**BINDURA UNIVERSITY OF SCIENCE EDUCATION**

FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCES

DEPARTMENT OF ENVIRONMENTAL SCIENCE

# An Analysis of the Risk Factors Associated With Construction Projects (A Case of Chase Contractors, Harare)

**By**

**Patrick Makwangudze**

**B224864B**

**Supervised by**

**Mr. D. Dzvene**

**SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE HONORS DEGREE IN SAFETY HEALTH AND ENVIRONMENTAL MANAGEMENT**

## DEDICATION

To my beloved wife Tsitsi Mashipe, I dedicate this dissertation work as a token of my immense gratitude for your unwavering support during my pursuit of a Bachelor of Science Honours in Safety, Health and Environmental Management. Your belief in me, intellectual contributions, and emotional support have been my guiding light through the challenges. Your love, patience, and unwavering faith in our dreams have made this journey bearable and beautiful. I am forever grateful for your sacrifices, late nights by my side, and acts of kindness that have smoothed my path. You are my rock, inspiration, and the love that lights up my life.

Signature of student                                        Date 30/05/25

**To be compiled by the supervisor**

This dissertation is suitable for submission to the faculty and has been checked for conformity with faculty guidelines.

Signature of supervisor                                        Date:30/05/2025

Signature of faculty chairperson                                        Date30/05/2025

**ACKNOWLEDGEMENTS**

My heartfelt gratitude goes to my supervisor Mr D. Dzvene who guided and offered valuable comments that motivated me throughout this research. I am forever grateful.

My appreciation also goes to my CHASE Contractors colleagues who helped through their moral support.

A huge thank you also goes to my four children Tanatswa,Tinevimbo,Tariro and Timukudze who urged me to embark on my studies as well as my mother for her unwavering support till the end. My apologies to those not mentioned.

**ABSTRACT**

The construction industry plays a pivotal role in economic development, yet its success is often undermined by multifaceted risks that lead to cost overruns, schedule delays, and safety incidents. This study examines the risk factors associated with construction projects, focusing on CHASE Contractors in Harare, Zimbabwe. Through a mixed-methods approach, including questionnaires distributed to 75 workers (96% response rate) and interviews with three key informants, the research identifies and evaluates critical risks, their impact on project outcomes, and the effectiveness of existing risk management practices.

Findings reveal that high-severity risks such as falls from heights, equipment accidents, and trench collapses pose significant threats, with strong correlations to cost overruns ($\rho = 0.74$–$0.81$), schedule delays ($\rho = 0.76$–$0.82$), and quality compromises. Chronic risks like noise exposure and chemical hazards, though less immediately visible, contribute to long-term health issues and project inefficiencies. Despite moderate compliance with basic safety measures (e.g., PPE enforcement), systemic gaps in incident reporting, training, and safety culture were identified, particularly in managing high-impact risks. Inferential analysis confirmed a negative correlation ($\rho = -0.762$) between risk severity and management effectiveness, indicating that the most dangerous risks are inadequately controlled.

The study underscores the need for a holistic risk management framework tailored to Harare's context, emphasizing technology-driven solutions (e.g., BIM integration), strengthened protocols for high-risk activities, and a cultural shift toward proactive safety practices. Recommendations include enhancing workforce training, improving supervisory ratios, and adopting predictive tools to mitigate both acute and chronic risks. By addressing these challenges, CHASE Contractors and similar firms can enhance project resilience, worker safety, and overall performance, contributing to sustainable growth in Zimbabwe's construction sector

**TABLE OF CONTENTS**

**DEDICATION**........2
**ACKNOWLEDGEMENTS**........3
**ABSTRACT**........4
**Chapter 1**........7
**1.1 Background**........7
**1.2 Problem Statement**........8
**1.3 Objectives**........8
**1.3.1 Main Objective**........8
**1.3.2 Specific Objectives**........8
**1.4 Hypothesis**........9
**1.5 Justification of the Study**........9
**1.6 Study Area**........10
**1.7 Limitations of the study**........10

**Chapter Two** ........ 11
**2.1 Introduction** ........ 11
**2.2 Key Risk Factors in Construction Projects** ........ 11
**2.2.1. Stakeholder-Related Risks** ........ 11
**2.2.2. Financial Risks** ........ 12
**2.2.3. Design and Technical Risks** ........ 12
**2.2.4. Supply Chain Disruptions** ........ 12
**2.2.5. Human Error and Labour Challenges** ........ 12
**2.2.6. Regulatory and Environmental Risks** ........ 13
**2.2.7 The Role of Technology in Risk Mitigation** ........ 13
**2.3. Impacts of Identified Risk Factors on Projects Undertaken by the Construction Industry** ........ 14
**2.3.1 Impact of Stakeholder Fragmentation and Management Complexity** ........ 14
**2.3.2 Financial Risks and Cost Escalations** ........ 14
**2.3.3 Design Flaws and Technical Risks** ........ 15
**2.3.4 Supply Chain Disruptions** ........ 15
**2.3.5 Human Error and Labour Challenges** ........ 15
**2.3.6 Regulatory and Environmental Risks** ........ 16
**2.4 The Effectiveness of Existing Risk Management Practices Employed by Construction Companies** ........ 16
**2.4.1 Risk Identification Practices** ........ 16
**2.4.3 Risk Assessment and Prioritisation** ........ 17
**2.4.4 Mitigation Strategies** ........ 17
**2.4.5 Monitoring and Review Mechanisms** ........ 18
**CHAPTER FOUR** ........ 18
**Introduction** ........ 18
4.0 Questionnaire Distribution, Key Informant Interviews and Response Rate ........ 19
4.1 **Demographic Characteristics of Respondents** ........ 19
**4.1.1 Gender of Respondents** ........ 20
**4.1.2 Age Distribution** ........ 20
**4.1.3 Years of Service** ........ 20
**4.1.4 Educational Qualifications** ........ 21
**4.1.5 Employment Position** ........ 21
**4.2 The Primary Risk Factors Present in Construction Projects Undertaken by Chase Contractors** ........ 21
**4.3 The Impact of Identified Risk Factors on Project Success** ........ 24

**4.4 The Effectiveness of Existing Risk Management Practices**......................................26
**4.5 Conclusion**.............................................................................................................29
**CHAPTER 5: DISCUSSION**..........................................................................................29
**5.1 Demographics and primary risk factors present in construction projects**............29
**5.2 Impact of identified risk factors on project success**.................................................31
**5.3** Impact **of identified risk factors on project success**...................................................32
**5.4 Effectiveness of existing risk management practices**................................................34
**CHAPTER 6: CONCLUSION AND RECOMMENDATIONS**........................................35
6.1 Conclusion.................................................................................................................35
**6.2 Recommendations**.......................................................................................................36
**References**.....................................................................................................................37

## Chapter 1

### 1.1 Background

Construction projects represent a significant sector in the economy, contributing to infrastructure development, economic growth, and employment opportunities. However, the inherent complexity of construction projects often leads to a multitude of risks that can impact project success. Understanding and effectively managing these risks is essential for ensuring the timely completion, quality, and profitability of construction projects.(Bahamid et al., 2019)

Construction projects are subject to a multitude of risk factors, including but not limited to cost overruns, schedule delays, design changes, labour shortages, material procurement challenges, safety incidents, regulatory compliance issues, and environmental uncertainties. These risks can stem from both internal and external sources, and their effective management is critical for project success.

Within the construction industry, risk factors can manifest in various forms, such as cost overruns, delays, design changes, labour shortages, material shortages, safety incidents, regulatory compliance issues, and unforeseen environmental challenges. These risks can have cascading effects on project timelines, budgets, and stakeholder relationships. Therefore, identifying, assessing, and mitigating these risks are critical tasks for construction project managers and stakeholders.(Leo-Olagbaye & Odeyinka, 2018)

In the case of CHASE Contractors in Harare, a detailed analysis of risk factors specific to their operations can provide valuable insights into the challenges they face and the strategies they employ to manage risks effectively. By focusing on a specific company within a localized context, this research can offer a nuanced understanding of how external and internal factors interact to influence project outcomes in the construction industry in Harare.

Moreover, studying risk factors associated with construction projects in Harare can contribute to the broader body of knowledge on risk management in the construction sector. By examining the unique challenges faced by CHASE Contractors and other construction firms in the region, researchers can develop best practices, frameworks, and tools that can be applied more broadly to enhance risk management practices in the industry.

CHASE Contractors, as a key player in the construction industry in Harare, serves as an ideal case study for understanding the dynamics of risk management in the local context. By examining the specific risk factors that impact CHASE Contractors' operations, we aim to provide valuable insights that can inform decision-making processes and enhance risk management practices within the company and the broader construction sector in Harare.

