

DEVELOPMENT OF A COLLABORATIVE RISK MANAGEMENT FRAMEWORK FOR
ENHANCED PERFORMANCE OF ASPHALT ROAD CONSTRUCTION PROJECTS IN ADDIS
ABABA



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Development of a Collaborative Risk Management Framework for Enhanced
Performance of Asphalt Road Construction Projects in Addis Ababa



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DECLARATION

I, Sisay Alemayehu, declare that this thesis entitled “**Development of a Collaborative Risk Management Framework for Enhanced Performance of Asphalt Road Construction Projects in Addis Ababa**” is my own work and has not been submitted to any university for similar purpose. The references used in this proposal are duly recognized by proper citations.

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THESIS APPROVAL

I hereby certify that the recommendation and suggestion given by the thesis review the committee are appropriately incorporated into the final thesis entitled “**Development of a Collaborative Risk Management Framework for Enhanced Performance of Asphalt Road Construction Projects in Addis Ababa**” by Sisay Alemayehu.

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ABSTRACT

This study addresses the critical need for an enhanced approach to managing risks in asphalt road construction projects in Addis Ababa, Ethiopia, recognizing that existing practices are often inadequate and lack collaborative integration. The general objective was to develop a context-specific Collaborative Risk Management Framework (CRMF) aimed at enhancing project performance under the Addis Ababa City Road Authority (AACRA). Utilizing a mixed-methods research design, data were collected through a quantitative survey from 54 construction professionals and qualitative semi-structured interviews with 11 experts involved in AACRA asphalt road projects. Findings indicate that current risk management practices are moderately implemented, with less systematic and proactive techniques in use. The most significant risks impacting overall project performance were identified, including Accidents on site/Safety risks (Agg. RII=0.788), Poor site management (Agg. RII=0.788), and Frequent breakdown of equipment (Agg. RII=0.782). Crucially, the study revealed that the most critical barriers to collaborative risk management are cultural and relational, led by the lack of a general risk-aware culture (RII=0.907), lack of trust and commitment (RII=0.904), and lack of clear and open communication (RII=0.904). Synthesizing these findings, the study proposes a structured CRMF (visualized in Figure 4.2), founded on principles of transparency, trust-building, and shared responsibility, designed to proactively address high-impact risks and overcome identified collaborative barriers. The framework provides sequential stages and processes to improve risk management maturity and enhance project performance in this context.

Keywords: Addis Ababa, Asphalt Road Construction, Collaborative Risk Management, Project Performance, Risk Management,

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Road transport infrastructure plays a vital role in facilitating economic growth, social development, and poverty reduction, particularly in developing countries. Well-maintained road networks contribute to improved accessibility, reduced transportation costs, and increased trade and investment opportunities (Adetola and Goulding, 2016). Recognizing this importance, governments worldwide, including in Ethiopia, have invested heavily in road construction and maintenance projects. However, the successful execution of these projects, particularly asphalt road construction, is frequently fraught with numerous challenges, including risks and uncertainties that significantly impact project performance, leading to issues such as delays, cost overruns, and compromised quality (Aarthipriya et al., 2020; Ahmed et al., 2023; Chekol and Henry, 2024).

Asphalt road construction projects are inherently complex, involving diverse stakeholders, intricate technical processes, and substantial financial investments. Consequently, these projects are susceptible to a wide array of risks, such as inadequate planning, financial constraints, material shortages, equipment breakdowns, design errors, contractual disputes, and adverse weather conditions (Ahmed et al., 2023; Belay et al., 2021; Chekol and Henry, 2024), which can impede their timely completion, cost-effectiveness, quality, and overall success, sometimes even leading to project abandonment.

In Ethiopia, where the construction industry is a rapidly growing contributor to economic development, the government has embarked on ambitious road infrastructure programs to enhance connectivity and support economic growth (Asnakew, 2016; Ferede et al., 2020). Despite these efforts, the Ethiopian construction sector, particularly asphalt road construction projects in urban centers like Addis Ababa, has continually faced challenges. A significant factor contributing to these challenges, as identified in this study's problem statement and supported by existing literature (Asnakew, 2016; Belay et al., 2021; Ferede et al., 2020; Cheng and Darsa, 2021), has been the inadequacy of existing risk management practices. This inadequacy has frequently

manifested in project delays, cost overruns, and quality deficiencies, thereby hindering the nation's development objectives.

Several studies (Aarthipriya et al., 2020; Ahmed et al., 2023; Belay et al., 2021; Debela, 2018; Chekol and Henry, 2024; Gebrehiwet and Luo, 2023; Tessema et al., 2022) have highlighted the prevalence of various risk factors, including design-related, financial, construction-related, and external risks, and their detrimental impact on Ethiopian construction projects. However, prior to this research, a limited understanding existed regarding the underlying structure of these risks, their specific impact on project performance dimensions (time, cost, quality, safety), and the barriers to effective risk management, particularly within the context of asphalt road construction projects in Addis Ababa. This gap pointed to the need for a more nuanced investigation into these areas.

Furthermore, a critical deficiency identified was that existing risk management practices in the Ethiopian construction industry often lacked a collaborative approach. This resulted in fragmented risk mitigation efforts and limited stakeholder engagement, whereas a collaborative framework—emphasizing communication, coordination, and shared responsibility among clients, contractors, consultants, and subcontractors, is crucial for effective risk management throughout the project lifecycle (Adetola and Goulding, 2016; Marinelli and Salopek, 2019). The absence of such a context-specific collaborative framework tailored to the unique risks and stakeholder dynamics in Addis Ababa constituted a significant research gap.

In recognition of these critical needs, to address risk management challenges, understand risk impacts and barriers, and enhance the performance of asphalt road construction projects in Addis Ababa, this study aimed to develop a collaborative risk management framework. This framework was intended to provide a structured and systematic approach to identify, analyze, and mitigate risks by integrating the perspectives and expertise of all stakeholders involved (Kapogiannis and Sherratt, 2018; Xia et al., 2018), thereby improving project planning, decision-making, and overall performance.

To achieve this, the study first assessed current risk management practices. It then employed quantitative methods, including Relative Importance Index (RII) analysis, to identify and prioritize critical risk factors based on their perceived impact on project performance dimensions (time, cost, quality, and safety) and to identify key barriers to collaborative risk management. Qualitative

methods, through semi-structured interviews, were subsequently used to explore stakeholder perspectives, validate quantitative findings, and gather insights on risk management challenges and best practices. These analyses provided a comprehensive understanding of the risk landscape, its interdependencies, and the efficacy of current mitigation strategies. Based on these synthesized findings, and addressing the specific objectives of assessing current practices, quantifying risk impacts, and identifying collaborative barriers, a context-specific collaborative risk management framework was developed. This framework integrates stakeholder input, incorporates effective mitigation strategies, and provides practical guidance for managing risks throughout the project lifecycle, with the ultimate goal of improving project outcomes and enhancing road infrastructure development in Addis Ababa.

1.2 Statement of the Problem

The construction industry is vital to Ethiopia's economic development, and road infrastructure remains a key driver of its growth and social progress (Ahmed et al., 2023). Despite this, asphalt road construction projects in Addis Ababa, Ethiopia, have frequently encountered significant challenges that hindered their successful completion and overall performance. These challenges typically manifested as project delays, cost overruns, and compromised quality, which ultimately undermined the intended benefits of these critical infrastructure investments (Gain et al., 2022).

A critical factor contributing to these performance issues, as highlighted by the literature review for this study, was the inadequacy of existing risk management practices. Existing literature (e.g., Xia et al., 2018) indicated that prevailing approaches often overlooked the complexities of stakeholder collaboration and failed to systematically integrate diverse perspectives into risk management processes. This deficiency commonly led to reactive rather than proactive risk management, thereby hindering the timely identification, comprehensive assessment, and effective mitigation of potential threats (Abd El-Karim et al., 2017).

Consequently, a significant gap identified prior to this research was the lack of a comprehensive and context-specific collaborative risk management framework tailored to the unique risks and stakeholder dynamics inherent in asphalt road construction projects within Addis Ababa. As noted by Kumar et al. (2017), prevailing risk management practices often relied on generic approaches that did not adequately address these local specificities. This resulted in inadequate risk identification and ineffective mitigation strategies, ultimately compromising project performance.

This research, therefore, was undertaken to address these critical gaps. It aimed to move beyond the limitations of existing generic and often reactive approaches by developing a collaborative risk management framework. This framework, specifically tailored for asphalt road construction projects in Addis Ababa, was developed through a rigorous methodological approach. This involved assessing current risk management practices, quantifying the impact of identified risk factors on project performance dimensions, and prioritizing the key barriers hindering the implementation of collaborative risk management. The resulting framework is designed to provide a robust, proactive, and context-specific approach to enhance stakeholder collaboration, improve communication, and ultimately promote the successful and efficient delivery of high-quality road infrastructure projects in Addis Ababa.

