skilled workforce to meet deadlines often leads to taking shortcuts. Also, lack of training for unskilled workforce can lead to incorrect use of equipment. I6 stated that supervisors failed to provide adequate safety training and refresher training for employees. Hence, I6 advocated that poor housekeeping might result in employees slipping and falling.

I7 revealed that not adhering to the occupational health and safety regulations, or others not being aware of what they are doing can cause a hazard because they might not be cautious about. Basically, it means that they are not adhering to all the regulations. Either they are following OSHA regulations or OSHA regulations or any other form of regulations that workers must adhere to but violating any of the others, no matter how small or big, which can lead to hazards. I7 added also that supervisors and managers, although they are at work, they are inside, and there might be something that is not going according to plan or something that might be of danger or hazardous to the who are working so, if they are not continuously or effectively present, as they should be, that might contribute to hazards. I7 uncovers that just leaving things lying around where they shouldn't be, can contribute to hazards. According to I8, sometimes employees are inducted but, after the induction, they end up not following the

rules according to which they were inducted. For example, if they are working with dust, they do not wear masks. Also, I8 stated that:

Sometimes those who are working on heights, especially on the scaffolding, they do not check after the scaffolding, they just think that because they have erected the scaffolding, then it is suitable for use, but they don't test them or, in most cases, they do not call for inspection to certify that the scaffolding is safe for use.

I8 revealed lack of suitable signage on site, fuel unprotected against the sun/heat, and erected scaffolding not being tested. The ninth interview was conducted with the facilities manager at the university. The facilities manager believed that wearing safety boots was number one, based on the work they would be doing. The facilities manager believed that having total PPE on the project was most significant to protect against exposure to hazards. However, I10 stressed the importance of taking care of PPE and housekeeping on construction projects to avoid safety risks.

4.4.2. The Connection between Safety Risks and Workarounds

To answer the second research sub-question that asked: What are the risks associated with workarounds on construction sites? the qualitative data collected in this case were analysed thematically using one theme: comprehending construction safety risks and workarounds.

4.4.2.1. *Comprehending Construction Safety Risks and Workarounds*

According to I1, sometimes they were doing tilework, and they had to cut some tiles. Sometimes, they would want to use a different tool, such as an electrical tool that was not in good condition, but they used it anyway, which might contribute to risk. Also, I1 revealed that compacting, removal of wood planks and paint were all related to hazards. According to I2, the construction workforce often tended not to wear the general PPE which included safety boots, reflector, and overalls. I2 stated further that people were not trained effectively to work on heights which was a major factor as well, because some people are afraid of working on heights and if they are not trained effectively, that automatically can become a risk.

I3 suggested that there were risks discovered from the hazards that were caused by construction teams. I3 substantiated this by stating that workarounds are a type of shortcuts from the acceptable work procedures. Therefore, they will have risks because they introduce a method

of work execution as opposed to an established, safe, work procedure. Also, I3 noted working on heights (painting ceilings), and chasing on walls when working with electricity/tubing which puts workers at risk of inhaling dust because of the drilling and cutting. The interview with I4 suggested that there were risks discovered from the hazards caused by construction teams. I4 noted that is crucial for construction managers, site engineers, and health and safety managers to identify and address risks on construction sites. In addition, I4 revealed that construction projects involve multiple contractors and tight deadlines which increase the potential for co-ordination failures and safety oversights.

According to I5, there were risks discovered from the hazards caused by construction teams. I5 said that when taking shortcuts, they were just thinking of what they were doing. I5 added giving unnecessary instructions to the workers because of rushing productivity. I5 revealed that using machines, e.g. grinders, was risky when they do not know how to use them. They must use goggles, ear plugs and safety gloves. I6 revealed that mechanical engineering construction sites involve a variety of tasks that can pose significant risks if not managed effectively. I6 also stated that lack of commitment of the management team compromises safety during site activities. I6 added that inadequate supervision and poor oversight can result in workers taking shortcuts or using unsafe practices, which contribute to potential hazards.

The interview with I8 suggested that uncollected equipment that is left lying around after use can cause high risk of people being hurt. Another factor could be that, when erecting scaffolding, people can fall from it. If they do not wear safety harnesses, they are likely to fall; the scaffolding does not guarantee safety, it only enables workers to reach certain heights. If workers are not protecting themselves, then they can fall. I8 added further that management cause risks on site by forcing or pressurising the workers on site by saying that we are behind time, we must make money, we must do this within a certain period. I8 stated that the risk related to his project would be the insecurity of the site. Should the site not be secured well, it poses a risk that property or usable equipment is being misplaced on site. According to I9, a safety office must always be there to foresee whether the work is progressing harmoniously. If it is not, then the company must be liable. I10 on the other hand, revealed that poor housekeeping is very dangerous in a construction project.

4.4.3. Workarounds turn Hazards into Safety Risks

To answer the third research sub-question that asked: How do workarounds turn hazards into

risks on construction sites? the qualitative data collected in this case were analysed thematically using one theme: the connection between hazards and safety risks.

4.4.3.1. *The Connection between Workarounds and Safety Risks*

According to I1, workarounds and hazards do connect; it is necessary to reduce the risks, which occur most of the time when shortcuts are taken. Also, I1 said that when they take a shortcut, the risks will always exist, and they are very high since workers are working in an unsafe space. I2 stated that not much time is taken to ensure that the health and safety aspect is established, so this will lead automatically to hazards that will likely cause accidents at a later stage. I2 suggested further that workarounds and safety risks contribute to the risks for the reasons stated before, so they increase the risks, not reduce them. I2 revealed that workarounds are blank and unplanned to rush work, which means that the work is not planned sufficient.

I3 revealed that risks are always present when a workaround is executed on construction sites, and all workarounds should be performed under strict supervision of site management and performed by experienced construction teams. Moreover, the project manager stressed that workarounds are alternatives, temporary solutions that are outside the acceptable work procedures. Therefore, there will be hazards and risks present during their execution. I4 revealed that workarounds can lead to direct hazards by bypassing established safety protocols. When workers take shortcuts to complete tasks quickly, they often ignore important safety steps, which can result in inappropriate use of equipment, exposure to hazardous conditions, and an increased risk of accidents such as falls, electrical shocks, or machinery-related injuries. I4 noted further that workarounds and safety risks on construction sites increase safety risks by deviating from established protocols, bypassing critical safety measures, and compromising individual and team safety. The interaction between workarounds, hazards, and safety risks on construction sites impacts site safety significantly. Workarounds and informal deviations from standard procedures, often arise from time pressures, resource limitations, or perceived inefficiencies.

According to I5, shortcuts creating hazards is the link between workarounds and hazards. I5 added also that, when they take shortcuts, and follow the procedure, then there will be no hazard. The Interview with I6 revealed that, on a mechanical engineering construction site, workarounds can introduce hazards directly by bypassing essential safety measures. I6 gave an example of ignoring PPE: workers might skip wearing PPE, such as gloves, safety glasses, or helmets to save time, which increases the risk of injuries from sharp objects, flying debris, or

falling items. According to I6, compromised structural integrity, such as skipping steps in the installation or maintenance of mechanical systems, such as HVAC or plumbing systems, can result in failures. According to I8, the link between workarounds and hazards is that, with the shortcut, the product will not be done correctly. Also, I8 revealed, for example, that safety risk could be if all the appropriate signage is not put up on site, and the safety risk is that failure to do so, workers are most likely to go over the prohibited area if there is not any signage that is visible. I9 states that throwing objects down when using a ladder, that might cause an unnecessary hazard. Moreover, I9 revealed that risks are going to turn into hazards once shortcuts are taken. I10 stated that workarounds can lead directly to hazards by bypassing essential safety measures.