The findings of this research can have practical implications for construction project managers, policymakers, investors, and other stakeholders involved in the construction industry. By identifying common risk factors, analyzing their impact on project performance, and proposing effective risk mitigation strategies, this research can help improve project outcomes, reduce uncertainties, and enhance the overall resilience of construction projects in Harare and beyond.(Chileshe & Boadua Yirenkyi-Fianko, 2012)

### 1.2 Problem Statement

Construction projects inherently involve various risk factors that can impact project success, worker safety, and overall project outcomes. In the case of CHASE Contractors based in Harare, it is essential to analyse and identify the specific risk factors associated with their construction projects. Understanding these risk factors is crucial for effective risk management and the development of mitigation strategies. By conducting an analysis of the risk factors, this study aims to provide valuable insights into enhancing project planning, safety measures, and overall project performance for CHASE Contractors and the wider construction industry in Harare.

## 1.3 Objectives

### 1.3.1 Main Objective

The main objective of this study is to analyse the risk factors associated with construction projects undertaken by CHASE Contractors in Harare.

### 1.3.2 Specific Objectives

1. To identify the primary risk factors present in construction projects undertaken by CHASE Contractors in Harare.

2. To assess the impact of identified risk factors on projects undertaken by CHASE Contractors in Harare.

3. To evaluate the effectiveness of existing risk management practices employed by CHASE Contractors in addressing the identified risk factors.

## 1.4 Hypothesis

The presence and effective management of identified risk factors in construction projects undertaken by CHASE Contractors in Harare have a significant impact on project success, resulting in lower instances of cost overruns, schedule delays, and quality issues.

## 1.5 Justification of the Study

Construction projects are complex endeavours that involve various risk factors that can significantly impact project success, worker safety, and overall project outcomes. Understanding and effectively managing these risk factors is crucial for the construction industry, particularly for firms like CHASE Contractors operating in Harare. Therefore, this study aims to analyse the risk factors associated with construction projects undertaken by CHASE Contractors in Harare, providing valuable insights into improving project planning, execution, and overall performance.

One key aspect of project success is the ability to deliver projects within budget and on schedule. Risk factors such as unforeseen delays, cost overruns, and quality issues can have detrimental effects on project outcomes. By identifying and analysing the specific risk factors present in CHASE Contractors' projects, this study can contribute to cost control and schedule adherence, enabling the development of strategies to mitigate these risks. The findings will assist CHASE Contractors and other construction firms in Harare in improving project management practices, ultimately leading to better project success rates.

Worker safety and well-being are paramount considerations in construction projects. Construction sites are inherently hazardous environments, and the presence of risk factors can pose significant threats to the safety and health of workers. By analysing the risk factors specific to CHASE Contractors' projects, this study aims to identify potential hazards and develop strategies to enhance safety measures. The findings can inform the implementation of proactive measures to mitigate risks, ensuring a safer working environment for construction workers and promoting their overall well-being.

**1.6 Study Area**

The study area for this research on the risk factors associated with construction projects, specifically focusing on CHASE Contractors in Harare, is located at no 76 Harare Drive, Mt Pleasant in Harare. The coordinates for CHASE Contractors' location are approximately latitude -17.8163 and longitude 31.0470.

Harare, the capital city of Zimbabwe, serves as a significant hub for construction activities, infrastructure development, and economic growth in the region. Situated in southern Africa, Harare's construction sector faces a unique set of challenges and opportunities shaped by local market dynamics, regulatory frameworks, socio-economic conditions, and environmental factors.

CHASE Contractors, located in the Mt Pleasant area of Harare, operates within this dynamic environment, engaging in a variety of construction projects that contribute to the city's urban landscape and development. By focusing on this specific geographical area and company, this research aims to delve into the localized intricacies of construction project risk management within the context of Harare's construction industry.

## 1.7 Limitations of the study

The research focusing on the risk factors associated with construction projects, particularly centred on CHASE Contractors in Harare, faces several limitations that warrant consideration. Firstly, the study's narrow focus on a single construction company within a specific geographic location may constrain the generalizability of the findings to the broader construction industry. The unique operational environment and challenges encountered by CHASE Contractors may not fully represent the diverse array of risks prevalent in construction firms across different regions.

Secondly, the reliability and availability of data pertaining to risk factors in construction projects present a significant limitation. Issues such as incomplete records, data quality concerns, and potential biases in the information provided by the company could compromise the accuracy of the analysis and conclusions derived from the study. Additionally, the time constraints inherent in the research may limit the depth of analysis that can be achieved. Comprehensive understanding of complex risk factors in construction projects often necessitates long-term observation and data collection, a scope that may not be feasible within the study's timeframe.

Moreover, limited access to proprietary or confidential information within CHASE Contractors could impede a holistic understanding of all risk factors influencing the company's projects. Without complete transparency, critical insights might be overlooked or inadequately represented in the study. External factors, such as economic conditions, regulatory changes, market trends, and geopolitical events, also pose a challenge. The study may struggle to fully capture the impact of these external influences on the identified risk factors within CHASE Contractors.

Methodological constraints, such as limitations in the research methodology employed, could also impact the depth and breadth of the analysis. The potential for interpretation bias in qualitative analyses of risk factors is another consideration. Researchers' subjective views, experiences, and interpretations could inadvertently influence the conclusions drawn from the collected data. Lastly, resource constraints, encompassing limitations in time, budget, and expertise, may restrict the study's scope and impede the thoroughness of the analysis of risk factors associated with construction projects.

## Chapter Two

### 2.1 Introduction

Construction projects are inherently complex and exposed to multifaceted risks that can jeopardize their success. These risks arise from dynamic internal and external factors, including stakeholder dynamics, financial constraints, design inaccuracies, supply chain disruptions, and technological challenges (Wuni et al., 2019; Okaford, 2022). In Zimbabwe, where CHASE Contractors operates in Harare, the construction industry faces unique challenges such as economic volatility, regulatory uncertainties, and limited adoption of modern technologies (Ameyaw et al., 2016). This section synthesizes existing literature to identify primary risk factors relevant to construction projects, with a focus on their applicability to CHASE Contractors.

### 2.2 Key Risk Factors in Construction Projects

#### 2.2.1. Stakeholder-Related Risks

Stakeholder fragmentation and management complexity are consistently ranked as the most critical risk factors in construction projects. Wuni et al. (2019) identified this as the top risk in modular integrated construction (MiC), citing poor communication, conflicting priorities, and inadequate coordination among clients, designers, contractors, and subcontractors. Frequent changes in client requirements, particularly in the IT sector, exacerbate scope creep, leading to delays and cost overruns (Okaford, 2022). For instance, unclear initial design specifications in construction projects were found to contribute to 27% of scope creep incidents (Okaford, 2022).

#### 2.2.2. Financial Risks

Financial risks, including budget overruns and cost escalation, are pervasive in construction. Studies attribute this to inaccurate cost estimation, inflation, and unforeseen site conditions. Cooke (1996) emphasized the importance of financial risk management to prevent budget breaches, while Huang (2021) noted that Building Information Modelling (BIM) can reduce unforeseen costs by up to 35% through improved visualization and planning. Higher initial capital costs, particularly in modular construction, were cited in 11 studies as a significant barrier (Wuni et al., 2019).

#### 2.2.3. Design and Technical Risks

Defective designs and change orders rank among the top seven risk factors in MiC projects. Shahtaheri et al. (2017) highlighted that geometric and dimensional variabilities between manufacturing and assembly tolerances often stem from flawed designs. In traditional construction, poor requirements definition during the planning phase was linked to 27% of scope creep cases (Okaford, 2022). Additionally, reliance on outdated technologies increases vulnerability to technical failures, especially in projects involving prefabrication (Zou et al., 2017).

### 2.2.4. Supply Chain Disruptions

Supply chain integration issues and material delivery delays were reported in 9 studies as critical risks (Wuni et al., 2019). Factors include supplier insolvency, logistical bottlenecks, and quality inconsistencies. For example, manual handling of heavy modular elements during transportation and assembly exposes workers to musculoskeletal disorders, further delaying schedules (Hsu et al., 2018). In Zimbabwe's context, economic instability and foreign currency shortages exacerbate procurement challenges (Ameyaw et al., 2016).

### 2.2.5. Human Error and Labour Challenges

Human resource errors, such as skill gaps and poor workforce management, were identified as major risks in large-scale projects (Zou et al., 2017). Aibinu and Venkatesh (2014) noted that misjudged time and resource allocations often lead to inefficiencies. In Harare, where labor unions and informal workforce dynamics are prevalent, inadequate training and safety protocols heighten risks of accidents and disputes (Hassim et al., 2009).

### 2.2.6. Regulatory and Environmental Risks

Non-compliance with regulatory standards and environmental uncertainties pose significant threats. For instance, sudden policy shifts or environmental impact assessments can halt projects (Hammad et al., 2012). In Zimbabwe, regulatory enforcement has been inconsistent, creating ambiguity for contractors navigating approvals and sustainability requirements (Hong Kong Buildings Department, 2018).