1.3 Research Questions

The following research questions will be answered in the study:

- ~ What are the current risk management practices employed in asphalt road construction projects in Addis Ababa?
- ~ What is the quantifiable impact of identified risk factors on key project performance dimensions in asphalt road construction projects in Addis Ababa?
- ~ What are the key barriers hindering the implementation of collaborative risk management in asphalt road construction projects in Addis Ababa, and how can they be prioritized?
- ~ How can a collaborative risk management framework be developed that effectively integrates stakeholder perspectives and incorporates appropriate mitigation strategies to enhance the performance of asphalt road construction projects in Addis Ababa?

1.4 Objective of the Study

1.4.1 General Objective

The general objective of the study is to develop a collaborative risk management framework for enhanced performance of asphalt road construction projects in the case of Addis Ababa City Road Authority, Ethiopia

1.4.2 Specific Objectives

The specific objectives of the study are:

- ~ To assess the current risk management practices employed in asphalt road construction projects in Addis Ababa.
- ~ To prioritize the identified risk factors based on their impact key performance dimensions of asphalt road construction projects.
- ~ To identify and prioritize the barriers hindering to the implementation of collaborative risk management in asphalt road construction projects.
- ~ To develop a collaborative risk management framework that integrates the perspectives of all stakeholders and incorporating mitigations strategies to enhance the performance of asphalt road construction projects.

1.5 Significance of the Study

The successful execution of asphalt road construction projects is paramount for the socio-economic development of Addis Ababa, yet these projects are frequently plagued by performance issues such as time and cost overruns, and quality deficiencies. This study holds significant practical and academic importance as it addressed the identified gap in current risk management practices, specifically the lack of a collaborative approach. Practically, the development of a context-specific Collaborative Risk Management Framework (CRMF) provided a structure anticipated to offer tangible benefits to key stakeholders, including the Addis Ababa City Road Authority (AACRA), consulting firms, and contracting organizations. By fostering enhanced communication, shared responsibility, and proactive risk mitigation, the developed framework is designed to improve project planning, decision-making, and ultimately, the overall performance of asphalt road construction projects in terms of time, cost, and quality. This, in turn, contributes to more efficient utilization of public funds, enhanced infrastructure durability, and greater stakeholder satisfaction.

Academically, this research has contributed to the body of knowledge in construction engineering and management, particularly in the domain of risk management within developing country contexts. It offered empirical insights into the specific risk factors affecting asphalt road projects in Addis Ababa, quantified their impacts, and identified the critical barriers to implementing collaborative strategies. The developed CRMF, grounded in empirical data and stakeholder perspectives, serves as a model for similar infrastructure projects in comparable urban environments. Furthermore, the study's findings provide a valuable resource for policymakers,

industry practitioners, and researchers seeking to enhance risk management maturity and collaborative practices in the construction sector, thereby contributing to more sustainable and resilient infrastructure development.

1.6 Scope of the Study

This research was specifically focused on developing a collaborative risk management framework tailored to enhance the performance of asphalt road construction projects undertaken within the jurisdiction of Addis Ababa, Ethiopia. The geographical scope was therefore confined to projects located in Addis Ababa, primarily those overseen or implemented by the Addis Ababa City Road Authority (AACRA). The study encompassed projects that were active at the time of data collection as well as those recently completed to ensure a comprehensive understanding of contemporary risk management practices and their outcomes.

Thematically, the scope included the identification and prioritization of risk factors pertinent to asphalt road construction, the assessment of their impact on key project performance dimensions (time, cost, quality, and safety), and an investigation into the barriers hindering the effective implementation of collaborative risk management approaches. Key stakeholders whose perspectives were solicited included professionals from client organizations (AACRA), consulting firms, and contracting companies (both main and subcontractors) directly involved in these projects. The primary deliverable of this research is a structured Collaborative Risk Management Framework (CRMF), outlining principles, processes, stakeholder roles, and critical success factors for its implementation. The study did not extend to other types of construction projects (e.g., building, water infrastructure), nor did it cover road projects outside of Addis Ababa. Furthermore, while financial aspects of risk were considered, detailed financial auditing of specific projects was beyond the scope of this research.

1.7 Limitations of the Study

While this study aimed to provide robust and actionable insights, certain limitations were acknowledged. Firstly, the geographical focus on Addis Ababa means that the findings and the developed framework, while highly relevant to this specific urban context, may not be directly generalizable to other regions within Ethiopia or to different developing countries without

appropriate contextual adaptation and further validation. The unique socio-economic, regulatory, and operational environment of Addis Ababa inherently shaped the research outcomes.

Secondly, the data collection relied on the perceptions, experiences, and willingness of professionals involved in asphalt road construction projects. While a mixed-methods approach was employed to enhance validity through triangulation, the potential for respondent bias, subjectivity in responses, or limitations in recall accuracy were inherent in survey and interview-based research. The sample size, though aimed to be representative of key stakeholders in AACRA projects, was potentially constrained by the availability and accessibility of these professionals, which may have affected the statistical power of some quantitative analyses.

Thirdly, the study focused on developing a framework; its actual implementation and long-term effectiveness would depend on various organizational and contextual factors beyond the direct control of this research. The dynamic nature of the construction industry and external economic conditions also mean that the risk landscape could evolve, which would necessitate periodic review and adaptation of the proposed framework. Finally, the research was conducted within specific time and resource constraints, which limited the depth of investigation into certain peripheral aspects.

1.8 Organization of the Paper

This thesis is structured into five chapters to systematically present the research undertaken and its findings.

Chapter One serves as the introduction, outlining the background of the study, articulating the statement of the problem, and defining the research questions and objectives. It also discusses the significance, scope, and limitations of the study, providing an overall context for the research.

Chapter Two is dedicated to a comprehensive Literature Review. This chapter explores existing knowledge on project risk management, collaborative risk management principles and practices, common risk factors in road construction projects (particularly in developing countries), and key performance indicators. It also reviews existing risk management frameworks and identifies the research gaps that this study aimed to address.

Chapter Three details the Research Methodology employed. This section describes the research design (mixed-methods approach), the study area, the target population and sampling techniques,

and the data collection instruments (questionnaire surveys and semi-structured interviews). It also explains the procedures for data analysis, including quantitative (e.g., RII, correlation) and qualitative (thematic analysis) techniques, and the process undertaken for developing the collaborative risk management framework. Issues of reliability and validity are also addressed.

Chapter Four presents the Results and Discussion. This chapter systematically presents the findings from the quantitative and qualitative data analysis, aligned with the research objectives. It discusses the current risk management practices, the impact of identified risk factors on project performance, and the barriers to collaborative risk management. The development process and components of the proposed collaborative risk management framework are detailed, integrating empirical findings and literature.

Chapter Five provides the Conclusions and Recommendations. This final chapter summarizes the key findings of the study, draws overall conclusions in relation to the research objectives, and discusses the contributions of the research. It also offers practical recommendations for the implementation of the proposed framework by AACRA and other stakeholders, and suggests potential avenues for future research in this area.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Road transport infrastructure plays a crucial role in the physical, socioeconomic, political, and technological advancement of nations, significantly contributing to global gross domestic product (Adetola and Goulding, 2016). It facilitates trade, enables access to essential services, and supports economic growth. However, road construction projects are inherently complex and fraught with risks, particularly in developing countries like Ethiopia, where resources are often limited, and institutional capacity can be weak (Aarthipriya et al., 2020). These risks, if not properly managed, can lead to project delays, cost overruns, and compromised quality, ultimately hindering the intended socioeconomic benefits (Ahmed et al., 2023; Ayalew et al., 2016).

In Ethiopia, the construction industry faces numerous challenges, including inadequate planning and scheduling, poor project management systems, and various risk factors related to labor, materials, equipment, finance, design, and the external environment. Studies have shown that Ethiopian road construction projects often experience significant time and cost overruns, highlighting the urgent need for effective risk management practices (Kassa, 2020).

Recognizing the complexity and multifaceted nature of risks in road construction, there is a growing emphasis on collaborative risk management (CRM) (Marinelli and Salopek, 2019). CRM moves away from traditional, fragmented approaches, where risk is often perceived as the sole responsibility of the contractor, towards a more integrated model that engages all stakeholders: clients, contractors, consultants, and relevant government agencies: in a proactive and cooperative manner. This collaborative approach leverages the collective knowledge, expertise, and resources of stakeholders to enhance risk identification, assessment, and mitigation, ultimately leading to improved project performance (Marinelli and Salopek, 2019; Adetola and Goulding, 2016; Friday et al., 2018).

2.2 Project Risk Management

Risk management is a crucial aspect of project management, aiming to identify, analyze, and respond to potential uncertainties that may impact project objectives (Cagliano et al., 2015;

Eskander, 2018; Iqbal et al., 2015; Marinelli and Salopek, 2019). It involves a systematic process of proactively addressing risks throughout the project lifecycle. The construction industry, characterized by its complex nature, high capital investments, and long durations, is inherently prone to risks. These risks can stem from various sources, including design errors, material price fluctuations, unforeseen site conditions, contractual disputes, and external factors like economic downturns or political instability (Marinelli and Salopek, 2019; Ferede et al., 2020; Belay et al., 2021).