4.5. Discussions of the findings

Based on the three case studies to which the study was carried on it can be realised participants from the qualitative study concur with the fact that, there are risks which are associated with workarounds. Although there are other risks that are unidentified risks, thus risks that have not been anticipated by the project managers and stakeholders. For instance, termination of contract by suppliers, unexpected archaeological finds, unique geological faults, or contaminated soil; a sudden, mid-project change in environmental laws or building codes that forces a major redesign or use of new, expensive materials, which was not foreseeable during the planning phase. In addition, these risks can also be Natural disasters/Extreme weather events; Geopolitical events; New technology failure. While the passively accepted risks are Minor weather delays; Minor material price fluctuations; Supplier delivery times; Minor scope clarifications. It can be realized that in most cases the project managers will overlook these risks resulting into fatalities. Should there be proper H & S precautions especially upon identifying or realizing risks it is important to stop the project and ensure safety as safety is more important than just completing the projects.

4.6. Chapter Summary

In Chapter 4, a detailed analysis of the data collected using qualitative methods in the multiple case studies was presented. The qualitative data collected from the multiple case studies were analysed using thematic analysis. As a result, thematic analysis helped to categorise the data and identify themes associated with the objectives of the study. Each case was investigated

independently.

Chapter 5: Results and discussions of the Quantitative Data Analysis

5.1. Introduction

In this chapter, the findings from a survey that was distributed to the construction personnel working in the Free State Province of South Africa, are presented. The quantitative questionnaires were distributed to one hundred and twenty (120) individuals, and ninety-four (94) of them completed the survey. The survey questionnaires were presented on printed copies. The questionnaires returned were analysed using descriptive analysis, including the mean score (MS) and standard deviation (SD), using SPSS Software. Consequently, the surveys were evaluated using a Likert Scale with a range of 1 to 5.

5.2. Quantitative Data Analysis

This section contains a summary of the quantitative data collected from construction personnel working in the Free State Province of South Africa. The quantitative data were analysed using descriptive statistics, including the mean score (MS) and standard deviation (SD). In addition, the reliability of the data was tested using Cronbach alpha.

5.3. The Hazards Connected to Workarounds on Construction Sites

To answer the first sub-question of the research: What are the hazards associated with workarounds on construction sites? a Likert Scale of 1 to 5 was used to evaluate the elements that connect hazards to workarounds on construction sites. The Likert Scale can be summarised as follows: minor = 1, near minor = 2, somewhat = 3, near major = 4, and major = 5. The findings of the descriptive analysis are presented in Table 5.1.

Foremost among these results were flammable substances which were ranked the highest with a mean score (MS) of 4.36. This factor generally has a major impact on hazards associated with workarounds on construction sites. Working at height was ranked second with an average MS of 4.27. The respondents acknowledged that working at height is the second most important factor that has a major impact on hazards associated with workarounds on construction sites. Electrocutation was ranked third with an MS of 4.24, as most respondents endorsed the impact of electrocution on hazards associated with workarounds on construction sites. Despite being

ranked the lowest with an MS of 3.35, construction vehicles have an impact on hazards associated with workarounds on construction sites. Nevertheless, all the mean scores were above 3.95 which indicated that the collective hazard factors had a significant impact on workarounds on construction sites. In summary, the findings of the study underlined the vital factors, including flammable substances, working at height, and electrocution.

Table 5.1: The elements of hazards associated with workarounds on construction sites

Elements of hazards associated with workarounds	MS	SD	Rank	Cronbach's alpha
Flammable substances	4.36	0.774	1	0.786
Working at height	4.27	0.882	2	
Electrocution	4.24	0.900	3	
Falling objects	4.23	0.955	4	
Defective plant machinery	4.22	0.985	5	
Demolition	4.02	0.880	6	
Slippery and wet floors	3.94	0.878	7	
Toxic substances	3.80	0.990	8	
Noise	3.61	0.941	9	
Excavation	3.43	0.849	10	
Construction vehicle	3.35	0.991	11	

Source: Created by the researcher

In addition, as shown in Table 5.1, Cronbach's alpha was used to measure the internal consistency of the variables. The Cronbach's alpha for the variables was 0.786, which is acceptable.

5.4. The Safety Risks Associated with Workarounds on Construction Sites

To answer the second sub-question of the research: What are the safety risks associated with workarounds on construction sites? a Likert Scale of 1 to 5 was used to evaluate the elements

that connect safety risks to workarounds on construction site. The Likert Scale can be

summarised as follows: minor = 1, near minor = 2, somewhat = 3, near major = 4, and major = 5.

In addition, the findings in Table 5.2 show that being electrocuted because of working on a live wire was given the highest score in safety risks associated with workarounds on construction sites, with an MS of 4.45. This was supported by the large number of respondents who noted that being electrocuted because of working on a live wire was a major factor that contributed to safety risks associated with workarounds on construction sites. Harm and injuries caused by defective plant machinery were ranked second, with an MS of 4.38. The third-ranked safety risk associated with workarounds on construction sites was fire caused by working with explosive substances with an MS of 4.34. The safety risk factor ranked lowest, with an MS of 3.82, was being bumped by a construction vehicle. Nonetheless, evidence from Table 5.2 shows that the average MS was 4.06 which is above the threshold of 3.00, and this indicates that all these factors contributed to safety risks associated with workarounds on construction sites.

Table 5.2: The elements of safety risks associated with workarounds on construction sites

Elements of safety risks	MS	SD	Rank	Cronbach's alpha
Being electrocuted because of working on a live wire	4.45	0.863	1	0.816
Harm and injuries caused by defective plant machinery	4.38	0.805	2	
Fire caused by working with explosive substances	4.34	0.887	3	
Fall from a height.	4.27	0.806	4	
Inhaling dust and fumes from toxic substances	4.19	0.907	5	
Being struck by falling objects	4.15	0.803	6	
Falling of debris, premature collapse from structure being demolished.	4.05	0.795	7	
Slipping while working on wet floors	3.98	0.950	8	

Being in contact with noisy plant machinery for long hours without necessary PPE	3.77	1.062	9	
Fall to the excavation.	3.64	0.993	10	
Being bumped by a construction vehicle	3.39	1.138	11	

Source: Created by the researcher

In addition, it is highlighted in Table 5.2 that the Cronbach's alpha was used to measure the internal consistency of the variables. The Cronbach's alpha for the variables was 0.816, which is acceptable.

5.5. Workarounds Turning Hazards into Safety Risks on Construction Sites

To answer the third sub-question of the research: How do workarounds turn hazards into risks on construction sites? the identified variables of workarounds were assessed using a Likert Scale from 1 to 5. The Likert Scale can be summarised as follows: minor = 1, near minor = 2, somewhat = 3, near major = 4, and major = 5. The findings of the descriptive analysis are shown in Table 5.3.

Poor quality of materials was regarded as being the most common variable of workarounds to turn hazards into safety risks on construction sites. Evidence from an overwhelming MS of 4.54 indicated that the majority of the respondents believed that this was the major variable of workarounds that contributed to turning hazards into safety risks on construction sites and was ranked highest, followed by lack of training as the second most significant variable of workarounds that turned hazards into safety risks on construction sites, with an MS of 4.43. Miscommunication was ranked as the third most important variable of workarounds to turn hazards into safety risks on construction sites, endorsed by an MS of 4.36. It is noted that the variable of workarounds ranked lowest in turning hazards into safety risks on construction sites, with an MS of 4.16, was overlooking hazardous conditions because of focusing on quick solutions. Table 5.3 shows the average MS of 4.28.