#### *2.2.6.1. Categorization of Risks: Internal vs. External*

| Risk Category | Examples | References |
| --- | --- | --- |
| **Internal Risks** | Poor design specifications, budget mismanagement, labor inefficiencies | Okaford (2022); Wuni et al. (2019) |

| | | |
|---|---|---|
| **External Risks** | Supply chain disruptions, regulatory changes, economic instability | Hsu et al. (2018); Ameyaw et al. (2016) |

### *2.2.6.2. Critical Risk Factors in Modular Integrated Construction (MiC)*

Wuni et al. (2019) conducted a systematic review of 30 critical risk factors (CRFs) in MiC projects, identifying the following top-ranked risks:

| Rank | Risk Factor | Frequency in Studies |
|---|---|---|
| **1** | Stakeholder fragmentation | 12 |
| **2** | Higher initial capital cost | 11 |
| **3** | Poor supply chain integration | 9 |
| **4** | Defective design and change orders | 6 |

These factors are particularly relevant to CHASE Contractors if they adopt off-site construction methods, as MiC projects demand precise coordination and upfront investment.

### 2.2.7 The Role of Technology in Risk Mitigation

BIM and digital tools have emerged as solutions to address risks related to cost overruns, design inaccuracies, and safety hazards. Huang (2021) demonstrated that BIM reduces unforeseen costs by enabling clash detection and real-time collaboration. Similarly, Cha and Lee (2020) proposed a BIM-based framework to minimize human error and enhance efficiency. However, adoption barriers, such as limited technical expertise, persist in regions like Zimbabwe (Zou et al., 2017).

## 2.3. Impacts of Identified Risk Factors on Projects Undertaken by the Construction Industry

Construction projects managed by CHASE Contractors in Harare operate within a complex environment influenced by internal and external risk factors that significantly affect project outcomes. These risks, ranging from stakeholder fragmentation and financial mismanagement to supply chain disruptions and regulatory uncertainties, manifest as cost overruns, schedule delays, quality compromises, and safety hazards. This analysis evaluates the specific impacts of these risks on CHASE's projects, integrating global insights with local contextual challenges in Zimbabwe's construction sector.

### 2.3.1 Impact of Stakeholder Fragmentation and Management Complexity

Stakeholder fragmentation remains a critical risk factor globally, particularly in modular integrated construction (MiC) projects. Research by Wuni et al. (2019) identified this as the top risk in MiC, attributing it to poor communication, conflicting priorities, and inadequate coordination among clients, designers, contractors, and subcontractors. For CHASE Contractors, stakeholder misalignment could lead to uncontrolled changes in project requirements, contributing to 25% of project delays and 14% of quality compromises due to rushed deliverables, as noted by Okaford (2022). Poor collaboration further increases the likelihood of rework, with studies reporting up to 35% higher costs in poorly coordinated projects (Huang, 2021). In Zimbabwe, Ameyaw et al. (2016) highlighted that stakeholder disputes in public infrastructure projects led to delays exceeding 12 weeks on average, with cascading effects on budgets and client satisfaction. Such delays strain contractual obligations and erode client trust, particularly in a market where project timelines are tightly linked to funding cycles and regulatory approvals.

### 2.3.2 Financial Risks and Cost Escalations

Financial risks, including inaccurate cost estimation and inflation, are pervasive in Zimbabwe's construction sector. Cooke (1996) emphasised that inadequate financial risk management often results in budget breaches. Key impacts include cost overruns , with higher initial capital costs in modular construction reported in 11 studies (Wuni et al., 2019). For CHASE Contractors, reliance on imported materials amid foreign currency shortages exacerbates cost volatility. Huang (2021) demonstrated that Building Information Modelling (BIM) can reduce unforeseen costs by 35% through clash detection and real-time budget tracking. Without such tools, CHASE may face unanticipated expenses, eroding profit margins. Okaford (2022) found that 31% of surveyed projects experienced budget overruns due to scope creep, with costs rising by 15–20% in the IT sector. In Harare's context, where funding is often tied to rigid donor agreements, such overruns could jeopardize project viability and organizational credibility.

### 2.3.3 Design Flaws and Technical Risks

Defective designs and change orders rank among the top seven risk factors in MiC projects (Wuni et al., 2019). For CHASE Contractors, unclear initial design specifications contribute to 27% of scope creep cases , as noted by Okaford (2022). Geometric and dimensional tolerances between manufacturing and assembly stages lead to rework, causing delays and quality compromises. Hsu et al. (2018) found that defective designs caused 12-week delays in 25% of modular construction projects due to on-site modifications. Rushed adjustments to flawed designs often result in substandard outputs, with 14% of surveyed projects reporting quality issues (Okaford, 2022). In Zimbabwe, where technical expertise in advanced construction methods is limited, reliance on outdated technologies further heightens vulnerability to technical failures, particularly in prefabrication projects.

### 2.3.4 Supply Chain Disruptions

Supply chain integration issues and material delivery delays were reported in nine studies (Wuni et al., 2019) as critical risks. For CHASE Contractors operating in Harare, logistical bottlenecks and fuel shortages delay material deliveries, increasing project timelines by up to 20% (Ameyaw et al., 2016). Quality inconsistencies from unreliable suppliers raise rework rates, escalating costs by 15–25% (Hammad et al., 2012). Manual handling of heavy modular elements during transportation and assembly exposes workers to musculoskeletal disorders, further delaying schedules (Wuni et al., 2019). Zimbabwe's economic instability and foreign currency shortages exacerbate procurement challenges, as noted by Ameyaw et al. (2016). These disruptions not only inflate costs but also undermine client confidence in CHASE's ability to meet deadlines.

### 2.3.5 Human Error and Labour Challenges

Labor inefficiencies and skill gaps directly affect project safety and productivity. Aibinu and Venkatesh (2014) linked misjudged resource allocations to 20–30% productivity drops in large-scale projects. In Harare, informal labor unions often demand sudden wage renegotiations, causing project halts and budget revisions (Hassim et al., 2009). Inadequate training and safety protocols heighten accident rates, with manual handling of heavy materials posing significant risks (Hsu et al., 2018). For CHASE Contractors, these challenges threaten workforce stability and project timelines, particularly in a market where skilled labor shortages are common.

### 2.3.6 Regulatory and Environmental Risks

Non-compliance with regulatory standards and environmental uncertainties pose significant threats. Sudden policy shifts, such as Zimbabwe's land reform policies, have stalled projects indefinitely (Ameyaw et al., 2016). Environmental impact assessments (EIAs) add 5–10% to project budgets in regions with stringent regulations (Hammad et al., 2012). Inconsistent enforcement of regulatory frameworks creates ambiguity for contractors navigating approvals and sustainability mandates, as noted by Ameyaw et al. (2016). For CHASE Contractors, these risks complicate project planning and increase administrative burdens.

The cumulative effect of these risks on CHASE Contractors' projects includes cost overruns estimated at 15–35% above initial budgets, schedule delays averaging 12 weeks per project, and quality compromises affecting 14% of deliverables (Okaford, 2022; Wuni et al., 2019). Safety hazards and labour disputes further strain operational efficiency, while regulatory ambiguities create unpredictable project environments. These impacts collectively threaten CHASE's profitability, client relationships, and market competitiveness.

### 2.4 The Effectiveness of Existing Risk Management Practices Employed by Construction Companies

CHASE Contractors in Harare operate within a high-risk environment characterized by stakeholder fragmentation, financial constraints, design inaccuracies, supply chain disruptions, labour inefficiencies, and regulatory uncertainties. To mitigate these risks, the organization likely employs a combination of traditional risk management frameworks and localized strategies. This section evaluates the effectiveness of these practices in addressing the identified risk factors, drawing on insights from global studies and contextual challenges in Zimbabwe's construction sector. The analysis focuses on four key aspects: risk identification, risk assessment, mitigation strategies, and monitoring mechanisms.

#### 2.4.1 Risk Identification Practices

Effective risk management begins with the systematic identification of potential threats. CHASE Contractors may utilise stakeholder analysis, historical project data, and industry benchmarks to identify risks. However, studies highlight that many construction firms, particularly in developing economies, rely on reactive or informal identification methods (Wuni et al., 2019). For instance, stakeholder fragmentation—a critical risk factor—requires structured communication protocols to preempt scope creep and conflicting priorities. While PRINCE2 methodology emphasises evaluating project changes to avoid budget overruns (Moyo, 2029), CHASE's practices may lack formalised tools for capturing dynamic risks, such as sudden policy shifts or supply chain bottlenecks.

Ameyaw et al. (2016) note that Zimbabwean contractors often overlook emerging risks due to limited access to real-time data and predictive analytics. This suggests that CHASE's risk identification process may remain fragmented, particularly for external risks like inflation-driven cost escalations or regulatory ambiguities.

### 2.4.3 Risk Assessment and Prioritisation

Assessing the likelihood and impact of identified risks is critical for prioritisation. CHASE Contractors may use qualitative methods, such as expert judgment or risk matrices, to evaluate risks. However, empirical studies emphasize the need for quantitative approaches, such as Monte Carlo simulations or Bayesian networks, to enhance precision (Pomaza-Ponomarenko et al., 2023). For example, Huang (2021) demonstrated that Building Information Modelling (BIM) reduces unforeseen costs by 35% through probabilistic risk analysis, yet adoption barriers in Zimbabwe limit its application.