The International Organization for Standardization (ISO) defines risk as "the effect of uncertainty on objectives" (Wubet et al., 2023), a definition that underscores the intrinsic relationship between risk and uncertainty and emphasizes the potential influence on desired project outcomes. To effectively manage these uncertainties, the ISO 31000:2018 standard provides a comprehensive framework characterized by iterative processes.

Initially, Risk Identification involves the systematic identification of potential risks that could affect the project, employing techniques such as brainstorming, expert interviews, the review of historical data, and the analysis of project documents (Aarthipriya et al., 2020; Cheng and Darsa, 2021; Wubet et al., 2023). This thorough identification is fundamental to establishing a comprehensive understanding of the uncertainties surrounding the project. Subsequently, Risk Assessment evaluates identified risks based on their likelihood of occurrence and potential impact, often employing both qualitative and quantitative analysis. Qualitative assessment categorizes risks by severity, while quantitative analysis assigns numerical values to their likelihood and impact (Aarthipriya et al., 2020; Wubet et al., 2023; Boateng et al., 2020; Gain et al., 2022).

Following assessment, Risk Analysis delves deeper into understanding the nature and interdependencies of risks, utilizing techniques like risk matrices, sensitivity analysis, and Monte Carlo simulation to model their potential impact on project objectives such as cost, time, and quality. This analysis facilitates the prioritization of risks based on their overall significance and informs the development of appropriate response strategies (Aarthipriya et al., 2020; Naderpour et al., 2019; Gain et al., 2022). The Risk Response stage then focuses on developing and implementing strategies to address the identified risks, typically categorized as avoidance, mitigation, transfer, and acceptance. The selection of a particular strategy depends on the nature

of the risk, the project context, and stakeholder preferences (Fikru, 2023; Hopkin, 2018; Szymański, 2017).

Finally, Risk Monitoring and Control is an ongoing process that involves tracking identified risks, monitoring the effectiveness of response strategies, and identifying new or emerging risks. This continuous monitoring and control are crucial for ensuring the risk management plan remains relevant and adaptable to evolving project circumstances (Cagliano et al., 2015; Gain et al., 2022; Friday et al., 2018). Ultimately, effective risk management in construction projects is essential for minimizing adverse effects and maximizing opportunities, thereby significantly contributing to overall project success (Ferede et al., 2020).

Assessing the practices of risk management in construction projects is crucial due to the inherent proneness of the construction process to risks (Aarthipriya et al., 2020; Bahamid and Doh, 2017). Risk management is an essential and integral part of project management on all construction projects (Aarthipriya et al., 2020). Without properly understanding and managing these uncertainties, projects can face negative impacts such as cost overruns, schedule delays, and quality deficiencies (Tessema et al., 2022). Furthermore, the literature indicates that in developing countries, the application of risk management is often less popular due to fewer know-how and awareness, resulting in a small track record of successfully handling risks and affecting project goals (Bahamid and Doh, 2017). Therefore, a thorough assessment of current risk management practices is needed to understand the existing level of implementation and identify areas for improvement (Bahamid and Doh, 2017).

Evaluating the current risk management practices allows organizations to gain a more timely, comprehensive, and deeper understanding of the risks that may pose potential threats to project performance (Aarthipriya et al., 2020). This understanding, in turn, facilitates better decision-making and increases confidence in undertaking new ventures or accepting higher levels of risk (Aarthipriya et al., 2020). By assessing the effectiveness of techniques used for risk identification and analysis (Bahamid and Doh, 2017), the clarity and implementation of risk response mechanisms (Bahamid and Doh, 2017; Fikru, 2023), and the presence of a maintained risk register (Gain et al., 2022), organizations can pinpoint weaknesses in their current approaches. Moreover, such assessments can reveal the extent to which risk management strategies are developed and

implemented for identified risk factors (Cheng and Darsa, 2021; Darko et al., 2020; Kumar et al., 2017), providing a basis for targeted improvements.

Failure to assess risk management practices can lead to a reactive and informal approach to dealing with risks, which is prevalent in many industries in developing countries (Bahamid and Doh, 2017). This lack of systematic assessment hinders the ability to prevent unpleasant effects on project participants due to deficiencies in actions aimed at preventing uncertainty and risks. The literature suggests a gap between the theory and actual practice of risk assessment in construction (Bahamid and Doh, 2017). Continuous assessment and re-evaluation of risk management processes are necessary to bridge this gap and ensure that organizations move towards a more proactive and effective risk management culture. As the awareness about risk management is ongoing and there is an intense desire to learn from past mistakes in the construction industry (Bahamid and Doh, 2017), regular assessments are vital for facilitating this learning and driving continuous improvement in risk management practices.

Table 2. 1 Criterion for assessing current risk management practices

Criterion	Source(s)
Existence and application of a systematic risk management process, including risk identification, analysis, evaluation, treatment, and monitoring and control.	Aarthipriya et al., 2020; Bahamid and Doh, 2017
Consideration of risk impact on diverse project objectives (e.g., cost, schedule, quality).	Bahamid and Doh, 2017
Effectiveness of risk identification and analysis techniques used.	Bahamid and Doh, 2017; Iqbal et al., 2015
Clarity and implementation of risk response mechanisms.	Bahamid and Doh, 2017; Fikru, 2023
Consideration of risk across the different lifecycles of construction projects (e.g., pre-construction, construction, post-construction).	Gebrehiwet and Luo, 2023
Presence and quality of a maintained and updated risk register.	Gain et al., 2022

Conducting meetings among stakeholders to identify significant risk factors.	Gain et al., 2022
Provision of training for risk assessment and analysis to relevant parties.	Gain et al., 2022
Effectiveness of preventive risk management techniques, such as proper scheduling and learning from past projects.	Iqbal et al., 2015
Effectiveness of remedial risk management techniques, such as close supervision and coordination.	Iqbal et al., 2015
The extent of contractors' management of risk.	Boateng et al., 2020
The degree to which risk management strategies are developed and implemented for identified risk factors.	Cheng and Darsa, 2021; Darko et al., 2020; Kumar et al., 2017
The level of risk management maturity within the organization.	Nieswaag, 2020
The approach to risk allocation in contracts (e.g., cooperative).	Osipova, 2015
The systematicity of risk identification and classification processes.	Wubet et al., 2023
The degree of integration between risk management and stakeholder management.	Xia et al., 2018
The extent of collaboration in risk assessment processes.	Xue et al., 2024
The level of utilization of Building Information Modeling (BIM) in risk management.	Darko et al., 2020; Zou et al., 2017
The presence and consideration of critical recommended actions to reduce cost overrun and delay, categorized by stakeholder (Client, Consultant, Contractor).	Belay et al., 2021

Understanding and addressing the challenges in project risk management implementation.	Fikru, 2023
Consideration of risk quantification in terms of impact and probability.	Marinelli and Salopek, 2019
Contribution of risk management to effective decision-making and efficient communication.	Maseko, 2021

2.3 Collaborative Risk Management

Collaborative risk management (CRM) is an innovative approach that moves beyond traditional, fragmented risk management methods to foster a more integrated and relationship-focused model. It emphasizes the collective engagement of all stakeholders in the risk management process, advocating for shared responsibility, transparency, and open communication (Osipova, 2015; Maseko, 2021). This paradigmatic shift recognizes that construction projects, particularly in dynamic environments like Addis Ababa, inherently involve multiple stakeholders with diverse perspectives and interests. The success of such projects, especially asphalt road construction which entails significant public investment and social impact, hinges on effectively addressing the complexities arising from these interdependencies (Gebrehiwet and Luo, 2023; Chekol and Henry, 2024; Assefa, 2021).

CRM distinguishes itself from traditional risk management by its emphasis on proactive engagement and shared responsibility. Instead of viewing risk as a compartmentalized concern addressed solely by designated individuals or departments, CRM treats risk as a collective challenge requiring the input and commitment of all stakeholders (Xue et al., 2024; Xia et al., 2018). This approach acknowledges that stakeholders possess unique insights and knowledge about potential risks, their potential impacts, and effective mitigation strategies (Cheng and Darsa, 2021; Boateng et al., 2020).

The benefits of adopting a CRM approach are multifaceted. Firstly, CRM promotes a more comprehensive and robust risk identification process, drawing on the diverse expertise and perspectives of stakeholders. This collaborative approach facilitates the identification of a wider

range of potential risks, including those that might be overlooked using traditional methods (Friday et al., 2018; Maseko, 2021). Secondly, CRM encourages the development of more effective risk mitigation strategies. By engaging stakeholders in open dialogue and shared decision-making, CRM harnesses collective intelligence and creativity to formulate innovative and context-specific mitigation plans (Xia et al., 2018; Marinelli and Salopek, 2019). This shared ownership of the risk management process also fosters a greater sense of accountability among stakeholders, leading to more diligent implementation of mitigation measures (Osipova, 2015).