Table 5.3: The variables of workarounds in construction

Variables of workarounds in construction	MS	SD	Rank	Cronbach's alpha
Poor quality of materials	4.54	5.219	1	0.701

Variables of workarounds in construction	MS	SD	Rank	Cronbach's alpha
Lack of training	4.43	0.726	2	
Miscommunication	4.36	0.815	3	
Compromising Health and Safety standards	4.33	0.712	4	
Lack of supervision and normalising unsafe practices on construction sites	4.22	0.895	5	
Outdated tools	4.17	0.838	6	
Sub-contractor mistakes	4.12	0.746	7	
Human error	4.02	0.950	8	
Inaccurate field information	3.96	0.761	9	
Overlooking hazardous conditions because of focusing on quick solutions	3.94	0.930	10	

Source: Created by the researcher

It is highlighted in Table 5.3 that the Cronbach's alpha was used to measure the internal consistency of the variables. Cronbach's alpha for the variables was 0.701, which is acceptable

5.6. Discussion of findings

Based on the findings of the quantitative results it can be noted that there are hazards which are connected to workarounds which has posed safety risks among construction workers. Thus, the sector is more risk as it deals with heavy machinery and equipment which put the employees at risk more than any other sector. While it can be noted that project managers would be mainly be driven with profits and completion of projects it can be noted that most of the employees acknowledge that they are at risk. As presented by the researcher it is not that the employees careless about their lives, but it is the conditions and the circumstances that they are exposed to which result in them having or rather taking such risks. Findings are also supported by literature which argue that; "The Health and Safety Executive revealed that the British Construction Industry had the highest level of fatal injuries across all their industries, with a total of 38 fatalities in 2017/2018" (Umeokafor, 2020: 16). Furthermore, Manu *et al.* (2018:188) in support of the findings it can also be noted that, "... the construction industry in developing countries, such as Malaysia and Singapore, recorded the highest number of fatal injuries compared with other industries". This is not exceptional of South Africa as it is also among the developing countries.

5.7. Summary

In this chapter, the analysis of the quantitative data that were used to evaluate the variables that contributing to objectives 1, 2 and 3 was presented. The descriptive data presented in this chapter showed that there is a relationship between hazards, safety risks and workarounds on construction sites. In addition, the findings produced similar results to the findings presented in Chapter Four.

Chapter Six: Protocol Development

6.1. Introduction

The fourth sub-question of the research which is addressed in this chapter is: How would the development of a protocol to control safety risk mitigate workarounds and hazards on construction sites? The proposed protocol to control safety risk was developed based on the current protocol, which is depicted in Figure 2.1 in Chapter Two. The protocol to control safety risk proposed in this chapter is modified using the primary and secondary data from this study project.

6.2. Development of a Protocol to Control Safety Risk

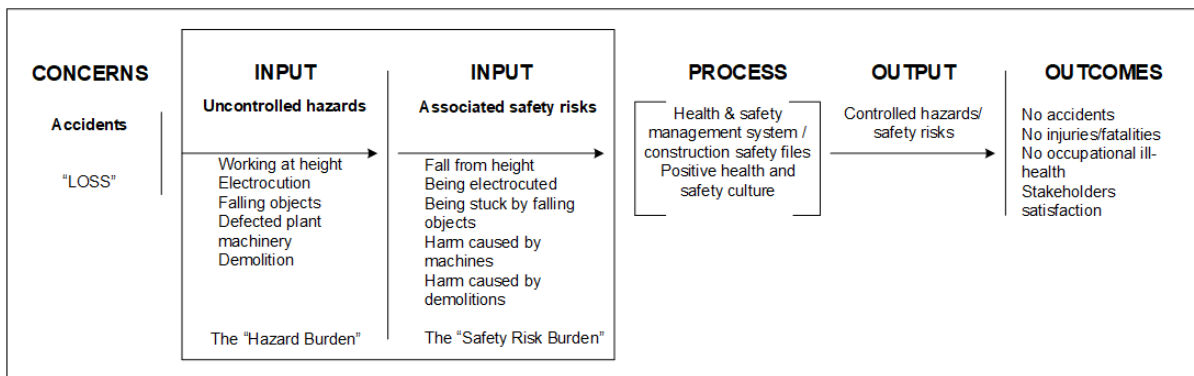
According to Flechsig (2022), a protocol is a set of accepted rules or instructions that specify how to carry out a particular task or follow procedures. The researcher developed a protocol to control safety risk to specify the actions that should be taken to oversee hazards while working on construction projects. There are five components in the developed protocol to control safety risk: (1) concerns; (2) input; (3) process; (4) output; and (5) outcomes. Figure 6.1 shows the procedure to control safety risk.

To address effectively the research sub-question: How would the development of a protocol to control safety risk mitigate workarounds and hazards on construction sites? the proposed protocol to control safety risk must include the five components outlined in Figure 6.1. It is crucial to note that the protocol is informed regulatory changes & increased accountability; technology integration; prevention through design (PtD); data-driven & proactive approaches; and human & cultural factors. It is also important to note that the protocol should be based on a balanced approach that integrates:

- **Concern:** Acknowledge the issue identified. The problem originates from accidents that pose a significant risk of loss of life for victims.
- **Input:** Monitor hazards and safety risks. Accidents occur because of uncontrolled hazards, which are often revealed through safety risks. Therefore, it is essential to monitor actively the burden of hazards and safety risks.
- **Process:** Implement active monitoring of hazards and safety risks through health and safety management systems or documentation of safety. This proactive approach will

foster a positive health and safety culture.

- **Output:** Diligent monitoring of identified hazards and safety risks.
- **Outcomes:** Effective monitoring of hazards and safety risks leads to zero accidents and satisfied stakeholders.



Source. Created by the researcher

Figure 6.1: Proposed protocol to control safety risk

6.2.1. Concern: Acknowledge the Issue Identified

The problem, which is accidents, is acknowledged: because of its tendency towards riskier operations, the construction industry has a greater accident record and mortality rate than other industries (Boadu *et al.*, 2020). Accidents in the construction industry have the potential to cause harm or even death. Accidents are a problem in both developed and under-developed countries. For example, the British Construction Sector had the highest number of fatal injuries of any industry in 2017–2018, with 38 fatalities, according to the Health and Safety Executive (Umeokafor, 2020: 16). In 2020, there were 6,157 incidents on South African construction sites, 605 of which resulted in permanent injuries to workers, and 48 of which were fatalities, according to reports (FEM, 2023: 2). It is well known that these construction accidents are caused by several hazards that vary from project to project. This information clarifies that accidents are acknowledged as being a problem in the construction industry. Therefore, it is essential to monitor the root causes of the problem and prioritise risk control.

6.2.2. Input: Monitor Hazards and Safety Risks

Monitoring hazards and safety risks is crucial in construction. As reported in the previous

component, accidents often occur because of hazards that are inherent in construction activities. The significance of these hazards determines the safety risks that must be controlled. Hazards arise from a combination of factors related to people, equipment, materials, the environment, construction processes, and can also be influenced by organisation of work and psychological factors (Guo *et al.*, 2022). This perspective was supported by the interviewees in the case studies presented in Chapter Four.

In Case 1, it was noted that workers contribute to unsafe working habits that create hazards on construction sites. Workers often ignore safety rules by attempting to take shortcuts, seeking “simpler” ways to complete their tasks. Similarly, in Case 2, R2 reported that hazards frequently occur when bricklayers lay brickwork; they cut bricks and throw them on the ground and leave shovels lying around. Such activities are related directly to hazards that have the potential to cause accidents, as highlighted by researchers such as Guo *et al.* (2022).

According to Famakin *et al.* (2023), a hazard is defined as an unsafe act or condition that poses a risk of injuries, fatalities, or environmental contamination. Common causes of hazards include:

- Working at height.
- Electrocutation.
- Falling objects.
- Defective plant machinery.
- Demolition.

In addition, these identified hazards are measured in Chapter Five and are confirmed, as shown in Table 5.1.

In the literature, it is indicated that safety risks cannot be discuss without understanding the hazards present in the construction industry. Therefore, this proposed protocol begins with hazard identification, followed by the identification of associated safety risks. Some of the identified safety risks include:

- Falls from height.

- Electrocution.
- Being struck by falling objects.
- Injury caused by machinery.
- Injury caused by demolition activities.

These identified safety risks are also measured in Chapter Five, and the results in Table 5.2 demonstrate positive acceptance of these safety risks. In summary, the information in the second component provides essential insights into controlling safety risks to ensure that workarounds and hazards are mitigated on construction sites.