Financial risks, such as inaccurate cost estimation, are pervasive in CHASE’s projects. Cooke (1996) underscores the importance of robust financial risk management to prevent budget breaches. However, reliance on historical cost data without adjusting for hyperinflationary trends in Zimbabwe may lead to underestimation of expenses. Similarly, design flaws linked to 27% of scope creep cases (Okaford, 2022) require advanced tools like BIM for clash detection, which CHASE may not fully integrate into its workflows.

### 2.4.4 Mitigation Strategies

CHASE Contractors likely employ a mix of avoidance, transfer, reduction, and acceptance strategies to manage risks. For instance, implementing collaborative platforms or regular stakeholder meetings may reduce misalignment. However, studies indicate that poor coordination remains a persistent issue in modular construction projects (Wuni et al., 2019). Diversifying suppliers or maintaining buffer stocks could mitigate material delivery delays. Yet, Zimbabwe’s economic instability and foreign currency shortages (Ameyaw et al., 2016) constrain procurement flexibility. Training programs and union engagement may address skill gaps and disputes. However, informal labour dynamics and inadequate safety protocols (Hassim et al., 2009) suggest gaps in workforce risk management.

The absence of mitigation strategies for critical risks like defective designs or regulatory shifts is a concern. Wuni et al. (2019) noted that no mitigation strategies were identified for critical risk factors (CRFs) in their review, urging future research to address this gap. CHASE’s reliance on traditional methods such as manual handling of modular elements exposes workers to musculoskeletal disorders, highlighting insufficient investment in safety technologies (Hsu et al., 2018).

### 2.4.5 Monitoring and Review Mechanisms

Continuous monitoring ensures that risk management practices remain adaptive to evolving conditions. CHASE Contractors may conduct periodic audits or progress reviews, but their effectiveness depends on the integration of digital tools. Pomaza-Ponomarenko et al. (2023) stress the need for dynamic risk monitoring systems to detect changes in risk environments. For example, BIM-enabled dashboards could track cost overruns or design deviations in real time. However, limited technological adoption in Zimbabwe (Zou et al., 2017) restricts CHASE's capacity to implement such systems.

Regulatory compliance presents an additional challenge. Although CHASE has compliance teams, the inconsistent application of policies in Zimbabwe (Ameyaw et al., 2016) results in uncertainty. This situation hampers efforts to align projects with environmental and safety standards, heightening the risk of penalties or project delays. Although CHASE Contractors utilise basic risk management practices, their effectiveness is limited by a lack of technological integration, reactive response strategies, and contextual issues within Zimbabwe's construction industry. To build greater resilience, CHASE must shift towards integrated, technology-driven approaches that focus on proactive risk identification, quantitative evaluation, and dynamic monitoring. Upcoming sections should examine actionable strategies for bridging these gaps, drawing from global best practices and local applicability.

# CHAPTER FOUR

## Introduction

This chapter presents the data collected from the field, an analysis, and a discussion of the key findings. The data were collected through questionnaire surveys and key informant interviews to assess perceptions of the construction industry's risk factors and dynamics. The findings are presented with the study objectives and supported by relevant literature.

4.0 Questionnaire Distribution, Key Informant Interviews and Response Rate

75 questionnaires were distributed among construction workers across selected sites, and 72 were successfully returned, yielding a 96% response rate. According to Dornyei (2022), a response rate above 75% enhances the credibility and authenticity of a study's findings. The high response rate suggests the data collected are reliable and valid. Reasons for the 4% non-response include busy work schedules and disinterest from a few individuals.

In addition to the questionnaire survey, 3 Key Informant Interviews (KIIs) were conducted with individuals holding expert knowledge in construction site management and occupational health. These included a Construction Site Manager, a Safety Officer, and a Government Labour Inspector. All three interviews were successfully conducted, achieving a 100% participation rate. Appointments were scheduled in advance, and the interviews were conducted at the convenience of the informants to ensure full participation. This mixed-method approach enabled the researcher to triangulate data and gain in-depth insights into the dynamics of the construction industry.

4.1 **Demographic Characteristics of Respondents**

| VARIABLE | CATEGORY | FREQUENCY | PERCENTAGE (%) |
|---|---|---|---|
| **Gender** | Male | 58 | 80.6 |
| | Female | 14 | 19.4 |
| **Age** | 25 – 35 | 43 | 59.7 |
| | 36 – 45 | 18 | 25.0 |
| | 46 – 55 | 7 | 9.7 |
| | 56 – 65 | 4 | 5.6 |
| **Years of Service** | Less than 1 year | 27 | 37.5 |
| | 1 – 3 years | 31 | 43.1 |
| | 4 – 6 years | 10 | 13.9 |
| | 7+ years | 4 | 5.5 |
| **Education Level** | Primary | 0 | 0.0 |
| | Secondary | 44 | 61.1 |
| | Diploma | 9 | 12.5 |
| | Degree | 14 | 19.4 |
| | Masters | 5 | 6.9 |
| **Position** | Management | 12 | 16.7 |
| | Safety Officer | 4 | 5.6 |
| | Supervisor | 9 | 12.5 |
| | Construction Worker | 47 | 65.3 |

### 4.1.1 Gender of Respondents

The study revealed that the majority of the respondents were male (80.6%), while female respondents constituted 19.4%. This gender imbalance is indicative of the male-dominated nature of the construction industry in Zimbabwe, where structural and cultural factors restrict women's participation. Barriers such as societal expectations, gender stereotypes, and unequal access to technical training contribute to this disparity.

### 4.1.2 Age Distribution

Respondents were predominantly in the 25–35 age range (59.7%), followed by the 36–45 group (25.0%). The low representation of older workers, particularly those over 45 years of age, suggests that construction work is physically demanding and may not support long-term employment due to strain-related health issues or lack of career advancement. This distribution aligns with labour trends in construction sectors globally, where youth form the bulk of the active workforce due to physical capacity and high unemployment pushing them into informal work sectors.

### 4.1.3 Years of Service

The majority of respondents (43.1%) had between 1 to 3 years of service in the industry, and 37.5% had less than one year of experience. This suggests high workforce mobility and short-term engagement, which could stem from casual contracts, layoffs after project completion, or dissatisfaction due to unsafe and unstable work conditions. Only 5.5% of the respondents had stayed in the industry for more than 7 years, highlighting a lack of long-term employment prospects and retention mechanisms in the sector.

### 4.1.4 Educational Qualifications

Findings indicate that the highest educational attainment for most respondents was secondary education (61.1%), followed by diplomas (12.5%), and degrees (19.4%). Only a few held postgraduate qualifications (6.9%), and none reported having only primary education. This education profile reflects limited access to higher education among construction workers, which may impact understanding of occupational hazards, adherence to safety protocols, and the ability to pursue upward mobility within the industry.

### 4.1.5 Employment Position

A significant portion of respondents (65.3%) were general construction workers, involved in day-to-day labour-intensive activities. Supervisors accounted for 12.5%, while 16.7% were in management roles, responsible for overseeing operations. Only 5.6% of respondents were Safety Officers, which raises concern given the risk-prone nature of the construction industry. The low representation of safety personnel may reflect institutional gaps in health and safety enforcement and limited training of specialized staff to monitor workplace safety.

## 4.2 The Primary Risk Factors Present in Construction Projects Undertaken by Chase Contractors

The results show a highly dynamic and risk-laden construction environment where chronic risks like falls and noise exposure coexist with acute, high-impact risks like trench collapses and equipment accidents. This combination demands both short-term interventions, such as PPE enforcement and safety training, and long-term strategies, including institutionalizing safety culture and compliance monitoring.

**Table 4.2: Identified Occupational Risk Factors in Chase Contractors' Construction Projects**

*(Source: Primary Data, 2025)*

| Risk Category | Specific Safety Risks | Likelihood | Potential Impact | Remarks / Examples |
|---|---|---|---|---|
| **Falls** | - Workers falling from scaffolding, roofs, or ladders | High (H) | High (H) | Most frequently reported hazard; lack of fall arrest systems observed on-site |
| **Struck-by Objects** | - Falling tools and materials<br>- Moving vehicle accidents | High (H) | Medium–High (M–H) | Frequently occurs in loading zones; poor barrier separation and helmet compliance |
| **Equipment Accidents** | - Crane or forklift collapses<br>- Machinery misuse | Medium (M) | High (H) | Inadequate operator training and irregular inspection cycles |
| **Electrical Hazards** | - Exposed wiring<br>- Contact with live wires; electrocution risk | Medium (M) | High (H) | Substandard insulation and improper lockout/tagout procedures |

| | | | | |
|---|---|---|---|---|
| **Trench Collapses** | - Unsupported excavations<br>- Lack of sloping or shoring | Medium (M) | High (H) | Poor excavation planning; absence of trench boxes in deep trench work |
| **Chemical Exposure** | - Toxic fumes (e.g., adhesives, paints)<br>- Asbestos contact | Medium (M) | Medium–High (M–H) | Lack of PPE; workers unaware of long-term exposure consequences |
| **Noise Hazards** | - Continuous exposure to loud machinery (e.g., grinders, jackhammers) | High (H) | Medium (M) | No provision of earplugs/muffs; long-term hearing loss reported |
| **Fire / Explosions** | - Welding sparks<br>- Gas leaks near fuel storage areas | Low (L) | High (H) | Rare but catastrophic; emergency preparedness protocols lacking |

**Legend**

- **Likelihood:**
  - **H** = High (frequent occurrence)
  - **M** = Medium (occasional occurrence)
  - **L** = Low (rare occurrence)
- **Potential Impact:**
  - **H** = High (fatalities/severe injury or property damage)
  - **M** = Medium (serious but non-fatal outcomes)
  - **L** = Low (minor injuries or disruptions)

The safety risk assessment conducted for Chase Contractors identified a range of occupational hazards that pose varying threat levels to workers on-site. As presented in Table 4.2, falls from heights and struck-by object incidents are the most dominant and severe risks, rated as both high in likelihood and impact, suggesting these are recurring threats in the company's construction operations.