Moreover, CRM significantly enhances communication and trust among stakeholders, establishing a foundation for more harmonious and productive project relationships. Open and transparent communication channels facilitate the timely sharing of risk-related information, ensuring all stakeholders are well-informed and equipped to contribute meaningfully to risk mitigation efforts. By fostering a culture of trust and mutual respect, CRM reduces the likelihood of adversarial relationships and conflicts, paving the way for more collaborative problem-solving and improved project outcomes (Boateng et al., 2020; Kapogiannis and Sherratt, 2018).

Ultimately, the implementation of CRM in asphalt road construction projects in Addis Ababa has the potential to significantly enhance project performance. By proactively identifying and mitigating potential risks through collaborative engagement, CRM can minimize cost and schedule overruns, improve construction quality, and enhance safety outcomes. Additionally, by fostering strong relationships and open communication, CRM contributes to a more efficient and harmonious project environment, leading to greater stakeholder satisfaction and increased likelihood of project success (Cheng and Darsa, 2021; Gebrehiwet and Luo, 2023).

2.4 Risk Factors in Road Construction Projects

Empirical studies on road construction projects, particularly in developing countries, consistently highlight a multitude of risk factors that can significantly impact project performance. These risks often stem from various sources, encompassing material, labor, equipment, finance, design, project management, and the external environment. In the Ethiopian context, research has underscored the prevalence of these risks, emphasizing their potential to derail project objectives and hinder infrastructure development. Studies conducted in Addis Ababa, the focus of this thesis, have revealed a complex interplay of risk factors that demand comprehensive mitigation strategies.

Material-related risks frequently cited include price fluctuations, supply chain disruptions, and quality issues. These risks are particularly salient in Ethiopia, where the construction industry often relies on imported materials subject to global market volatility and logistical challenges (Ahmed et al., 2023; Tessema et al., 2022). Labor-related risks, such as shortages of skilled labor, low productivity, and labor disputes, also pose significant challenges in Ethiopia. The rapid growth of the construction sector has outpaced the development of a skilled workforce, leading to labor shortages and impacting project schedules and quality (Chekol and Henry, 2024; Iqbal et al., 2015). Equipment-related risks encompass breakdowns, unavailability of specialized equipment, and inadequate maintenance. These risks can disrupt construction operations, leading to delays and cost overruns (Ahmed et al., 2023). Financial risks are particularly acute in developing countries like Ethiopia, where projects often face funding constraints, inflationary pressures, and currency fluctuations (Belay et al., 2021). Ahmed et al. (2023) identified finance as a key factor influencing time overruns in Ethiopian road projects.

Design-related risks, such as errors in design, incomplete designs, and inadequate site investigations, can lead to costly rework, compromise quality, and contribute to project delays (Ahmed et al., 2023; Kivrak and Udan, 2023). Eskander's (2018) study in Egypt highlighted the significance of design risks as a major contributor to project challenges (Aarthipriya et al., 2020). Project management-related risks encompass poor planning, inadequate coordination, and ineffective communication. These risks can exacerbate other project risks, leading to a cascading effect on performance (Ferede et al., 2020; Boateng et al., 2020; Belay et al., 2017).

External environment-related risks are often beyond the control of project stakeholders but can significantly disrupt road construction projects. These include adverse weather conditions, political instability, and changes in government regulations. In Ethiopia, where the political and economic landscape can be volatile, these risks are particularly pertinent (Belay et al., 2021). A study on road construction projects in Ethiopia highlighted the challenges posed by right-of-way issues, inflation, contractor capacity, and scope changes, underscoring the importance of considering the external environment in risk management (Chekol and Henry, 2024).

Table 2. 2 Risk factors in road construction projects

Risk Factor	Source(s)
Inflation and price increases	Belay et al., 2021; Tessema et al., 2022
Inaccurate cost estimates	Belay et al., 2021
Variations and changes in work	Belay et al., 2021; Cheng and Darsa, 2021
Unforeseeable fluctuation in material and labor prices	Belay et al., 2021
Shortage of cash flow / Financial constraints	Wubet et al., 2023; Tessema et al., 2022
Delay in payments	Cheng and Darsa, 2021; Fikru, 2023
Lack of access to foreign currency	Wubet et al., 2023
Economic conditions (currency, exchange rate fluctuation)	Belay et al., 2021; Iqbal et al., 2015
Financial failure of the contractor	Naderpour et al., 2019; Fikru, 2023
Owner bankruptcy	Fikru, 2023
Inadequate planning and scheduling	Wubet et al., 2023; Belay et al., 2021
Poor site management	Belay et al., 2021; Naderpour et al., 2019
Poor communication between project team	Belay et al., 2021
Slow decision making by owner	Tessema et al., 2022; Cheng and Darsa, 2021
Poor coordination within the contractors' team and with other stakeholders	Wubet et al., 2023; Naderpour et al., 2019
Lack of management skill	Assefa, 2021
Poor resource management (labor, materials, equipment)	Belay et al., 2021; Cheng and Darsa, 2021
Corruption and bribery	Iqbal et al., 2015; Cheng and Darsa, 2021; Ferede et al., 2020
Lack of policy and procedures for risk management	Fikru, 2023
Resistance to change and sticking to old ways of doing things	Boateng et al., 2020
Lack of support for risk management from top management	Boateng et al., 2020
Defective design / Design errors	Darko et al., 2020; Iqbal et al., 2015; Tessema et al., 2022
Delay in preparation and approval of drawings	Belay et al., 2021
Incomplete designs	Naderpour et al., 2019
Insufficient inspections on the project site	Naderpour et al., 2019

Changes in scope of work	Belay et al., 2021; Naderpour et al., 2019; Iqbal et al., 2015
Incorrect estimation of time and cost	Naderpour et al., 2019
Shortage of construction materials	Belay et al., 2021; Cheng and Darsa, 2021
Delay in delivery of material and equipment	Cheng and Darsa, 2021
Escalation of material prices	Belay et al., 2021
Poor labor productivity	Naderpour et al., 2019; Cheng and Darsa, 2021
Frequent breakdown of equipment	Wubet et al., 2023
Rework and mistakes	Cheng and Darsa, 2021
Unforeseen site conditions	Naderpour et al., 2019; Iqbal et al., 2015
Adverse weather conditions / Climatic conditions	Iqbal et al., 2015; Abd El-Karim et al., 2017
Accidents on site / Safety risks	Iqbal et al., 2015; Naderpour et al., 2019
Poor quality of work / Quality defects	Tessema et al., 2022; Naderpour et al., 2019
Technology shortage	Naderpour et al., 2019
Delay in possession of site / Delays in acquiring site access (ROW)	Wubet et al., 2023; Tessema et al., 2022
Unavailability of utility at site (electricity, water)	Cheng and Darsa, 2021
Lack of space at site	Naderpour et al., 2019
Difficulty to access the site	Tessema et al., 2022
Political instability / Uncertain political conditions	Tessema et al., 2022; Iqbal et al., 2015
Changes in government laws and regulations / Change in codes and regulations	Iqbal et al., 2015
Social risks	Chekol and Henry, 2024
Environmental risks (pollution, etc.)	Abd El-Karim et al., 2017; Naderpour et al., 2019
Legal Risks	Chekol and Henry, 2024
Lack of peace and security / Rebellion / Terrorism/war threats / Labor strikes, revolutions, riots, protests	Cheng and Darsa, 2021; Wubet et al., 2023
Delay in obtaining permits and approvals	Fikru, 2023
Unpredicted Weather conditions / Precipitation / flood / Earthquake	Abd El-Karim et al., 2017
Force Majeure / Acts of God	Eskander, 2018

2.5 Key Performance Dimensions in Road Construction Projects

Project performance in road construction is a multifaceted endeavor, encompassing several critical dimensions that collectively dictate its success. These dimensions are intricately intertwined, and any deviation in one can significantly impact the others.

Timely completion within the stipulated schedule is paramount (Ahmed et al., 2023). Delays can lead to cost overruns due to prolonged labor costs, equipment rental, and potential penalties for missed deadlines. Moreover, time constraints may necessitate compromises in quality as contractors rush to meet deadlines, potentially leading to subpar materials or inadequate workmanship.

Cost efficiency is another crucial aspect, requiring meticulous budget management and effective cost control measures (Ahmed et al., 2023; Belay et al., 2021). Unforeseen expenses, such as unexpected site conditions or equipment breakdowns, can significantly impact the project's financial viability. Furthermore, cost overruns can necessitate budget reallocations, potentially impacting other critical areas like quality or safety.

Quality assurance is essential to ensure the durability and functionality of the constructed road infrastructure (Assefa, 2021; Belay et al., 2021; Chekol and Henry, 2024; Tesfaye, 2023). Meeting specified technical standards is crucial to withstand traffic loads, environmental pressures, and the test of time. Compromises in quality can lead to premature deterioration, requiring costly maintenance and posing safety risks to road users.