6.2.3. Process: Active Monitoring of Hazards and Safety Risks

Implementing safety management systems or safety files on construction sites necessitates a systematic approach that encompasses planning, execution, and ongoing improvement to mitigate hazards effectively. The planning phase is conducted by safety managers, who are tasked with identifying, assessing, and controlling risks associated with construction projects and worker safety. For example, safety managers are responsible for identifying hazards and evaluating them to ascertain the safety risks that require control measures, as illustrated in Cases 1, 2, and 3. The aim of this methodology is to enhance the safety culture and foster a safe and healthy work environment within the construction industry. The implementation of safety management systems includes the following essential elements:

- Health and safety policy of the organisation.
- Planning process for prevention of accidents and illness.
- Management responsibilities.
- Continuous improvement of safety management systems.

This process serves as a proactive intervention by identifying and addressing potential hazards before they lead to harm. By assessing risks and implementing control measures, it transforms unsafe conditions or high-risk activities into manageable and safer environments. As a result, the overall risk is reduced to acceptable levels to ensure the safety of people, assets, and operations.

6.2.4. Output: Diligent Monitoring of Identified Hazards and Safety Risks.

Diligent monitoring of identified hazards and safety risks is essential. Identifying hazards involves recognising any condition, process, or substance that could lead to injury, illness, or damage. Once identified, these hazards are assessed to evaluate the associated risks, considering factors such as the frequency of exposure, the severity of consequences, and the vulnerability of individuals involved. This risk assessment aids in prioritising hazards that require immediate attention and determines the necessary interventions to protect individuals and property.

Monitoring and mitigating risks to acceptable levels necessitate continuous observation and evaluation of the effectiveness of safety measures, together with the implementation of controls, of which the aim is to eliminate or minimise dangers. These controls might include engineering solutions (e.g. machine guards), administrative actions (e.g. safety training or scheduling adjustments), and personal protective equipment. The objective is not always to eliminate all risks completely – since some are inherent in specific activities – but to manage them effectively to ensure that they do not pose unacceptable threats. Maintaining this balance is crucial for ensuring a safe and compliant working or living environment.

6.2.5. Outcomes: Effective Monitoring of Hazards and Safety Risks

These desired outcomes are clear success metrics for any health and safety management system. The following is a breakdown of how they reflect achievement of the process:

- Effective monitoring of hazards and safety risks: This ensures that risks are identified early, controls are implemented, and safety is improved continuously.
- No accidents or injuries: This outcome demonstrates that preventive measures are working and that safety protocols are being followed effectively.
- Fewer fatalities and no occupational ill health: These are critical indicators of a workplace where long-term health and life-threatening risks are well controlled.
- Stakeholder satisfaction: When workers, management, clients, and regulators are confident in the safety process, it shows trust, compliance, and organisational integrity.

Together, these outcomes define a proactive and successful health and safety culture, where the goal is not just compliance but the well-being and confidence of everyone involved.

6.3. Application of the Protocol to Control Safety Risk

The proposed protocol to control safety risk, as illustrated in Figure 6.1, can be implemented effectively in a construction project by commencing with the identification and assessment of uncontrolled hazards, including risks associated with working at height, electrocution, and defective machinery. A comprehensive, site-specific risk assessment should be conducted during the planning phase to catalogue all potential hazards and their associated risks. The findings must be documented and communicated clearly to all stakeholders through toolbox talks, induction programmes, and visible signage. For each identified hazard, a corresponding safety risk (e.g. fall from height or harm caused by demolition) must be recognised, and appropriate mitigation strategies must be developed. These strategies might include the installation of guard-rails, the use of personal protective equipment (PPE), and the regular maintenance of machinery.

The implementation phase should be focused on enforcing a robust health and safety management system (HSMS) that integrates construction safety regulations, standard operating procedures (SOPs), and fosters a strong safety culture among the workforces. Continuous monitoring, inspections, and audits should be performed to ensure that safety controls are reducing risks effectively to acceptable levels. Site safety officers and supervisors are responsible for ensuring compliance and addressing any breaches promptly. As risks are managed, the aim of this approach is to achieve outcomes such as a reduction in incidents and enhanced site safety. Over time, this will result in fewer injuries, the elimination of occupational illnesses, and improved stakeholder satisfaction, thereby fulfilling the desired outcomes of the safety protocol.

6.4. Chapter Summary

In this chapter, findings based on the development of a safety and risk protocol were presented. This section can be summarised as showing that there are various steps which are crucial for developing a protocol. These are: concern, input, process, output and outcomes. In the section, the application of a protocol to control safety was presented also. A protocol to control safety risk can be implemented effectively in a construction project by commencing with the identification and assessment of uncontrolled hazards, including risks associated with working at height, electrocution, and defective machinery. A comprehensive site-specific risk

assessment should be conducted during the planning phase to catalogue all potential hazards and their associated risks. These are observed and identified based on the steps discussed.

Chapter Seven: Conclusions and Recommendations

7.1. Introduction

In this chapter, a summary of the research findings, conclusions, and recommendations are presented based on the objectives of this study. In this section, the key findings of the study, possible contributions to knowledge, and identified implications for practice within the construction industry are summarised. Then, the chapter is concluded.

7.2. Conclusions

The results of the study, which addressed four research objectives, are summarised in this section. The presentation of data includes a summary of the qualitative and quantitative data from Chapters 4 and 5. The findings indicated a strong correlation between the qualitative and quantitative methods, which supported the development of protocols to control safety risk that will mitigate hazards and workarounds on construction sites. The summary of the research results is presented based on the following research objectives:

- To identify hazards associated with workarounds on construction sites.
- To determine safety risks associated with workarounds on construction sites.
- To outline how workarounds turn hazards into safety risks on construction sites
- To develop a protocol to control safety risk to mitigate workarounds and hazards on construction sites.

7.2.1. Conclusion Regarding the Connection between Hazards and Workarounds on Construction Sites

This sub-section contains a summary of the first objective which was to identify the connection between hazards and workarounds on construction sites. A review of the available literature was conducted to acquire meaningful results for this purpose, and research survey questionnaires were distributed to three case studies (construction sites), including semi-structured interviews with construction personnel who were exposed to construction operations daily. The qualitative findings showed that the preventative measure for the connection between hazards and workarounds on construction sites is a protocol to control safety risk that will mitigate workarounds and reduce dangers on construction sites that might include environmental and site-related risks, poor housekeeping, compromised site safety, and poor

planning and supervision.

Thus, the researcher used descriptive statistics to analyse the quantitative data presented in chapter 5. The connection between hazards and workarounds on construction sites results in dangers such as inflammable substances, working at height, electrocution, falling objects, noise, and excavation. As indicated in Table 5.6, Cronbach's alpha was used to measure the internal consistency of the variables. The Cronbach's alpha for the variables was 0.786, which is acceptable. Therefore, based on the literature and findings of the study, the importance of recognising and addressing the link between hazards and workarounds on construction projects could be deduced, as it plays a pivotal role in ensuring safety within construction sites. Furthermore, implementing robust protocols to control safety risk that are designed to address these specific risks can enhance safety on construction sites significantly, reduce accidents, and improve the efficiency of the overall project.

7.2.2. Conclusion Regarding the Connection between Safety Risks and Workarounds on Construction Sites

In this second sub-section, the second objective is addressed, which was to identify the connection between safety risks and workarounds on construction sites.

The qualitative results of the study revealed that the respondents affirmed that there is a connection between safety risks and workarounds on construction sites. Based on the findings, it was noted that the key factors that contribute to these risks include the presence of incompetent or untrained workers, who lack the necessary skills and awareness to adhere to established safety protocols. In addition, the findings revealed that workarounds inherently introduce hazards, as they involve shortcuts and deviations from standard procedures, often leading to unsafe practices. Another risk which was identified in the study was neglecting the use of PPE, and the deliberate bypassing of established safety measures further escalates risks on construction sites. It was affirmed also that poor communication among workers and management exacerbated these challenges, resulting in misunderstandings, ineffective identification of hazards, and compromised safety compliance.