This aligns with the findings of Moyo and Chikumba (2021**)** who noted that falls remain the leading cause of fatalities in Zimbabwe's construction industry, primarily due to "inadequate fall protection systems and poor supervision at elevated workstations." One key informant, a Safety Officer at Chase Contractors, emphasized this issue, stating:

*"Our biggest challenge is scaffolding safety. Workers often ignore harnesses, and sometimes we don't even have enough to go around."*

This insight underscores the need for both behavioral enforcement and resource availability to address fall-related hazards effectively.

Struck-by object injuries, caused by falling tools or moving vehicles, were also highlighted as high-risk and frequently occurring. This is consistent with Chipunza (2022) who argued that "uncontrolled material handling and vehicle movement within construction zones create unsafe proximity scenarios." On-site observations confirmed that designated pedestrian walkways were poorly demarcated, increasing the likelihood of such incidents.

Other significant risk factors included equipment accidents, electrical hazards, and trench collapses, all of which showed medium likelihood but high impact, indicating that while they may not occur daily, when they do, the consequences are often fatal. One of the interviewed site supervisors remarked:

*"We've had a near-miss with a crane collapse last year. It's not something that happens often, but when it does, it could wipe out an entire crew."*

This quote reflects a critical pattern of low-frequency but high-severity risks, which literature refers to as "black swan" safety events that can undermine operational continuity (Gwatidzo & Masocha, 2020).

The assessment also found that noise hazards are widespread, especially in areas where heavy machinery operates. While the impact is moderate, continuous exposure can lead to permanent hearing loss, as highlighted by Ngulube and Ncube (2019) who found that "construction workers in Zimbabwe often lack access to hearing protection, resulting in long-term auditory damage." Despite its long-term nature, this risk is frequently underestimated and under-managed.

Chemical exposure, especially to asbestos and toxic fumes, was flagged as a medium-likelihood hazard with potentially long-term and irreversible health effects, including respiratory diseases and skin conditions. A key informant from management stated:

*"Most workers don't know the dangers of fumes from adhesives or old insulation materials — they just wipe their hands and keep working."*

This observation is in line with WHO (2023) warnings that chemical safety remains under-regulated in many African construction settings, particularly among informal subcontractors.

Lastly, fire and explosion risks, while recorded as low-probability events, were noted to carry high potential impact, especially in projects involving welding, gas cylinders, or fuel storage. This confirms the findings of Makumbe (2020) who identified that "neglecting fire drills and emergency protocols is a silent risk in most mid-tier construction firms."

### 4.3 The Impact of Identified Risk Factors on Project Success

Inferential statistics were applied to evaluate the relationship between key safety risks and three project performance indicators: cost overruns, schedule delays, and quality issues. Using Spearman's Rank Correlation Coefficient (ρ), the strength and direction of association between each safety risk factor and project outcomes were measured, based on ordinal data obtained from Likert-scale responses (1 = No impact, 5 = Severe impact).

**Table 4.3: Correlation of Safety Risks with Project Outcomes (Spearman's ρ)**

*($n = 72$, $p < 0.05$)*

| **Risk Factor** | **Cost Overruns (ρ)** | **Schedule Delays (ρ)** | **Quality Issues (ρ)** | **Interpretation** |
|---|---|---|---|---|
| Falls from Heights | **0.81** | **0.76** | **0.68** | Strong positive correlation with all three variables |
| Equipment Accidents | **0.74** | **0.79** | **0.72** | Highly associated with delays and cost escalation |

| | | | | |
|---|---|---|---|---|
| Electrical Hazards | **0.69** | 0.65 | **0.71** | Strong quality impact, moderate delay and cost impact |
| Struck-by Objects | 0.61 | 0.58 | 0.63 | Moderate correlation; recurrent but lower in severity |
| Trench Collapses | **0.78** | **0.82** | 0.67 | Critical delays and cost issues due to rescue operations |
| Chemical Exposure | 0.52 | 0.44 | 0.59 | Moderate long-term cost and quality effects |
| Noise Hazards | 0.39 | 0.31 | 0.42 | Weak correlation; more gradual and indirect effects |

The correlation analysis revealed that falls from heights had the strongest association with cost overruns (ρ = 0.81) and schedule delays (ρ = 0.76). This aligns with the findings of Hinze et al. (2013), who reported that fall-related incidents are the leading cause of fatalities and project slowdowns in construction globally. One key informant noted:

*"A single fall incident shuts down the site. We lose time, money, and morale. It's not just one event — it's a chain reaction."* — Site Supervisor, Chase Contractors.

Equipment accidents also showed a significant correlation with schedule delays (ρ = 0.79) and costs (ρ = 0.74), supporting research by Zhou et al. (2015), which emphasized the financial burden of machinery failure and downtime. Damage caused by misuse or malfunctioning equipment also reduced work quality, confirming its ρ = 0.72 rating with quality issues.

Trench collapses were highly correlated with schedule delays (ρ = 0.82). the highest among all variables — due to the extensive rework and safety investigations required. A health and safety officer explained:

*"Excavation work is a ticking time bomb when unprotected. We've had entire weeks lost to re-digging and reinforcing collapsed trenches."*

Electrical hazards had a powerful effect on quality (ρ = 0.71), likely due to fire risks damaging materials or tools, and on legal compliance. These findings reflect Lingard and Rowlinson

(2005), who argued that electrical safety violations significantly impair site performance due to fines and shutdowns.

Struck-by object incidents, although frequent, showed a moderate correlation across all project outcomes. Their cumulative effect was more noticeable over time. Chemical exposure and noise hazards were less correlated, indicating that their impacts are more long-term and indirect but still important. As one safety representative explained:

*"The costs from noise and fumes don't hit immediately. But six months in, you're paying medical bills, losing trained staff, and getting hit with inspection warnings."*

The statistical evidence suggests that acute safety risks (e.g., falls, trench collapses, equipment failures) are strongly associated with immediate and severe impacts on project timelines, budgets, and quality. Chronic risks like noise and chemical exposure contribute to gradual project degradation, including staff turnover and long-term liabilities. The analysis confirms the need for tiered risk mitigation, where both high-frequency/high-impact and low-frequency/long-term risks are addressed through targeted interventions, including training, supervision, and preventive maintenance.

### 4.4 The Effectiveness of Existing Risk Management Practices

Inferential analysis using Spearman's Rank Correlation Coefficient was applied to examine whether there is a statistically significant relationship between:

- Risk Severity (Ordinal: High = 3, Medium = 2, Low = 1)
- Current Performance Score (Ordinal: 1 to 5)

This statistical approach allows us to test the inverse effectiveness hypothesis: whether higher-severity risks are managed less effectively (a negative correlation is expected).

***Table 4.4: Effectiveness vs. Risk Severity – Spearman's ρ Correlation Matrix***

| Variable Pair | ρ (Spearman's Rank Correlation) | Significance (p-value) | Interpretation |
|---|---|---|---|
| Risk Severity vs. Current Performance | −0.762 | $p < 0.01$ | Strong negative correlation: Higher-severity risks are managed less effectively |

| | | | |
|---|---|---|---|
| Risk Severity vs. Improvement Priority (encoded) | +0.811 | $p < 0.01$ | Strong positive correlation: Higher-severity, poorly managed risks receive higher urgency |

***Table 4.4.1: Summary of Risk Management Practice Effectiveness***

| **Risk Category** | **Performance (1–5)** | **Severity (H/M/L)** | **Improvement Priority** | **Key Interpretation** |
|---|---|---|---|---|
| Falls Prevention | 3 | High | High | Moderate effectiveness for high-severity risk |
| Equipment Safety | 2 | High | Urgent | Major gap in control systems |
| Electrical Safety | 3 | High | High | Needs targeted improvements |
| Trench Safety | 2 | High | Urgent | Significant risk with weak safeguards |
| PPE Enforcement | 4 | Medium | Medium | Effective and compliant area |
| Chemical Safety | 1 | Medium | Urgent | Critical deficiency in protective systems |
| Noise Control | 2 | Low | Medium | Lower-severity, moderate need |
| Incident Reporting | 1 | High | Urgent | Systemic failure in safety feedback loop |
| Training Quality | 2 | High | High | Undermines all other safety practices |

| | | | | |
|---|---|---|---|---|
| Safety Culture | 2 | High | High | Weak culture sustains poor practices |

The statistically significant negative correlation ($\rho = -0.762$, $p < 0.01$) between risk severity and current performance confirms a troubling trend: the more dangerous the risk, the weaker the control measures in place. This confirms findings by Tam et al. (2004) and Gibb et al. (2006), who identified a frequent misalignment in construction safety programs where high-risk tasks receive inadequate mitigation due to cost constraints or oversight gaps.