Safety is a paramount concern throughout the entire project lifecycle, encompassing both the construction phase and the operational life of the road (Aarthipriya et al., 2020; Chekol and Henry, 2024; Iqbal et al., 2015). Adequate safety measures are crucial to prevent accidents, injuries, and fatalities among workers and the public. Neglecting safety can result in significant delays, increased costs due to work stoppages and accident-related expenses, and potentially damage the project's reputation and social acceptance.

Sustainability considerations are increasingly important in modern road construction (Chekol and Henry, 2024; Kumar et al., 2017; Tessema et al., 2022). Minimizing environmental impact through measures such as erosion control, waste management, and the use of eco-friendly materials is

crucial. Furthermore, promoting long-term social and economic benefits for the local community is essential for sustainable development.

These dimensions are intricately interrelated, and any deviation in one can significantly impact the others. For instance, delays in project completion (time) often lead to cost overruns and may compromise quality due to rushed work or material substitutions. Similarly, inadequate attention to safety can result in accidents, causing delays, increased costs, and potentially jeopardizing the project's sustainability. Risks inherent in road construction projects can significantly impact all performance dimensions.

2.6 Relationship Between Risks and Performance Dimensions in Road Projects

Construction projects, particularly road infrastructure projects, are inherently susceptible to various risks that can severely impact project performance (Ahmed et al., 2023; Aarthipriya et al., 2020; Gebrehiwet and Luo, 2023). A study conducted in Ethiopia found that cost overruns in road construction projects can range from 1% to 61% (Belay et al., 2021). Another study conducted in Ethiopia found that the construction stage is the riskiest stage of a construction project, with an average schedule delay risk of 38% (Gebrehiwet and Luo, 2023).

Empirical studies consistently underscore the significant impact of various risk factors on project performance in road construction, notably affecting time, cost, and quality outcomes (Belay et al., 2021; Wubet et al., 2023). Research in developing countries, particularly in Ethiopia, reinforces this relationship, emphasizing the urgent need for robust risk management strategies, especially in asphalt road construction projects in Addis Ababa.

A critical performance dimension is time performance, where delays directly escalate project costs, disrupt resource allocation, and negatively impact stakeholder satisfaction (Ahmed et al., 2023; Belay et al., 2021). Several studies have identified key risk factors contributing to project delays. Material-related risks such as price fluctuations and supply chain disruptions are prominent causes, particularly in nations like Ethiopia that rely heavily on imported materials (Ahmed et al., 2023). This dependence on external sources makes projects vulnerable to global market dynamics and logistical challenges, leading to delays. Additionally, labor shortages and disputes further exacerbate time overruns. A study by Ahmed et al. (2023) specifically identified labor as a

significant contributor to time overruns in Ethiopian road projects, highlighting the importance of addressing labor-related challenges.

Equipment breakdowns and unavailability also disrupt construction schedules, causing significant delays (Ahmed et al., 2023). The lack of readily available replacements or repair facilities, especially in developing countries, prolongs downtime and pushes back project completion dates. Financial constraints pose another significant challenge, as funding shortfalls and delayed payments frequently lead to project postponements (Kassa, 2020). This is particularly relevant in developing countries where access to capital and efficient payment systems might be limited. Delays arising from design-related risks requiring rework and revisions further extend project timelines (Belay et al., 2021). Belay et al. (2021) highlighted variations, including design changes and extra work, as a major risk factor causing schedule delays in Ethiopian infrastructure projects. This emphasizes the need for comprehensive planning, thorough design reviews, and effective change management processes to minimize disruptions and maintain project schedules.

External environment-related risks, such as adverse weather conditions and political instability, can also cause unpredictable disruptions and delays (Ahmed et al., 2023). In Ethiopia, for example, road projects in the South Wollo Zone and Dessie City Administration experienced time overruns due to the combined effects of labor, material, equipment, finance, design, and project management-related factors (Ahmed et al., 2023). This example highlights the multifaceted nature of risks and the importance of a holistic approach to risk management.

Another crucial performance dimension impacted by risk factors is cost performance. Cost overruns are a widespread issue in road construction, jeopardizing project feasibility and stakeholder returns (Belay et al., 2021). Research has identified several key contributors to cost escalation. Material price volatility and supply chain disruptions directly impact construction costs (Tessema et al., 2022). Fluctuations in material prices, particularly for imported materials, make it challenging to accurately estimate and control project costs. Labor-related issues, including shortages, low productivity, and wage increases, also contribute to cost overruns (Belay et al., 2021). A shortage of skilled labor often drives up wages, while low productivity can necessitate the hiring of additional workers, increasing labor costs.

Equipment breakdowns and unavailability lead to increased expenses for repairs, rentals, and idle time (Ahmed et al., 2023). The cost of maintaining and repairing construction equipment,

especially in remote locations or when specialized parts are required, can significantly strain project budgets. Financial risks, such as inflation and interest rate fluctuations, can significantly escalate project costs (Belay et al., 2021). High inflation rates erode the purchasing power of budgeted funds, requiring additional financing and potentially leading to cost overruns. Design errors requiring rework are another major source of cost increases (Fikru, 2023). Corrections and modifications, especially those involving structural elements, can necessitate costly demolition and reconstruction. Additionally, inadequate project management practices can result in inefficiencies, rework, and poor resource allocation, all contributing to higher costs (Ferede et al., 2020). Poor planning, scheduling, and oversight can lead to wasted materials, labor, and time, ultimately driving up project expenses.

Quality performance represents the third critical dimension affected by risk factors. Achieving high-quality standards is paramount for road infrastructure, ensuring durability, safety, and functionality. Several risk factors can negatively impact the quality of road construction. The use of substandard materials due to cost constraints or supply chain issues compromises the quality of road construction, leading to premature deterioration, reduced lifespan, and safety concerns (Ahmed et al., 2023). Similarly, shortages of skilled labor can result in workmanship defects and deviations from quality standards (Chekol and Henry, 2024). Inexperienced or inadequately trained workers may make mistakes that compromise structural integrity or aesthetic appeal, leading to costly repairs or even reconstruction.

Inadequate equipment and poor maintenance practices can also lead to construction errors and reduce the lifespan of road infrastructure (Chekol and Henry, 2024; Tessema et al., 2022). Using outdated or poorly maintained equipment can result in inaccurate measurements, improper compaction, and other construction flaws that affect the quality and durability of the road. Financial limitations often necessitate the use of cheaper, lower-quality materials, ultimately affecting the long-term performance of the road (Tessema et al., 2022). Sacrificing quality to stay within budget can have significant long-term consequences, resulting in increased maintenance costs and shorter lifespans for road infrastructure. Design flaws, if not addressed during the planning and design phases, can result in structural deficiencies and compromised functionality. These flaws may manifest as drainage problems, uneven surfaces, or inadequate load-bearing capacity, requiring costly and time-consuming repairs (Tessema et al., 2022).

Furthermore, compressed schedules due to time pressures often lead to rushed work, compromising quality standards⁸. When projects are behind schedule, contractors may prioritize speed over precision, leading to shortcuts and deviations from established quality control procedures. This can result in a lower-quality final product, potentially compromising safety and durability. A study in Gondar City, Ethiopia, highlighted this issue, identifying risk factors like flawed design, poor material quality, subpar work, and delayed payments as significant risks affecting project performance (Chekol and Henry, 2024).

These empirical findings underscore the critical need for effective risk management in road construction projects, particularly in projects like asphalt construction in Addis Ababa. Proactive risk identification, assessment, and mitigation strategies are crucial for minimizing the negative impacts of these risks on project performance. This thesis will address this need by developing a collaborative risk management framework that integrates the perspectives of all stakeholders and incorporates effective mitigation strategies. This framework aims to enhance the performance of asphalt road construction projects in Addis Ababa by proactively addressing potential risks, minimizing delays, controlling costs, and ensuring high-quality outcomes.

2.7 Barriers Hindering the Implementation of Collaborative Risk Management

The effective implementation of collaborative risk management (CRM) in road construction projects, particularly in most developing countries, faces several significant barriers as evidenced by the empirical literature. A primary obstacle is the general lack of awareness, understanding, and adoption of systematic risk management processes within the construction industry of developing countries, including Ethiopia (Bahamid and Doh, 2017; Belay et al., 2017; Wubet et al., 2023). Bahamid and Doh (2017) noted that risk management is a "less popular technique" in developing countries, and there is often a deficiency in actions to prevent uncertainty and risks (). This fundamental lack of a risk-aware culture can inherently impede the adoption of a collaborative approach, as stakeholders may not appreciate its value or possess the necessary knowledge and skills to engage effectively in joint risk identification, analysis, and response (Boateng et al., 2020). Furthermore, decisions on risk management are often based on intuition and past experience rather than formal methods (Bahamid and Doh, 2017).