Like the qualitative findings, the quantitative data revealed that there is a connection between safety risks and workarounds on construction sites. This includes being electrocuted because of working on a live wire, harm and injuries caused by defective plant machinery, and fire

caused by working with explosive substances. It is noted that the quantitative findings were consistent with the qualitative findings, which highlighted the major need for interventions to improve safety on construction work sites. Thus, based on the findings as highlighted in Table 5.7, Cronbach's alpha was used to measure the internal consistency of the variables. Cronbach's alpha for the variables was 0.816, which is acceptable.

Therefore, to address these concerns, specialised interventions are required, such as better health and safety training programmes, stringent enforcement of safety rules, and improved communication practices between management and construction teams, to develop a culture of safety and risk awareness in construction workplaces. The summary of the results in response to the second research objectives are presented in Table 6.2.

7.2.3. Conclusion Regarding Workarounds Turning Hazards into safety Risks on Construction Sites

The purpose of the third objective was to evaluate the impact of how workarounds turn hazards into safety risks on construction sites. Literature review, qualitative and quantitative research methods revealed that, to some extent, workarounds turn hazards into safety risks on construction sites. Precisely, the qualitative findings revealed that the key factors that were identified included unstable structures, hazardous working conditions, pressure to prioritise productivity over safety, and the neglect of using personal protective equipment (PPE) during construction operations. Workarounds often stem from a lack of effective planning, resource constraints, or a culture that undervalues safety compliance. The pressure to meet deadlines and enhance productivity frequently leads workers to bypass critical safety measures which further exacerbated the risk of accidents and injuries.

Findings from the quantitative method concurred with the qualitative findings as they affirmed that poor quality of materials, lack of training, and miscommunication were key contributors to safety risks. Sub-standard materials compromise structural integrity which increases the likelihood of failures and accidents. Lack of adequate health and safety training leaves construction workers ill-equipped to address hazards effectively, while miscommunication leads to misunderstandings, errors, and failure to adhere to appropriate safety measures. Cronbach's alpha for the variables was 0.701, which is acceptable. In summary, to address how workarounds turn hazards into safety risks on construction sites, it is important to enforce strict safety protocols, improve quality control of materials, enhance health and safety training, and

achieving clear and effective communication.

7.2.4. Conclusion Regarding the Development of a Protocol to Control Safety Risk to Mitigate Workarounds and Hazards on Construction Sites

It can be concluded that there are various steps which are crucial for developing protocols. These are: concerns, input, process, output and outcomes. The application of a protocol to control safety risk based on these steps will mitigate workarounds and hazards positively on construction sites. It can also be concluded that protocol to control safety risk can be implemented effectively on a construction project by commencing with the identification and assessment of uncontrolled hazards, including risks associated with working at height, electrocution, and defective machinery. A comprehensive site-specific risk assessment should be conducted during the planning phase to catalogue all potential hazards and their associated risks. These are mainly observed and identified based on the steps that have been discussed.

7.3. Limitations of the Study

The limitations of the study include a small sample size and restricted demographics of the respondents, which might not represent other construction sites or workers' profiles fully, which affects the generalisability of the findings.

- The geographic scope was also restricted to a specific area in Bloemfontein, which restricts the application of the findings in other parts of South Africa where slightly different building procedures and protocols might be implemented.
- Respondents' bias might also have influenced the results, as self-reporting can lead to socially desirable responses.
- The study was conducted over a short period of time, which made it difficult to investigate the long-term effectiveness of safety standards or track changes over time.
- While focusing on workarounds and hazards, broader organisational, economic, or regulatory factors that impact safety, might not have been captured fully in the study, nor were the potential, safety risks, such as mental health or fatigue of workers on construction sites, addressed.
- Limited access to construction sites and safety-related documents, such as health and safety files and safety audits also restricted the depth of analysis.

7.4. Implications for Practice

The findings of the study have important practical implications for enhancing construction site safety by identifying workarounds and hazards which might turn into safety risks.

- Firstly, the findings of the study emphasise the importance of maintaining stringent safety regulations and strengthening H&S (health and safety) training programmes to ensure that all construction personnel have the necessary skills and knowledge to follow specified safety procedures.
- Contractors and H&S officers can use these findings to create more effective risk control systems (RCS) that mitigate execution of unsafe workarounds on construction work sites.
- The findings of the study emphasise the importance of effective site management and planning, to ensure that safety measures are integrated into construction operations during project execution rather than being viewed as an afterthought.
- The findings of the study underline the importance of continuous monitoring and strict enforcement of safety rules on construction sites, such as a safety protocols, as the findings indicate that employees' ignorance of risk control systems is an ongoing issue in the construction industry.
- Implementation of effective communication channels, such as regular safety meetings, daily instructions for site tasks, toolbox talks, ongoing monitoring by health and safety officers before and during construction operations, weekly or monthly site meetings, and safety audits to assure H&S compliance.
- Early discovery of poor-quality materials, as they are a contributing factor to safety concerns. Therefore, procurement officers and storemen should keep records of all material deliveries on site to enhance quality assurance and regulatory compliance.
- Overall, useful assistance is offered in this study for policymakers, construction site management, as well as safety officers in developing and implementing a complete, safety risk control programme, and for enhancing safety and productivity on construction work sites. By addressing the identified primary risk factors, construction industry personnel can improve safety on construction sites, reduce the annual accident rates in construction, and develop a culture of safety compliance which, ultimately, will result in increased efficiency of projects and well-being of construction workers.

7.5. Considerations for Future Research

In an effort to develop a protocol to control safety risk to mitigate workarounds and hazards on construction sites, this study was focused on the connection between hazards and workarounds on construction sites, the connection between safety risks and workarounds on construction sites, impacts of how workarounds turn hazards into safety risks on construction sites, and development of a protocol to control safety risk to mitigate workarounds and hazards on construction sites. Based on the findings emanating from this study, as well as the conclusions, the following are recommended:

- Enforce strict safety protocols: Contractors should strengthen the enforcement of safety regulations through regular inspections, safety audits, and disciplinary actions to ensure compliance and reduce the risks associated with workarounds on construction worksites to enhance the productivity and profitability of the construction business.
- Enhance the safety training and awareness of workers: Contractors should ensure regular safety training programmes to educate workers about the risks of workarounds, the appropriate use of personal protective equipment (PPE), and adherence to established safety protocols.
- Effective communication and hazard reporting: Contractors should establish clear communication channels and reporting mechanisms, regular site meetings and digital reporting systems, to ensure that all safety concerns and hazards are identified and addressed promptly to prevent construction project delays.
- Implementation of comprehensive risk control systems (RCS): Contractors should integrate proactive risk assessment strategies and continuous H&S monitoring systems to identify, mitigate, and prevent safety risks associated with hazardous workarounds.
- Enhanced effective planning and site management: Contractors should incorporate measures to control safety risk in project planning, ensure allocation of adequate resources, use high-quality materials, and maintain safe working conditions throughout the life cycle of a construction project.

7.6. Concluding Remarks

In this chapter, the relationship between workarounds, hazards and safety risks on construction sites was explored, highlighting the critical factors that contribute to unsafe practices on construction worksites. The aim of the study also was to answer the following research

questions:

- What are the hazards associated with workarounds on construction sites?
- What are the risks associated with workarounds on construction sites?
- How do workarounds turn hazards into risks on construction sites?
- How would the development of a protocol to control safety risk mitigate workarounds and hazards on construction sites?

The qualitative findings of this study revealed that workarounds often arise because of the hazards associated with incompetent or untrained construction workers, neglect of personal protective equipment (PPE), poor communication, and the pressure to prioritise productivity over safety. In addition, hazardous conditions, unstable structures, and bypassing established safety measures were identified as key risks that compromise the safety of construction workers on construction sites. The quantitative analysis further reinforced these findings by demonstrating that poor quality materials, lack of H&S training, and miscommunication also contribute significantly to safety risks and, subsequently, compromise the productivity of contractors. The analysis also emphasised the need for well-defined risk control systems, effective planning, and strict enforcement of safety measures by health and safety (H&S) officers and site management. Furthermore, the ignorance of employees regarding existing risk control systems was identified as a major challenge in ensuring compliance with safety control protocols. To address these issues, a well-structured protocol to control safety risk was developed based on the study. The aim of these measures is to mitigate the risks associated with workarounds to ensure safer construction sites for all construction personnel.