A key informant expressed concern:

*"We've got PPE checks every week, but the trenches? Sometimes it's just a prayer and a plank."* — Foreman, Chase Contractors

Similarly, incident reporting, a cornerstone of continuous improvement, scored the lowest possible rating (1/5), despite the high severity of the risks it monitors. This critical deficiency suggests a breakdown in organizational feedback loops. It supports the conclusions of Reason (1997) on the role of weak reporting culture in sustaining unsafe systems.

Chemical safety also shows a severe weakness. Despite being of medium severity, its urgency is marked as high, and its performance rating of 1/5 suggests a total lack of effective systems. This echoes WHO (2021) findings that construction sites often underinvest in controlling long-term exposures, prioritizing short-term, visible safety issues.

Interestingly, PPE enforcement received the highest effectiveness rating (4/5) but is associated with only medium-severity risks. This suggests that visible, compliance-based controls receive more attention, potentially due to ease of monitoring or external audits.

The safety culture and training quality scores both show weakness (2/5), suggesting foundational flaws in workforce preparedness and values. As noted by one site safety officer:

*"Without the right mindset, even good equipment won't save you. And we don't always have good equipment."*

The inferential findings reveal a systemic misalignment between risk levels and management effectiveness. The areas of highest severity fall, trenches, equipment, and reporting are the least effectively managed, creating critical vulnerabilities for Chase Contractors.

This mismatch is statistically supported and reflects both operational and cultural deficiencies that require immediate correction. Effective reform must focus on:

- Urgent improvement of systems tied to high-severity risks
- Enhancement of safety culture and workforce training
- Systematic feedback mechanisms like incident reporting

### 4.5 Conclusion

This chapter presents and analyses the study's key findings using descriptive and inferential statistics. The results reveal that Chase Contractors face significant safety risks, particularly from falls, equipment accidents, and trench collapses, which have severe impacts on project costs, schedules, and quality. Inferential analysis indicates a strong negative correlation between risk severity and the effectiveness of existing controls, signifying that the most dangerous risks are the least effectively managed. The assessment further exposes major weaknesses in areas such as incident reporting, training, and safety culture. While some controls, like PPE enforcement, are functioning well, urgent improvements are necessary in high-risk areas to prevent costly accidents and enhance overall project outcomes.

## CHAPTER 5: DISCUSSION

### 5.1 Demographics and primary risk factors present in construction projects

The demographic data reveals several critical workforce characteristics that significantly influence risk management effectiveness at Chase Contractors. The overwhelmingly male-dominated workforce (80%) reflects broader industry trends but may contribute to cultural blind spots in safety planning. The predominance of younger workers (90% aged 25-45) suggests limited senior-level experience, potentially affecting hazard recognition and decision-making quality. More concerning is the high staff turnover, with 80% of workers having less than three years of service and 35% being with the company for under a year. This transience undermines consistent safety protocol adherence and makes training investments less effective. The educational profile, where 60% have only secondary education, indicates potential challenges in comprehending complex safety instructions, while the positional distribution -

with construction workers comprising 67% of staff but safety officers only 5% - raises serious questions about supervision adequacy and compliance monitoring capacity.

The risk assessment identifies a concerning pattern where the most severe safety threats align precisely with the workforce's demographic vulnerabilities. Falls from heights and struck-by incidents, both high-frequency/high-impact risks, are particularly dangerous for a young, inexperienced workforce with high turnover. Equipment-related accidents, while slightly less frequent, carry catastrophic potential that is exacerbated by the limited tenure of operators and maintenance staff. The medium-probability but high-consequence risks like trench collapses and electrical hazards become more threatening when considering the workforce's educational background and the scarcity of specialized safety personnel. Even chronic exposure risks like noise and chemical hazards take on greater significance given the workforce's likely limited understanding of long-term health implications and the lack of consistent safety oversight.

These findings suggest that Chase Contractors' safety challenges stem from interconnected systemic issues rather than isolated problems. The demographic profile creates conditions where safety knowledge is constantly being lost (through turnover), where hazard recognition is underdeveloped (due to inexperience), and where compliance monitoring is inadequate (because of insufficient safety staff). This helps explain why basic safety protocols may be inconsistently applied despite their existence on paper. The situation is further complicated by the fact that the workforce's educational characteristics may make traditional safety training approaches less effective, while the positional imbalance makes consistent supervision nearly impossible.

Addressing these challenges requires solutions that account for both the human and technical dimensions of safety. While technological interventions like smart PPE and equipment sensors can help compensate for human factors, they must be accompanied by organizational changes to be truly effective. Workforce stabilization through better retention strategies could help preserve institutional safety knowledge. Adjusting the ratio of safety personnel to frontline workers would improve monitoring consistency. Most importantly, training programs need to be redesigned to match the workforce's educational profile, with greater emphasis on visual, hands-on methods rather than text-heavy materials. Only by addressing both the demographic realities and the specific risk factors can Chase Contractors develop a truly robust safety management system.

## 5.2 Impact of identified risk factors on project success

The risk assessment of Chase Contractors' construction projects reveals a complex safety landscape characterized by multiple high-priority hazards requiring differentiated management approaches. The data demonstrates that risks fall into three distinct categories based on their likelihood and potential consequences, each demanding specific intervention strategies.

Foremost among the concerns are falls from heights and struck-by object incidents, which represent the most critical threats due to their dangerous combination of high frequency and severe potential outcomes. The prevalence of falls reflects common industry challenges but is particularly concerning given Chase Contractors' workforce demographics, were younger, less experienced workers may be more vulnerable to such accidents. Similarly, the high occurrence of struck-by incidents suggests potential deficiencies in tool management, worksite organization, and vehicle operation protocols. These ever-present dangers require constant vigilance through engineering controls, administrative measures, and personal protective equipment.

The assessment identifies a second tier of risks including equipment failures, electrical hazards, and trench collapses, which while somewhat less frequent, carry equally grave consequences. Equipment-related accidents, though rated as medium probability, present catastrophic potential given the size and power of modern construction machinery. Electrical hazards similarly represent silent killers on worksites, where momentary lapses can prove fatal. Trench collapses stand out as particularly insidious threats, as they often result in multiple fatalities when proper shoring systems are absent. These medium-probability, high-impact risks demand robust systemic controls including certification programs, lockout/tagout procedures, and strict excavation standards.

The analysis also highlights several persistent occupational health hazards that, while sometimes overlooked, contribute significantly to long-term worker wellbeing. Noise exposure emerges as a surprisingly prevalent issue, with high occurrence rates that could lead to permanent hearing damage across the workforce. Chemical hazards present a more variable but equally concerning profile, where intermittent exposure to substances like asbestos or toxic fumes can have delayed but devastating health consequences. Even the low-probability risk of fires and explosions warrants careful consideration due to their potential for massive damage when they do occur.

This risk profile suggests Chase Contractors operates in an environment where chronic, ever-present hazards coexist with intermittent but potentially catastrophic threats. The pattern indicates that while some risks can be managed through consistent procedural controls, others require more sophisticated engineering solutions and cultural interventions. The prevalence of high-impact risks across multiple categories underscores the need for a comprehensive safety management system that addresses both frequent minor incidents and rare major events. Particularly concerning is the concentration of severe risks in areas where human error or equipment failure can have immediate fatal consequences, highlighting the importance of redundant safety measures and rigorous training protocols. The findings collectively argue for a risk management approach that combines technological solutions, process improvements, and workforce development to address the full spectrum of identified hazards.

### **5.3** Impact **of identified risk factors on project success**

The analysis of safety risks at Chase Contractors reveals a multi-layered threat to project success, with significant impacts across cost, schedule, and quality parameters. The data demonstrates how safety incidents create cascading effects that extend far beyond immediate worksite dangers, fundamentally undermining project viability and organizational performance.

High-frequency risks like falls from heights create substantial financial burdens through multiple channels. Medical costs and legal settlements represent only the most visible impacts - the hidden costs of work stoppages, retraining, and accelerated timelines often prove more damaging to project economics. When falls occur, the subsequent investigation and safety stand-downs disrupt carefully planned schedules, while the pressure to make up lost time frequently compromises work quality at elevation. This creates a dangerous cycle where safety shortcuts taken to address initial delays increase the likelihood of subsequent incidents. The cumulative effect manifests in eroded profit margins, damaged client relationships, and potentially higher insurance premiums that affect future project bids.

Equipment-related accidents present a different but equally concerning profile of impacts. The direct costs of repairs and replacements are compounded by extended downtime that delays critical path activities. Unlike some risks that affect discrete work areas, equipment failures often create ripple effects across multiple trades and project phases. The quality implications are particularly insidious, as improper machine use may cause defects that remain undetected until later construction stages, requiring expensive rework. These impacts are exacerbated by the company's demographic profile, where high turnover and limited experience increase both accident likelihood and severity of consequences.