Another critical barrier is the absence of strong collaborative relationships and a collaborative ethos among project stakeholders. Marinelli and Salopek (2019) highlight the necessity of team integration, common goals, and early stakeholder engagement for successful joint risk management (JRM). However, the literature on Ethiopian construction suggests potential challenges in fostering such an environment. For instance, Assefa (2021) points to issues affecting the success of road projects in Addis Ababa, implying possible fragmentation among stakeholders. Kivrak and Udan (2023) found a "deficient practice of risk management" in Ethiopian Somali Regional State construction projects due to a lack of knowledge or budget, which could further hinder collaborative efforts. The development of trust, open communication, and mutual understanding, identified by Philemon et al. (2018) as crucial enabling factors for collaboration in risk management, may be lacking or underdeveloped in the context of AACRA projects (Philemon et al., 2018).

Contractual frameworks and risk allocation practices can also act as significant impediments to CRM. Adetola and Goulding (2016) emphasize that a fundamental requirement for successful public-private partnerships (PPPs) is the optimal sharing of risks and responsibilities. If contractual agreements do not clearly define roles, responsibilities, and mechanisms for collaborative risk management, stakeholders may be reluctant to engage in joint efforts (Adetola and Goulding, 2016; Philemon et al., 2018). Traditional approaches to risk management in developing countries often involve attempting to avoid or shift risks rather than collaboratively managing them (Bahamid and Doh, 2017). This tendency can create adversarial relationships and undermine the trust necessary for effective CRM. Furthermore, the legal and regulatory framework in Ethiopia, as mentioned by Debela (2018) in the context of insurance in road projects, may not explicitly promote or facilitate collaborative risk management practices (Debela, 2018).

Organizational issues, including a lack of clear communication channels, inconsistent risk management attitudes across different organizational levels, and a failure to integrate risk management into overall project management processes, present further barriers. Xia et al. (2018) argue that a project's risk management ability is not solely determined by the project management team but also by employees at various levels within the involved organizations. Poor risk management attitudes from upper leadership or a lack of risk management culture can significantly hinder the adoption of collaborative approaches (Xia et al., 2018). Boateng et al. (2020) found that risk identification was not always carried out in line with proper risk management processes in

Ghana, highlighting a potential systemic weakness that would impede collaboration. Similarly, Fikru (2023) aims to assess project risk management challenges in Addis Ababa city road construction projects, suggesting that current practices may be inadequate for effective collaboration (Fikru, 2023).

Resource constraints, including financial limitations and a lack of skilled personnel with expertise in collaborative risk management techniques, can also pose substantial challenges. Kivrak and Udan (2023) identified budget constraints as a reason for deficient risk management practices in Ethiopia. The implementation of CRM often requires dedicated time, resources for workshops and meetings, and skilled facilitators capable of fostering collaboration among diverse stakeholders (Xue et al., 2024). If these resources are lacking within AACRA and the participating contracting and consulting firms, the effective adoption of a collaborative framework will be severely hampered. Furthermore, Gebrehiwet and Luo (2023) found that Ethiopian construction projects face a significant average schedule delay risk, indicating underlying inefficiencies and challenges that could be exacerbated by a lack of collaborative risk mitigation strategies (Gebrehiwet and Luo, 2023).

In conclusion, the successful implementation of a collaborative risk management framework for asphalt road construction projects within AACRA is likely to be hindered by a combination of factors. These include a general lack of risk management maturity, the absence of strong collaborative relationships and a collaborative ethos, limitations in existing contractual and regulatory frameworks, organizational deficiencies in integrating risk management, and resource constraints. Addressing these barriers will be crucial for developing and deploying a CRM framework that effectively enhances project performance by leveraging the collective knowledge and capabilities of all stakeholders involved in asphalt road construction in Addis Ababa.

Table 2. 3 Barriers hindering implementation of collaborative risk management

Barrier	Source(s)
Lack of forming team collaboration	Kapogiannis and Sherratt, 2018
Lack of understanding of how to collaborate	Kapogiannis and Sherratt, 2018
Lack of culture of collaboration within parties	Marinelli and Salopek, 2019

Lack of understanding of collaborative relationships	Marinelli and Salopek, 2019
Client's/Contractor's focusing on its own interest	Marinelli and Salopek, 2019
Lack of a party's long-term outlook	Marinelli and Salopek, 2019
The parties' inability to adapt to changes	Marinelli and Salopek, 2019
Client's focusing on strict contractual conditions	Marinelli and Salopek, 2019
Tough economic times result in less use of joint efforts in risk management	Marinelli and Salopek, 2019
Strict funding conditions placed by financial institutions clash with JRM use	Marinelli and Salopek, 2019
The Client's desire to control the project	Marinelli and Salopek, 2019
Contractor's extensive focus on profit	Marinelli and Salopek, 2019
JRM requires significant resource investment	Marinelli and Salopek, 2019
Collaboration in RM requires a formal (contractual) approach	Marinelli and Salopek, 2019
The suitability of JRM use depends on the project's size/scale	Marinelli and Salopek, 2019
Collaboration in RM is only suitable for small projects	Marinelli and Salopek, 2019
Lack of a risk-aware culture	Bahamid and Doh, 2017
Absence of strong collaborative relationships and a collaborative ethos among project stakeholders	Marinelli and Salopek, 2019; Philemon et al., 2018
Inappropriate contractual frameworks and risk allocation practices	Adetola and Goulding, 2016
Lack of clear communication channels	Xia et al., 2018; Boateng et al., 2020
Inconsistent risk management attitudes across different organizational levels	Xia et al., 2018; Boateng et al., 2020
Failure to integrate risk management into overall project management processes	Xia et al., 2018; Boateng et al., 2020
Resource constraints such as financial limitations and a lack of skilled personnel with expertise	Kivrak and Udan, 2023; Gebrehiwet and Luo, 2023

Lack of policy and procedures	Fikru, 2023
Lack of proper risk models	Fikru, 2023
Lack of practical experience and insufficient history	Fikru, 2023
Lack of cooperation and commitment among construction team members	Fikru, 2023
Structure for facilitation	Maseko, 2021
Involvement of people with little or no experience in CRM	Maseko, 2021
Lack of trust and commitment	Philemon et al., 2018

2.8 Risk Management Frameworks for Road Construction Projects

Numerous risk management frameworks have been proposed in the literature, offering a structured approach to identify, assess, and mitigate risks. However, traditional risk management frameworks often fall short in addressing the unique challenges of collaborative environments, particularly in complex infrastructure projects like road construction. This section explores existing risk management frameworks, highlighting those specifically designed for collaborative environments and their applicability to road construction projects in Addis Ababa.

A noteworthy framework for collaborative risk management is the ISO 31000 (Rampini et al., 2019), an international standard providing principles and guidelines for risk management (Cagliano et al., 2015; Darko et al., 2020). Its strengths lie in its comprehensive and systematic approach, emphasizing the importance of context, communication, and stakeholder engagement. However, its generic nature requires tailoring to specific industry contexts, and its implementation in construction projects often faces challenges due to the industry’s fragmented nature and complex stakeholder relationships.

Another notable framework is the Collaborative Engagement Framework for Road Infrastructure Management (CEFRIM) developed specifically for the Nigerian context (Adetola and Goulding, 2016). This framework adopts a pragmatic, mixed-methods approach and emphasizes stakeholder engagement through tools like the “quality function deployment” to determine the correlation

between stakeholder needs and project drivers (Adetola and Goulding, 2016; Adetola, 2014). CEFRRIM'S emphasis on collaboration, shared resources, and mutual benefits offers valuable insights for the proposed framework. However, its contextual limitations require adaptations for the Ethiopian context and the specific challenges of asphalt road construction in Addis Ababa.

Researchers have also proposed risk management frameworks for specific aspects of road construction projects. For example, Cheng and Darsa developed a Construction Schedule Risk Assessment Model (CSRAM) for foreign general contractors in Ethiopia, incorporating an artificial neural network to predict schedule delays (Cheng and Darsa, 2021). This framework's strength lies in its predictive capabilities and its focus on a critical performance dimension - schedule adherence. However, its narrow focus on schedule risks may limit its applicability to a broader risk management framework considering other performance dimensions.

Several studies highlight the importance of stakeholder integration in risk management frameworks (Friday et al., 2018; Xia et al., 2018). Xia et al. conducted a systematic literature review and identified four linkage modes between risk and stakeholder management, highlighting the need for integrating these two areas to enhance project performance. They suggest incorporating stakeholder identification into risk management processes, considering stakeholders' responsibilities and abilities in risk mitigation, and managing stakeholder differences regarding risk perceptions (Xia et al., 2018). These insights are crucial for developing a collaborative risk management framework that effectively addresses the diverse perspectives and interests of stakeholders in road construction projects in Addis Ababa.

Examining case studies of successful collaborative risk management (CRM) implementation provides valuable insights for developing a robust framework for Addis Ababa. For instance, a study of the UK construction sector explored the collaborative ethos necessary for Joint Risk Management (JRM) (Marinelli and Salopek, 2019). The research emphasized the critical role of trust, contractual flexibility, early stakeholder engagement, and strategic alignment in achieving successful JRM implementation (Marinelli and Salopek, 2019). These findings underscore the importance of building strong relationships and fostering a collaborative culture among stakeholders from the project's outset.