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ANNEXURE A: COVER LETTER FOR INTERVIEW



ANNEXURE A: INTERVIEW GUIDE COVER LETTER

Attention: The Interviewees

Dear Sir/ Madam,

RE: Developing a safety risk control protocol to mitigate workarounds and hazards on construction sites

Thank you for honouring my invitation to participate in this research project. This research project aims to develop a safety risk control protocol to mitigate workarounds on construction sites. The research study partially fulfils the requirement for the Master of Construction at the Central University of Technology, Free State (CUT).

To take this study forward, interviews with construction site personnel working on the construction project are required. The interviews will comprise a short questionnaire and open-ended questions. The duration of the interview will not exceed 45 minutes. Based on your preference, the interview will be conducted in person or virtually, and all the communications will be recorded and transcribed later. Please note that the confidentiality of your responses to the interview will be protected.

Should you have any queries, please do not hesitate to contact Mr. Msimelelo Ronald Mona at mmona@cut.ac.za.

Yours sincerely,

Researcher

Supervisor

Co-Supervisor

Msimelelo Ronald Mona

Lesiba George Mollo, PhD

Fidelis Abumere Emuze, PhD

ANNEXURE B: INTERVIEW GUIDE



SECTION A: GENERAL INFORMATION

(Mark by X in the relevant box)

1. Please indicate your age.

20-29		30-39		40-49		50+	
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2. Please indicate your job description.

3. Please specify the level at which you are working on site.

Ground Level	
Elevated Heights	
Both	

4. Please specify the type of project you are involved in.

Residential Building	
Commercial Building	
Industrial/Civil Works	
Institutional Building	

5. Please state your highest qualification.

Honours Degree in Construction Management

6. Please state if you are registered with any council (i.e., SACPCMP, ECSA, etc.)?

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7. Please state your professional qualification(s).

Hazards: These refer to hazards on construction sites such as risks and dangers that can possibly affect individuals, property, or the work environment as a whole. Common hazards in construction are namely:

Falls- working on heights without the necessary personal protective equipment (PPE) which could lead to severe injuries and possibly death

Electrical Hazards: working on exposed electrical wires, faulty electrical equipment as well as inadequate electrical grounding which results in electrical shocks

Struck-By Hazards: When workers are at risk of being struck by falling objects from heights, moving objects as well as construction vehicles/ plant machinery.

Caught-In Between Hazards: These are hazards associated with being caught in between plant machinery, equipment as well as structural elements.

Risk: This refers to potential uncertainties and adverse events that can negatively affect construction projects. These risks are associated with accidents, injuries or health hazards during construction activities.

Safety Rules: Guidelines and precautions which are developed to prevent accidents, injuries or harm. These rules may be pertaining to wearing personal protective equipment, adhering to set procedures in various environments such as construction sites, workplaces as well as being aware of potential hazards.

Workarounds: A phenomenon that occurs when individuals feel the need to take shortcuts or bypass existing procedures or regulations which are predetermined by those in authority (Alter, 2014:1042). In construction workarounds can be referred to as temporary solutions or alternative approaches to address an issue that may arise during execution of construction projects. These are executed when the initial plan fails and are executed to counter any challenges, delays or complications that may transpire with the original plan. The construction team executes workarounds to fast-track construction projects and avoid any delays.





SECTION B: THE INTERVIEW GUIDE

(Mark by X where necessary)

Objective 1: To identify hazards linked to workarounds on construction sites.

1. Based on your work experience, please describe how construction workers (skilled and unskilled) contribute to the causes of hazards on construction sites.

2. Based on your experience, please describe how site management (construction manager, site agent, site engineer and forepersons) contribute to the causes of hazards on construction sites.

3. Based on work experience, please mention hazards you often encounter on construction sites.

4. Based on your work experience, please mention how hazards connect to the workarounds of safety rules on construction sites.



Objective 2: To determine safety risks linked to workarounds on construction sites.

1. Do you think there are risks discovered from the hazards, caused by construction team. Please describe the risks caused by the construction team on construction sites?

Yes	
No	
Please explain your answer:	

2. Based on your experience, please describe how management team (construction manager, residential engineer and health and safety manager) contribute to the causes of risks on construction sites?

3. Based on your previous responses relating to hazards caused by the nature of the project (project system design). Please describe the risks associated with the nature of the project on construction sites.



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4. Based on the project you are working on, please explain which construction activities pose risks and what types of risks are associated with those construction activities?

5. In your opinion, do you think risks linked to workarounds can be prevented on construction site?

Yes	
No	
Please explain your answer:	



Objective 3: To outline how workarounds turn hazards into safety risks on construction sites.

1. Please describe the link between workarounds and hazards on construction site.

2. Please describe the link between workarounds and safety risks on construction site.

3. Please describe the interplay between workarounds, hazards and safety risks on construction sites.

Objective 4: To develop a safety risk control protocol to mitigate workarounds and hazards on construction sites.



1. Based on your experience please describe your familiarity with a safety risk control protocol.

2. Based on your system, please explain how a safety risk control protocol would mitigate workarounds on construction sites.

3. Based on this interview and your work experience, please provide general comments on workarounds on construction sites.

ANNEXURE C: COVER LETTER FOR QUESTIONNAIRE



ANNEXURE B: QUESTIONNAIRE GUIDE COVER LETTER

Attention: The Respondents

Dear Sir/ Madam,

RE: Developing a safety risk control protocol to mitigate workarounds and hazards on construction sites_160224

Thank you for honouring my invitation to participate in this research project. This research project aims to develop a safety risk control protocol to mitigate workarounds on construction sites. The research study partially fulfils the requirement for the Master of Construction at the Central University of Technology, Free State (CUT).

To take this study forward, interviews with construction site personnel working on the construction project are required. The interviews will comprise a short questionnaire and open-ended questions. The questionnaires will not exceed 25 minutes. The questionnaire can be answered manually or electronically for your convenience, and all communications will be recorded and transcribed later. Please note that the **confidentiality** of your responses to the interview will be protected.

Should you have any queries, please do not hesitate to contact Mr. Msimelelo Ronald Mona at mmona@cut.ac.za.

Yours sincerely,

Researcher



Msimelelo Ronald Mona

Supervisor



Lesiba George Mollo, PhD

Co-Supervisor



Digitally signed by Prof
FA Emuze
Date: 2024.02.16
09:22:47 +02'00'

Fidelis Abumere Emuze, PhD

ANNEXURE D: QUESTIONNAIRE



DEFINITIONS

Hazards: These refer to hazards on construction sites such as risks and dangers that can possibly affect individuals, property, or the work environment. Common hazards in construction are namely:

Falls- working on heights without the necessary personal protective equipment (PPE) which could lead to severe injuries and possibly death

Electrical Hazards: working on exposed electrical wires, faulty electrical equipment as well as inadequate electrical grounding which results in electrical shocks

Struck-By Hazards: When workers are at risk of being struck by falling objects from heights, moving objects as well as construction vehicles/ plant machinery.

Caught-In Between Hazards: These are hazards associated with being caught in between plant machinery, equipment as well as structural elements.

Risk: This refers to potential uncertainties and adverse events that can negatively affect construction projects. These risks are associated with accidents, injuries or health hazards during construction activities.

Safety Rules: Guidelines and precautions which are developed to prevent accidents, injuries or harm. These rules may be pertaining to wearing personal protective equipment, adhering to set procedures in various environments such as construction sites, workplaces as well as being aware of potential hazards.

Workarounds: A phenomenon that occurs when individuals feel the need to take shortcuts or bypass existing procedures or regulations which are predetermined by those in authority (Alter, 2014:1042). In construction workarounds can be referred to as temporary solutions or alternative approaches to address an issue that may arise during execution of construction projects. These are executed when the initial plan fails and are executed to counter any challenges, delays or complications that may transpire with the original plan. The construction team executes workarounds to fast-track construction projects and avoid any delays.