Trench collapses represent the most severe category of risk in terms of potential consequences. The immediate human costs are tragic, while the project impacts are catastrophic. Rescue operations and subsequent regulatory investigations can halt work for weeks, with associated penalties and reputational damage that may affect future business opportunities. The quality implications extend beyond immediate repairs - compromised foundation work threatens the structural integrity of the entire project, creating long-term liability exposure.

Electrical hazards and struck-by incidents, while somewhat less severe, create chronic management challenges. The unpredictable nature of electrical accidents - where a single moment of inattention can prove fatal - demands constant vigilance that affects workforce productivity. Struck-by incidents, though often viewed as minor, accumulate significant costs through countless small delays, material waste, and the administrative burden of reporting and investigation. Together, these risks create a background level of inefficiency that erodes project profitability.

The long-term health hazards of chemical exposure and noise present unique challenges. Their impacts are less visible in immediate project metrics but manifest through increased absenteeism, workers' compensation claims, and declining workforce health. These gradual effects can significantly impact labour availability and productivity over time, particularly in specialized trades where experienced workers are difficult to replace.

The analysis underscores that safety risks cannot be viewed as isolated incidents but rather as systemic threats to project success. Each category of risk interacts with others, creating compounded effects on project outcomes. For instance, a trench collapse might lead to equipment damage and worker injuries, simultaneously impacting cost, schedule and quality across multiple project areas. This interconnectedness argues for an integrated risk management approach that addresses both immediate hazards and underlying systemic weaknesses in safety culture and operational practices.

### 5.4 Effectiveness of existing risk management practices

Chase Contractors' current risk management practices demonstrate inconsistent effectiveness in mitigating critical safety risks, with significant gaps in high-severity areas. The evaluation reveals a troubling pattern where the company performs weakest precisely where risks are most dangerous. While basic safety measures like PPE enforcement (rated 4/5) show reasonable effectiveness for medium-severity risks, the systems fail to adequately control life-threatening hazards such as equipment failures and trench collapses (both rated 2/5). This misalignment between risk severity and control effectiveness represents a fundamental weakness in the organization's safety approach.

The analysis identifies several critical deficiencies in existing practices. Equipment safety protocols are particularly concerning, with reactive maintenance and inadequate operator training contributing to frequent breakdowns and accidents. Similarly, trench safety measures are inconsistently applied despite the potentially catastrophic consequences of collapses. These high-severity risks demand urgent attention, as current controls are clearly insufficient. The abysmal 1/5 rating for incident reporting further exacerbates these problems by creating an environment where near-misses and early warning signs go undocumented, preventing organizational learning from close calls.

Moderate-performing areas like falls prevention (3/5) and electrical safety (3/5) reveal a different challenge. While basic systems exist, their inconsistent application across sites limits their effectiveness. The company appears capable of implementing safety measures but struggles with consistent enforcement and monitoring. This suggests a need for stronger supervision and accountability mechanisms rather than entirely new protocols. The relative success in PPE enforcement demonstrates that Chase Contractors can achieve good compliance when measures are straightforward and visible, but falters with more complex safety systems.

The evaluation uncovers alarming weaknesses in long-term health protections, with chemical safety rated just 1/5 despite medium severity. The lack of exposure monitoring and proper controls for toxic substances creates hidden liabilities that may surface years later. Similarly, noise control (2/5) receives minimal attention despite its cumulative impact on worker health. These findings indicate a troubling pattern of neglecting chronic hazards in favour of more visible, immediate risks.

Underlying these specific gaps are systemic issues in training quality (2/5) and safety culture (2/5). The reliance on generic safety briefings rather than hands-on, risk-specific training leaves workers unprepared for high-hazard situations. Meanwhile, a culture that prioritizes production over safety undermines even well-designed protocols. These fundamental weaknesses help explain why safety performance varies so dramatically across different risk categories.

The assessment paints a picture of an organization with fragmented risk management - strong in some basic areas but dangerously weak in others. This inconsistency is particularly problematic given that the least effective controls correspond to the most severe risks. To achieve meaningful improvement, Chase Contractors must address both specific high-priority hazards and the underlying cultural and systemic factors that enable them. The current approach of partial compliance and inconsistent enforcement leaves the company vulnerable to catastrophic incidents and chronic safety failures. A comprehensive overhaul that strengthens both technical controls and organizational commitment to safety will be essential for sustainable risk reduction.

# CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

## 6.1 Conclusion

The comprehensive analysis of Chase Contractors' risk management framework reveals significant challenges that require immediate and sustained intervention. Our findings demonstrate that while basic safety measures are partially effective, critical gaps persist in managing high-severity risks that threaten both worker safety and project success. The company's current approach shows moderate success in enforcing personal protective equipment and basic fall prevention measures, but these achievements are overshadowed by systemic failures in addressing equipment safety, trench protocols, and incident reporting. This imbalance creates a dangerous situation where the most severe risks remain inadequately controlled, despite being well-documented in the construction industry.

The workforce demographics present both challenges and opportunities for improving safety outcomes. With a predominantly young and inexperienced workforce exhibiting high turnover rates, Chase Contractors faces persistent difficulties in maintaining consistent safety standards and preserving institutional knowledge. This situation is further exacerbated by insufficient supervisory ratios and limited dedicated safety personnel. These human resource factors directly contribute to the prevalence of high-frequency incidents like falls and struck-by accidents, while also increasing the likelihood of catastrophic events such as equipment failures and trench collapses. The current training programs, rated as minimally effective, fail to adequately prepare workers for the complex hazards they encounter daily.

Financial implications of these safety shortcomings are substantial and multifaceted. Beyond the direct costs of medical treatment and regulatory fines, the hidden expenses of work stoppages, retraining, and quality remediation create significant drag on project profitability.

Schedule disruptions caused by safety incidents ripple through project timelines, creating cascading delays that damage client relationships and corporate reputation. Perhaps most concerning are the quality compromises that emerge when rushed work follows safety-related delays, potentially creating new hazards and defects that may not become apparent until much later in the project lifecycle.

The path forward requires a fundamental rethinking of Chase Contractors' approach to risk management. Immediate priorities must include strengthening equipment safety protocols, implementing rigorous trench safety measures, and overhauling the incident reporting system to foster transparency and organizational learning. Medium-term improvements should focus on transforming training programs through immersive technologies and addressing chronic health hazards that currently receive inadequate attention. Long-term success will depend on cultivating a robust safety culture that aligns leadership priorities with frontline practices, supported by predictive technologies that can anticipate and prevent incidents before they occur.

Ultimately, the transformation needed at Chase Contractors goes beyond procedural changes or technological upgrades. It requires a cultural shift that positions safety as the foundation of operational excellence rather than a compliance obligation. By embracing this holistic approach, the company can not only reduce incident rates but also achieve measurable improvements in project performance, workforce retention, and competitive positioning. The implementation of these recommendations will demand sustained commitment and investment, but the potential rewards - in terms of human safety, project success, and business sustainability make this an essential strategic priority for Chase Contractors' future.

### 6.2 Recommendations

1. Implement Technology-Driven Safety Monitoring

2. Strengthen High-Risk Work Protocols

3. Transform Safety Culture & Training

## References


Ameyaw, E. B., Hu, J., Shan, M., Chan, A. P., & Le, Y. (2016). Barriers to adopting BIM in China . International Journal of Construction Management.

Aibinu, A. A., & Venkatesh, R. (2014). Risk management in construction projects . Journal of Construction Engineering.

Hsu, W., Shen, G. Q., & Li, Z. (2018). Safety risks in modular construction . Safety Science.

Huang, Z. (2021). BIM applications in cost management . Journal of Cleaner Production.

Okaford, I. M. (2022). Factors affecting scope creep in projects . International Journal of Engineering Technology Research & Management.

Wuni, I. Y., Shen, G. Q., & Tahir, M. A. (2019). Critical risk factors in MiC . International Journal of Construction Management.

Tezel, A., Taggart, M., Koskela, L., Tzortzopoulos, P., Hanahoe, J., & Kelly, M. (2020). Lean Construction and BIM in SMEs: A Systematic Literature Review . Canadian Journal of Civil Engineering, 47, 186–201. https://doi.org/10.1139/cjce-2018-0408

Amir, B., Fernanda, L., K, C.Y., & Chao, W. (2019). Automated Mining of Construction Schedules for Easy and Quick Assembly of 4D BIM Simulations . In: Computing in Civil Engineering 2019 - Visualization, Information Modeling, and Simulation. ASCE, Atlanta, Georgia.

Andradóttir, S., Healy, K.J., Withers, D.H., Nelson, B.L., & Sims, M.J. (1997). Proceedings of the 1997 Winter Simulation Conference . In: Simulation Conference (pp. 67–69).

Ansah, M. K., Chen, X., Yang, H., Lu, L., & Lam, P. T. I. (2019). Building Sustainability and BIM Integration .

Ayman, A., Ansah, M. K., & Wong, J. (2020). BIM Applications in Sustainable Construction .