Another case study on a Finnish shopping center construction project examined three processes for collaborative risk management: risk workshops, contractor involvement in risk management,

and the utilization of performance feedback for risk management (Lehriranta, 2013). This case study demonstrates the practicality and benefits of incorporating collaborative approaches throughout the project lifecycle, suggesting the importance of regular communication, feedback loops, and continuous improvement in risk management processes.

The insights from these case studies, combined with the analysis of existing risk management frameworks, provide a valuable foundation for developing a collaborative risk management framework tailored to the specific needs of asphalt road construction projects in Addis Ababa. The proposed framework should prioritize stakeholder engagement, communication, and a systematic approach to risk identification, assessment, and mitigation, drawing on the strengths of existing frameworks and successful implementation strategies from relevant case studies.

2.9 Summary of Literature Review

The literature review underscores the vital role of road transport infrastructure in national development and the inherent complexities and risks within construction projects, particularly in developing countries like Ethiopia. These risks frequently lead to significant performance issues such as delays, cost overruns, and compromised quality. Traditional project risk management involves systematic processes for risk identification, assessment, analysis, response, and monitoring. However, the literature indicates that the application and awareness of these systematic processes are often less prevalent in developing countries, resulting in a smaller track record of successfully managing risks and impacting project goals. This highlights the importance of evaluating existing risk management practices to understand their implementation level and identify areas for improvement.

Consequently, there is a growing recognition of the need for Collaborative Risk Management (CRM), which shifts from fragmented approaches to an integrated model engaging all relevant stakeholders, including clients, contractors, consultants, and government agencies. This collaborative approach is seen as crucial for enhancing risk identification, assessment, and mitigation by leveraging collective knowledge, expertise, and resources. CRM fosters shared responsibility, improves communication and trust among parties, and ultimately leads to enhanced project performance by reducing adversarial relationships and promoting collaborative problem-solving.

The review also details specific risk factors frequently encountered in road construction projects, categorized broadly into areas such as material, financial, design, project management, and external environment risks. These factors have been empirically shown to have detrimental impacts on key project performance dimensions: time (schedule delays), cost (cost overruns), quality (defects), and safety (accidents and hazards). Studies focusing on Ethiopia and Addis Ababa specifically point to risks like price fluctuations, financial constraints, design issues, poor site management, equipment breakdown, and safety concerns as particularly impactful.

Furthermore, the literature identifies several significant barriers hindering the effective implementation of collaborative risk management. Evidenced by various studies, these obstacles include a general lack of awareness and adoption of systematic risk management processes, particularly in developing countries. Crucially, cultural and relational factors such as the absence of strong collaborative relationships, lack of trust and commitment, poor communication, and the tendency for parties to focus solely on individual interests are highlighted as prominent barriers. Technical, contractual, and resource constraints also contribute to these challenges.

Finally, the literature explores existing risk management frameworks, noting standards like ISO 31000 and context-specific frameworks such as CEFIM developed for road infrastructure. While these provide structured approaches, their applicability often requires tailoring to specific contexts, and they may not fully address the complexities of collaborative environments and diverse stakeholder dynamics. The importance of integrating stakeholder management with risk management is emphasized to enhance project performance. Case studies suggest critical success factors for collaborative risk management include trust, contractual flexibility, early stakeholder engagement, and strategic alignment. This body of literature collectively establishes the significance of risk management and collaboration in road construction, details common risks and their impacts, identifies key implementation barriers, and reviews existing frameworks, thereby highlighting the research gaps related to a context-specific collaborative risk management framework for asphalt road construction projects in Addis Ababa.

2.10 Research Gaps

Based on the preceding literature review and the subsequent outline of the study's methodology and results, several key research gaps within the context of asphalt road construction projects in Addis Ababa were identified. While the vital role of road transport infrastructure for national

development and the inherent complexities and risks in construction projects, particularly in developing countries, are acknowledged in the literature, existing risk management practices in Ethiopia have often been found inadequate, leading to significant performance issues like delays and cost overruns. A critical deficiency highlighted was the limited understanding regarding the underlying structure of these risks, their specific impact on crucial project performance dimensions (time, cost, quality, safety), and the barriers hindering effective risk management, particularly within the precise context of asphalt road construction projects in Addis Ababa. This pointed to a need for a more nuanced, context-specific investigation.

Furthermore, a significant gap was the prevalent lack of a collaborative approach in existing risk management practices within the Ethiopian construction industry, resulting in fragmented risk mitigation efforts and limited stakeholder engagement. The literature underscores the importance of a collaborative framework involving clients, contractors, and consultants for effective risk management across the project lifecycle. However, there was an identified absence of a context-specific collaborative risk management framework tailored to the unique risks and stakeholder dynamics inherent in asphalt road construction projects within Addis Ababa. Prevailing practices often relied on generic approaches that did not adequately address these local specificities, which could compromise project performance through inadequate risk identification and ineffective mitigation.

The current study directly addresses these identified gaps through its defined objectives and methodological approach. The general objective was to develop a collaborative risk management framework specifically for enhanced performance of asphalt road construction projects in Addis Ababa. To achieve this, the study pursued specific objectives aimed at assessing current risk management practices, quantifying the impact of identified risk factors on time, cost, quality, and safety, and identifying and prioritizing the barriers hindering the implementation of collaborative risk management. By employing a mixed-methods research design, starting with a quantitative assessment followed by qualitative exploration, the study gathered empirical data on current practices, stakeholder perceptions of risk impacts, and the nature and significance of barriers to collaboration within the Addis Ababa context.

Consequently, the key contributions of this research are multifaceted. Firstly, it provides empirical insights grounded in specific data from asphalt road construction projects in Addis Ababa

concerning current risk management practices, identifying both moderately implemented core strategies and significantly less implemented systematic or advanced techniques. Secondly, it quantifies the perceived impact of a wide range of risk factors on specific project performance dimensions (time, cost, quality, safety), identifying and prioritizing those most critical in this context, such as financial/economic risks, site management issues, equipment breakdown, and safety accidents. Thirdly, the study identifies and prioritizes the specific barriers hindering collaborative risk management in this environment, emphatically highlighting the dominance of cultural and relational factors like lack of risk-aware culture, trust, clear communication, and tendency for self-interest, over purely technical or procedural obstacles.

Finally, and as its primary practical contribution, the research develops a context-specific Collaborative Risk Management Framework (CRMF) that is directly synthesized from these empirical findings and incorporates valuable stakeholder input. This framework, built on principles such as transparency, trust-building, and shared responsibility, aims to counteract the identified barriers and provide a structured, proactive, and collaborative approach for managing risks throughout the project lifecycle in Addis Ababa. This empirically grounded and contextually tailored framework serves as a valuable resource for policymakers, industry practitioners (AACRA, consultants, contractors), and researchers, contributing to both the academic body of knowledge in construction management in developing countries and offering a practical model for enhancing risk management maturity and improving project performance in similar urban environments.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter delineates the systematic methodology employed to investigate the development of a collaborative risk management framework for enhanced performance of asphalt road construction projects in Addis Ababa. It provides a comprehensive account of the research design and approach, describes the study area, details the population and sampling techniques, outlines the data collection instruments and procedures, and explains the data analysis techniques utilized. The chapter further elaborates on the development process of the proposed collaborative risk management framework and addresses the reliability and validity of the study, thereby establishing the rigor underpinning the research process and its findings.

3.2 Study Area

The geographical context for this research is Addis Ababa, the capital and largest city of Ethiopia. The selection of Addis Ababa as the study area is strategically pertinent to the research objectives, given its status as a major hub of economic and infrastructural development within the country. As a rapidly urbanizing metropolitan center, the city experiences a continuous and pressing demand for the development, maintenance, and enhancement of its asphalt road infrastructure to accommodate burgeoning economic activities, population growth, and social needs. This dynamic environment, characterized by numerous ongoing and recently completed asphalt road construction projects undertaken by entities such as the Addis Ababa City Road Authority (AACRA), provides a rich and relevant setting for investigating current risk management practices, their impacts, and the potential for implementing collaborative frameworks. Figure 3.1, referenced from Ethio GIS (2022), presents a map illustrating the administrative boundaries and key features of Addis Ababa, providing a visual representation of the geographical scope of this investigation.