SECTION A: DEMOGRAPHIC DATA

Please mark the appropriate answer with an X in the applicable box.								
1.	Please indicate your current age	1 Under 20 years	2 21-30 years	3 31-40 years	4 41-50 years	5 More than 50 years		
2.	Please indicate your job description	1 Safety officer	2 Construction Manager	3 Engineer	4 Project Manager	5 Quantity Surveyor	6 Artisan	7 General Worker
3.	Please indicate your gender	Male						

4.	Please indicate the sector of your organisation	1 Public			2 Private	
5.	Please indicate the number of years you have worked in the construction industry	1 Below 5 years	2 6 - 10 years	3 11 – 15 years	4 16 – 20 Years	5 Over 20 Years

SECTION B: QUESTIONNAIRES

1. Objective 1: To identify hazards linked to workarounds on construction sites.

1.1. Using a scale of 1 to 5, please rate the impact of the hazards towards workarounds on construction sites.

No	Hazards	Scale					N/A
		1	2	3	4	5	
1	Excavation						
2	Work at height						
3	Falling objects						
4	Slippery and wet floors						
5	Defective plant machinery						
6	Electrocution						
7	Demolition						
8	Flammable substances						
9	Noise						
10	Construction vehicle						
11	Toxic substances						

2. Objective 2: To determine safety risks linked to workarounds on construction sites.

2.1. Using a scale of 1 to 5, please rate the impact of the safety risks towards workarounds on construction sites.

No	Safety risks	Scale					N/A
		1	2	3	4	5	
1	Fall to the excavation.						
2	Fall from a height.						
3	Being struck by falling objects						
4	Slipping while working on wet floors						
5	Harm and injuries caused by defective plant machinery						

6	Being electrocuted by electricity because of working on working on live wire						
7	Falling of debris, premature collapse from structure being demolished.						
8	Fire caused by working with explosive substances						
9	Being in contact with noisy plant machinery for long hours without necessary PPE						
10	Being bumped by a construction vehicle						
11	Inhaling dust and toxic fumes from toxic substances						

Objective 3: To outline how workarounds turn hazards into safety risks on construction sites.

3.1 Using a scale of 1 to 5, please outline how workarounds turn hazards into safety risks on construction sites.

No	Aspect	Scale					
		1	2	3	4	5	N/A
1	Human error						
2	Poor quality of materials						
3	Inaccurate field information						
4	Outdated tools						
5	Miscommunication						
6	Subcontractor mistakes						
7	Lack of training						
8	Compromising Health and Safety standards						
9	Lack of supervision and normalising unsafe practices on construction sites						
10	Overlooking hazardous conditions due to focusing on quick solutions						

Objective 4: Develop a safety risk control protocol to mitigate workarounds and hazards on construction sites.

No	Statement	Scale					
		1	2	3	4	5	N/A
1	Is the construction team familiar with safety risk control protocols?						
2	Are there trainings the company provides on risk control of workarounds on construction sites?						
3	Are there risk control systems implemented by H&S (health and safety) officers and management to mitigate all hazards and accidents on site?						
4	Do you think employees' ignorance of the RCS (risk control system) put in place on-site contributes to the hazards present on construction sites?						
5	How vital are Daily Site Task Inspections (DSTI) prior to the commencement of site activities every day on construction sites?						



6	Are health safety officers' expertise in RCS and risk assessment sufficient to mitigate all hazards and accidents during on-site activities?						
7	Will planning and implementing of safety risk control protocol mitigate workarounds and hazards on construction sites						
8	Will a safety risk control protocol mitigate workarounds on construction sites?						

ANNEXURE E: ETHICAL CLEARANCE

ANNEXURE C: ETHICAL CLEARANCE



FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY
Department of Civil Engineering

APPLICATION FOR ETHICAL CLEARANCE TO CONDUCT RESEARCH IN THE FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

The Central University of Technology (CUT) Research Ethics and Integrity Policy applies to all undergraduate and post graduate students, and staff members who conduct research on CUT campuses and outside the campus. CUT policy bounds any person who wishes to conduct research with CUT students and/or staff but is not CUT affiliated to abide by the ethics framework. All CUT members who conduct research take responsibility to implement this Policy.

1. APPLICANT INFORMATION

1.1.	Title (Prof Dr /Mr /Mrs /Ms)	Mr	
1.2	Name(s) and Surname	Msimelelo Ronald Mona	
1.3	Student / Staff number	222049108	
1.4	Department	Built Environment	
1.5	Campus	Bloemfontein	
1.6	Postal address	20 President Brand Street CUT Residence (Graduandi House) Bloemfontein Central 9301	
1.7	Contact details	Office	N/A
		Cell	0646153212
		e-mail	mmona@cut.ac.za
1.8	Supervisor (s)/Project Leader	Dr LG Mollo Prof. FA Emuze	
1.9	Qualification registered for/Level of research	Please tick relevant option:	
		Masters qualification	<input checked="" type="checkbox"/>
		Doctorate	<input type="checkbox"/>
		Independent research (Non-qualification purposes)	<input type="checkbox"/>
1.10	FRIC Approval Number (LS262a) (where applicable)		

1.11	Conflict of interest (Please underline/highlight):
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ANNEXURE F: APPLICATION FOR ETHICAL CLEARANCE

APPLICATION FORM FOR ETHICAL CLEARANCE: FEBIT

	1) Personal relationship	Yes/No
	2) Financial benefit	Yes/No
	<i>If yes, please provide details:</i>	

2. DETAILS OF THE STUDY

2.1	Approved/Proposed title of the study/project /dissertation/thesis
	Developing a safety risk control protocol to mitigate workarounds and hazards on construction sites
2.2	Research question(s)
	The main research question asks, 'how would a safety risk control protocol mitigate workarounds to reduce hazards on construction sites?'
	The following sub-questions were formulated to respond to the above main research question. The sub-questions include:
	<ul style="list-style-type: none"> • What are the hazards linked to workarounds on construction sites? • What are the safety risks linked to workarounds on construction sites? • How do workarounds turn hazards into safety risks on construction sites? • How would the development of a safety risk control protocol mitigate workarounds and hazards on construction sites?
2.3	Aim and objectives of the study
	The aim of this study is to develop a safety risk control protocol that will mitigate workarounds to reduce hazards on construction sites. Thus, the research objectives are as follows:
	<ul style="list-style-type: none"> • To identify hazards linked to workarounds on construction sites. • To determine safety risks linked to workarounds on construction sites. • To outline how workarounds turn hazards into safety risks on construction sites. • To develop a safety risk control protocol to mitigate workarounds and hazards on construction sites.
2.4	Research methodology
2.4.1	Research participants and their age brackets (where applicable, e.g. 10 Students from Civil Engineering Department)
	The study will be focused on construction personnel, including site managers, residential engineers, foremen, artisans, and general workers from case studies in Bloemfontein, South Africa. It should be noted that only people working on identified case studies will be participants.

APPLICATION FORM FOR ETHICAL CLEARANCE: FEBIT

2.4.2	How will participants be selected/sampled?
<p>Purposive sampling technique will be used for the qualitative data which will allow the researcher to choose participants with unique perspectives or those who occupy important roles from selected construction sites to represent theoretical categories or considerations.</p>	
2.4.3	Research site(s) (e.g. Borong Construction Site) Please list
<p>CUT Residence Construction (Qualicon Construction) Newly Proposed CUT Jewellery School</p>	
2.4.4	Data collection instruments (e.g. questionnaire(s)/interview schedule(s)/observation schedule(s)/artefacts/other)
<p><i>Semi-structured interviews</i> <i>Questionnaires survey</i></p>	
2.4.5	Data collection procedure (Please outline WHEN, WHERE and HOW data will be collected)
<p>QUALITATIVE DATA</p> <p>When?</p> <p>March 2024 – June 2024.</p> <p>Where?</p> <p>Two construction sites in Bloemfontein</p> <ul style="list-style-type: none"> • CUT Residence next to CUT Loggies Residence • CUT Jewellery School at CUT Main campus <p>How?</p> <p>By using semi-structured interviews.</p> <p>QUANTITATIVE DATA</p> <p>When?</p> <p>July 2024 – September 2024.</p> <p>Where?</p> <p>Bloemfontein (construction projects)</p> <p>How?</p> <p>Using survey questionnaires.</p>	

3. PROPOSED PLAN OF STUDY/RESEARCH

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Set out your intended plan of work for the research, indicating important target dates necessary to meet your proposed deadlines	
Research Tasks	Proposed Deadlines
Data Collection	March 2024
Interpretation of Data	June 2024
Discussion of Finding	July 2024
Recommendations & Conclusion	August 2024
Proofreading the Dissertation	September 2024
Professional English Editing	October 2024
Submission for Assessment	November 2024
Publications for Master of Construction	
Conference paper	January 2025
Journal paper	March 2025

4. ETHICAL ISSUES AND RISK ASSESSMENT

In order to assess whether your proposed research is ethically compliant, ethics risks are categorised into four categories:

(1) Research involving minor risk

The likelihood of projected harm or inconvenience in the research is not greater than that experienced in daily life.