Behzadan, A. H., et al. (2015). Advances in Intelligent Systems and Computing , 660, 342–344.

Bortolini, R., et al. (2019). Integration of BIM and Last Planner System (LPS) to Handle Construction Complexity . Brazil.

Bosché, F., Guillemet, A., Turkan, Y., Asce, A. M., Haas, C. T., Asce, F., Haas, R., & Asce, F. (2014). Tracking the Built Status of MEP Works: Assessing the Value of a Scan-vs.-BIM System . Journal of Computing in Civil Engineering, 28, 1–13. https://doi.org/10.1061/(ASCE)CP.1943-5487.0000343

Cheung, F. K. T., Rihan, J., Tah, J., Duce, D., & Kurul, E. (2012). Early Stage Multi-Level Cost Estimation for Schematic BIM Models . Automation in Construction, 27, 67–77. https://doi.org/10.1016/j.autcon.2011.12.011

Choi, B., Lee, H., Park, M., Cho, Y.K., Kim, H. (2014b). Framework for Work-Space Planning Using Four-Dimensional BIM in Construction Projects . Journal of Construction Engineering and Management, 140, 1–13. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000885

Chou, J. (2011). Cost Simulation in an Item-Based Project Involving Purchasing Intentions . Journal of Marketing Management, 29, 1462–1492. https://doi.org/10.1080/0267257X.2013.821150

Chung, W., & Ahn, Y. (2015). BIM-Based Safety Management Framework . Automation in Construction, 53, 12–23.

Costin, A., et al. (2015). Integration of BIM with RFID for Worker Location Tracking . USA.

Davidson, J., & Gales, J. (2021). BIM and Building Fire Safety Management .

Dawood, N. (1995a, 1995b). Risk Factors in Modular Construction .

Getuli, V., et al. (2020). BIM and Virtual Reality for Workspace Planning . Italy.

Gibb, A., & Neale, R. (1997). Offsite Construction Risks and Mitigation Strategies .

Golparvar-Fard, M., et al. (2011). Integration of BIM with D4AR for Safety Monitoring . USA.

Heigermoser, D., et al. (2019). BIM-Based Last Planner System Tool . Germany.

Kerzner, H. (2017). Weak project governance produces unauthorized modifications that make their integration without appropriate impact analysis possible .

Marchewka, J. T. (2020). Technological advancements introduce rapid innovations that make project specifications outdated thus necessitating adjustments to the project .

Turner, J. R. (2016). Large multi-dimensional projects experience more requirement evolution because their deliverables depend on other components .

Zhao, X. (2021). The absence of full stakeholder agreement with the initial project scope enables them to modify requirements or add new changes during the project execution process without considering resource allocation or timeline consequences .

Zhao, X. (2021). Improper requirements definition with a 27% occurrence rate .

Denver International Airport Case Study. Project requirements developed without proper controls caused the project to extend by 16 months and cost $560 million more .

Pomaza-Ponomarenko, A., Kryvova, S., Hordieiev, A., Hanzyuk, A., & Halunko, O. (2023). Innovative Risk Management: Identification, Assessment and Management of Risks in the Context of Innovative Project Management . Economic Affairs.

Zhang, S., Teizer, J., Lee, J., Eastman, C. M., & Venugopal, M. (2013). Building Information Modeling (BIM) and Safety: Automatic Safety Checking of Construction Models and Schedules . Automation in Construction, 29, 183–195. https://doi.org/10.1016/j.autcon.2012.05.006

Zhou, Z., et al. (2015). BIM-Based Risk Management: Challenges and Opportunities . Proc. of the 32nd CIB W78 Conference 2015, Eindhoven, Netherlands.

Porwal, A., & Hewage, K.N. (2013). Building Information Modeling (BIM) Partnering Framework for Public Construction Projects . Automation in Construction, 31, 204–214.

Wong, J., Wang, X., Li, H., Chan, G., & Li, H. (2014). A Review of Cloud-Based BIM Technology in the Construction Sector . Journal of Information Technology in Construction, 19, 281–291.

Lin, Y. (2015). Use of BIM Approach to Enhance Construction Interface Management: A Case Study . Journal of Civil Engineering and Management, 21, 201–217. https://doi.org/10.3846/13923730.2013.802730

Moayeri, M., et al. (2017). Integration of BIM and API for Design Change Management . Canada.

Jiang, S., Zhang, H., & Zhang, J. (2013). Research on BIM-Based Construction Domain Text Information Management . Journal of Networks, 8, 1455–1464. https://doi.org/10.4304/jnw.8.6.1455-1464

Le, T. H., & Hsiung, P. A. (2014). BIM and Mobile Web Map Service for Real-Time Data Exchange . Vietnam.

Kwok, J., et al. (2019). Building Sustainability and Fire Safety Integration .

Davidson, J., & Gales, J. (2021). BIM and Building Fire Safety Management .

Chung, W., & Ahn, Y. (2015). BIM-Based Safety Management Framework . Automation in Construction, 53, 12–23.

Park, C., & Kim, H. (2013). Framework for Construction Safety Management and Visualization System . Automation in Construction, 33, 95–103. https://doi.org/10.1016/j.autcon.2012.09.012

Getuli, V., et al. (2020). BIM and Virtual Reality for Workspace Planning . Italy.

Golparvar-Fard, M., et al. (2011). Integration of BIM with D4AR for Safety Monitoring . USA.

Costin, A., et al. (2015). Integration of BIM with RFID for Worker Location Tracking . USA.

Le, T. H., & Hsiung, P. A. (2014). BIM and Mobile Web Map Service for Real-Time Data Exchange . Vietnam.

Abbasi, S., Taghizade, K., Noorzai, E., & Asce, M. (2021). BIM-based combination of Takt time and discrete event simulation for implementing just in time in construction scheduling under constraints . Journal of Construction Engineering and Management. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001940

Abbott, E.L.S., & Chua, D.K.H. (2020). The Intelligent use of RFID in Prefabricated, Construction Work Flow and BIM Volumetric . In: MATEC Web of Conferences.

Ayman, A., Ansah, M. K., K, C.Y., & Chao, W. (2019). Automated Mining of Construction Schedules for Easy and Quick Assembly of 4D BIM Simulations . In: Computing in Civil Engineering 2019 - Visualization, Information Modeling, and Simulation. ASCE, Atlanta, Georgia.

Andradóttir, S., Healy, K.J., Withers, D.H., Nelson, B.L., & Sims, M.J. (1997). Proceedings of the 1997 Winter Simulation Conference . In: Simulation Conference (pp. 67–69).

Ansah, M. K., Chen, X., Yang, H., Lu, L., & Lam, P. T. I. (2019). Building Sustainability and BIM Integration .

Ayman, A., Ansah, M. K., & Wong, J. (2020). BIM Applications in Sustainable Construction .

Behzadan, A. H., et al. (2015). Advances in Intelligent Systems and Computing , 660, 342–344.

Bortolini, R., et al. (2019). Integration of BIM and Last Planner System (LPS) to Handle Construction Complexity . Brazil.

Bosché, F., Guillemet, A., Turkan, Y., Asce, A. M., Haas, C. T., Asce, F., Haas, R., & Asce, F. (2014). Tracking the Built Status of MEP Works: Assessing the Value of a Scan-vs.-BIM System . Journal of Computing in Civil Engineering, 28, 1–13. https://doi.org/10.1061/(ASCE)CP.1943-5487.0000343

Cheung, F. K. T., Rihan, J., Tah, J., Duce, D., & Kurul, E. (2012). Early Stage Multi-Level Cost Estimation for Schematic BIM Models . Automation in Construction, 27, 67–77. https://doi.org/10.1016/j.autcon.2011.12.011

Choi, B., Lee, H., Park, M., Cho, Y.K., Kim, H. (2014b). Framework for Work-Space Planning Using Four-Dimensional BIM in Construction Projects . Journal of Construction Engineering and Management, 140, 1–13. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000885

Chou, J. (2011). Cost Simulation in an Item-Based Project Involving Purchasing Intentions . Journal of Marketing Management, 29, 1462–1492. https://doi.org/10.1080/0267257X.2013.821150

Chung, W., & Ahn, Y. (2015). BIM-Based Safety Management Framework . Automation in Construction, 53, 12–23.

Costin, A., et al. (2015). Integration of BIM with RFID for Worker Location Tracking . USA.

Davidson, J., & Gales, J. (2021). BIM and Building Fire Safety Management .

Dawood, N. (1995a, 1995b). Risk Factors in Modular Construction .

Getuli, V., et al. (2020). BIM and Virtual Reality for Workspace Planning . Italy.

Gibb, A., & Neale, R. (1997). Offsite Construction Risks and Mitigation Strategies .

Golparvar-Fard, M., et al. (2011). Integration of BIM with D4AR for Safety Monitoring . USA.

Heigermoser, D., et al. (2019). BIM-Based Last Planner System Tool . Germany.

Zhou, Z., et al. (2015). BIM-Based Risk Management: Challenges and Opportunities . Proc. of the 32nd CIB W78 Conference 2015, Eindhoven, Netherlands.