(2) Research involving low risk

Research in which the only anticipatable risk is one of potential awkwardness or discomfort to the participants.

(3) Research involving medium risk

Research in which there is a possible risk of harm or discomfort, but where appropriate steps can be taken to lessen or moderate overall risk.

(4) Research involving high risk

Research in which there is a real and foreseeable risk of harm and discomfort, which may lead to a serious adverse event if not managed in a responsible manner.

4.1	Will human research participants be used in your study? <i>Please mark with an X or ✓ in the Yes/No/N/A box</i>	✓ Yes	No	N/A
4.2	If yes, does the research study involve any of the following:			
	a) Children or youth under the age of 18 (Attach parental consent letter)		✓	
	b) Individuals living with disabilities (physical, mental and/or sensory)		✓	

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(Attach consent letter of legal guardian)			
c) Individuals that might find it difficult to make independent and informed decisions for socio, economic, cultural, political and/or medical reasons		✓	
d) Communities that might be considered vulnerable, thus finding it difficult to make independent and informed decisions for socio, economic, cultural, political and/or medical reasons		✓	
e) Individuals who might be vulnerable for age related reasons e.g. the elderly		✓	
f) Individuals whose spoken language differs from the language used for the research (Make sure you translate your consent form and participant information sheet in the participants' first language – you should also have an interpreter if you do interviews – describe it below the table)			
g) Women considered to be vulnerable (pregnancy, victimisation, marginalised etc.)		✓	
h) Other (Please explain):			

4.3	Will data collection involve any of the following:	Yes	No	N/A
	a) Access to confidential data without prior permission of participants		✓	
	b) Participants expected to commit an act which might reduce self-respect or cause them to experience shame, embarrassment, or regret		✓	
	c) Expose participants to worrying or upsetting questions or to processes which may have disagreeable or harmful side effects		✓	
	d) The use of stimuli, errands or procedures which may be experienced as stressful, harmful, or hostile		✓	
	e) Any use of materials risky to human beings		✓	
4.4 If you answered "Yes", to any of the previously mentioned, explain (attach as an appendix) and justify. Explain, too, what steps you will take to minimise the potential stress/harm. (Please indicate if it is not applicable to your study)				

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N/A

4.5 Confidentiality of participants' identity

4.5.1	Will the identity and privacy of participants be protected through pseudonyms or other forms of identification and the use of an informed consent form, which specifies (in a language that participants will understand): <i>Place an 'X' or '✓' in the Yes/No box</i>	✓ YES	NO	N/A
4.5.2	Please note that participants should be informed about the following (where applicable)			
a)	The purpose/s of the research and how it is conducted	✓		
b)	The researcher, project leader and supervisor's identity, their institutional association and their contact details	✓		
c)	Voluntary participation of participants	✓		
d)	Making sure that participants' responses will be treated in a confidential manner	✓		
e)	Be transparent about any possible limits on confidentiality which may apply	✓		
f)	Ensuring participants that they are free to withdraw from the research at any time without any negative or undesirable consequences to themselves	✓		
g)	How the findings of the study will have any benefits, or may receive as a result of their participation in the research	✓		

4.5.2 Please attach the proposed consent and assent documents prepared to address all the above, if not a full explanation is needed explaining how will participants be respected and protected.

5. DOCUMENTS TO BE ATTACHED TO THE APPLICATION

The following documents must be attached as a prerequisite for approval to undertake research in the Department (where applicable)

5.1	LS 262a approved by the FRIC (FEBIT)
5.2	Proof of registration/Funding received and funder reference details

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5.3	Data collection instruments as identified under 2.4.4
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6. DECLARATION BY THE APPLICANT

I undertake to use the information that I acquire through my research, in a balanced and a responsible manner. I furthermore take note of, and agree to adhere to the following conditions (where applicable):



- a) I will schedule my research activities in consultation with the relevant Company or Organisation and research participants (where relevant);
- b) I agree that involvement of participants in my research is voluntary, and that participants have a right to decline to participate;
- c) I will obtain signed consent forms from participants prior to any engagement with them;
- d) I will inform participants about the use of recording devices such as tape-recorders and cameras, and participants will be free to reject them if they wish;
- e) I will honour the right of participants to privacy, anonymity, confidentiality and respect for human dignity at all times. Participants will not be identifiable in any way from the results of my research, unless written consent is obtained otherwise;
- f) All interviews (recordings) will be transcribed verbatim and analysed as per conventional data analysis techniques (example(s) of interview transcript to be included in final dissertation)
- g) I will adhere to the principles of rigorous data collection, analysis and interpretation consistent with the design of the study;
- h) I will keep a data trail for possible auditing purposes as well as the safe keeping of raw data for a period of three years after publication of the results;
- i) I will send the draft research findings to research participants before finalisation, in order to validate the accuracy of the information in the report;
- j) I will not use the resources of the university when I am conducting my research (such as stationery, photocopies, faxes, and telephones) and
- k) I will include a disclaimer in any report, publication or presentation arising from my research, that the findings and recommendations of the study do not represent the views of the Central University of Technology.
- l) Aside from laboratory as well as consumables or materials supplied by the university needed to complete practical projects which might be central to my study (dependent on study field), I will not use the resources of the University when I am conducting my research (such as stationery, photocopies, faxes, and telephones).
- m) All practical artefacts produced in support of my study using the university's laboratories, consumables, and materials will remain the property of the University.
- n) If I supplied my own materials and consumables, I will permit access to all practical projects or artefacts to the University for a period of three (3) years for exhibition purposes.
- o) All data collected for the research (including, but not limited to, completed questionnaires; statistical analysis performed on the data; interview audio-files/transcripts; artefacts/audio-visual materials; documents) will be kept safe at a designated space at the university for a period of at least three years. Computer files will be backed-up and password-protected.

I declare that all statements made in this application are true and accurate. I accept the conditions associated with the granting of approval to conduct research and undertake to abide by them.

STUDENT SIGNATURE / PROJECT LEADER SIGNATURE / SIGNATURE OF RESEARCHER	
DATE	23/01/2024


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7. DECLARATION BY SUPERVISOR(S) (where applicable)

I/We declare that I/we shall oversee the student's adherence to all statements as set out above.	
SIGNATURE (Main supervisor)	 Dr LG Mollo
SIGNATURE (Co-supervisor)	Prof F Emuze  Digitally signed by Prof FA Emuze Date: 2024.02.16 09:06:40 +02'00'
DATE	16 Feb. 24

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APPROVAL OF FEBIT ETHICAL COMMITTEE (FRIC)

Decision		Please tick relevant option
1.	Application approved	<input checked="" type="checkbox"/>
2.	Ethical clearance number	
3.	Application approved subject to certain conditions. <i>Specify conditions below</i>	
4.	Application not approved. <i>Provide reasons for non-approval below</i>	
SIGNATURE: Chairperson: Ethics committee		 Digitally signed by Prof Yali Woyessa Date: 2024.02.29 16:00:28 +02'00'
DATE		

Cc Dean: FEBIT