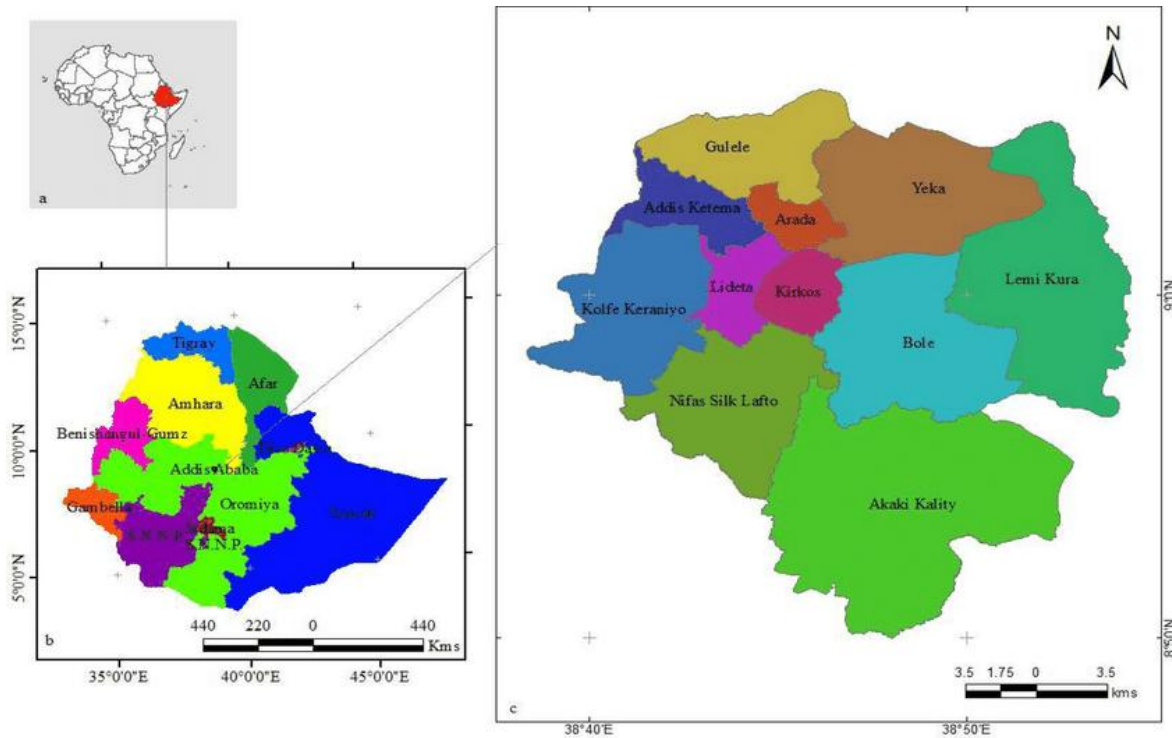


Figure 3. 1 Study map of Addis Ababa, Ethiopia (Ethio GIS, 2022)

3.3 Research Design and Approach

This study adopted a mixed-methods research design, specifically employing a sequential explanatory strategy. This methodological paradigm was selected for its capacity to provide a comprehensive and nuanced understanding of the complexities surrounding collaborative risk management in asphalt road construction projects within Addis Ababa. The research commenced with a quantitative phase, involving the administration of structured questionnaire surveys to a broad range of industry professionals. This initial phase aimed to identify prevailing risk management practices, quantify the perceived impact of various risk factors on project performance dimensions (time, cost, quality, and safety), and prioritize the barriers hindering the implementation of collaborative approaches.

Following the analysis of the quantitative data, a qualitative phase was undertaken. This involved conducting semi-structured interviews with a purposefully selected subset of experienced professionals who participated in the initial survey, as well as other identified experts. The primary objective of this qualitative phase was to elaborate upon, explain, and provide deeper contextual insights into the statistical findings from the survey. It allowed for an in-depth exploration of the

underlying reasons for observed trends, the practical manifestations of risks and barriers, and the solicitation of expert opinions regarding the essential components of an effective collaborative risk management framework. By systematically integrating the breadth of the quantitative findings with the depth of the qualitative insights, this sequential explanatory approach facilitated a robust interpretation of the data, forming a solid empirical basis for the development of the proposed context-specific collaborative risk management framework tailored to projects under the Addis Ababa City Road Authority (AACRA).

3.4 Population and Sample Size

The target population for this research encompassed professionals actively engaged in asphalt road construction projects under the purview of the Addis Ababa City Road Authority (AACRA). This included personnel from client organizations (AACRA), consulting firms, and contracting companies (both main contractors and subcontractors), as well as other relevant stakeholders such as representatives from other government agencies interacting with AACRA projects, suppliers, and individuals from research institutions with direct experience or insight.

The study focused on a defined set of 59 asphalt road construction projects. This portfolio comprised 22 active new construction projects being executed with in-house resources, 8 active maintenance projects, and 29 recently completed projects (i.e., those finalized within the past four years). Given the relatively small and definable number of these specific projects, a census approach was deemed appropriate for project consideration, thereby negating the need for statistical sample size calculations for project selection. Data were collected from 54 key respondents who were directly involved in, or possessed significant knowledge of, these 59 projects. This cohort of respondents was considered representative of the professional expertise and experience across the identified project portfolio, providing a comprehensive dataset for the study.

3.5 Sampling Techniques

Consistent with the census approach adopted for the project portfolio, the selection of projects did not involve probabilistic sampling techniques; rather, the aim was to gather data pertaining to the entirety of the 59 identified active and recently completed asphalt road projects under AACRA.

For the selection of the 54 respondents participating in the quantitative survey phase, a purposive sampling technique was employed. Professionals were identified and targeted based on their direct involvement and experience with the specified AACRA asphalt road construction projects and their roles within key stakeholder organizations (client, consultant, contractor). This ensured that the collected data originated from individuals possessing relevant and firsthand knowledge pertinent to the research objectives.

For the subsequent qualitative phase, participants for the semi-structured interviews were selected purposively from the pool of survey respondents who had indicated their willingness to participate further. This selection was augmented by identifying additional key informants through professional networks, ensuring a diverse representation of stakeholder perspectives (e.g., from AACRA, consulting firms, and contracting companies) and substantial experience in the domain. This purposive selection strategy for the interviews was critical for obtaining rich, in-depth qualitative data to explain and contextualize the survey findings, and to gather expert input for the development of the collaborative risk management framework.

3.6 Data Collection Instruments

To achieve the objectives of this research, a mixed-methods approach was employed, necessitating the use of multiple data collection instruments. These instruments were carefully designed to gather both quantitative and qualitative data, providing a comprehensive understanding of collaborative risk management in asphalt road construction projects within Addis Ababa. The primary instruments utilized were a structured questionnaire survey and semi-structured interviews. The questionnaire was designed to capture a broad range of perceptions regarding current risk management practices, the impact of various risk factors, and the barriers to collaborative risk management. The semi-structured interviews were subsequently used to delve deeper into the findings from the questionnaire, providing richer context, explanations, and nuanced perspectives from experienced professionals. The development and application of these instruments are detailed in the subsequent subsections.

3.6.1 Sources of Data

The data for this study were primarily sourced from professionals actively engaged in asphalt road construction projects under the purview of the Addis Ababa City Road Authority (AACRA). These

primary sources comprised individuals from a spectrum of stakeholder organizations integral to the project lifecycle. Among these were Client Representatives, specifically professionals from AACRA itself who are involved in project planning, oversight, and management. Additionally, data were gathered from consultants, encompassing engineering and management consultancy firms that provide design, supervision, and advisory services on AACRA projects. Contractors, including both main contractors and subcontractors responsible for the physical execution of asphalt road construction works, also constituted a key informant group. Finally, contributions were sought from Other Relevant Stakeholders, a category that included professionals from other government agencies interacting with AACRA projects and, to a lesser extent, suppliers or individuals from research institutions who possessed direct experience or insight into these specific projects.

The selection of these diverse sources was crucial to ensure a holistic view of risk management practices, impacts, and collaborative dynamics. Their direct experience and varied organizational perspectives provided the rich dataset necessary to identify common challenges and develop a contextually relevant collaborative risk management framework. Secondary data, primarily from existing literature, including academic journals, conference proceedings, books, and relevant industry reports, formed the basis for identifying initial risk factors, management practices, and collaborative barriers, which were then validated and contextualized through the primary data collection.

3.6.2 Questionnaire Survey

A structured questionnaire survey was the primary instrument for collecting quantitative data for this research. The purpose of the questionnaire was to systematically gather information from a relatively large sample of professionals regarding: (1) the extent of implementation of current risk management practices, (2) the perceived impact of various risk factors on project performance dimensions (time, cost, quality, safety), and (3) the significance of barriers hindering collaborative risk management.

The questionnaire was meticulously designed and structured into five distinct sections, each targeting specific aspects of the research. The initial section, Section A (Respondent's Profile), collected comprehensive demographic and professional background information, encompassing current role, type of organization, years of experience in both general construction and specifically

in asphalt road projects, highest educational qualification, and familiarity with formal risk management and collaborative approaches; this information was instrumental in understanding the sample characteristics and contextualizing the findings. Subsequently, Section B (current risk management practices) assessed the extent to which 23 distinct risk management practice criteria, derived from established literature as referenced in Table 2.1 of the literature review chapter, were implemented, utilizing a 5-point Likert scale ranging from 1 (Very Low Extent / Never Applied) to 5 (Very High Extent / Always Applied).

The third part, Section C (impact of risk factors on project performance), evaluated the perceived negative impact of 52 potential risk factors, also derived from literature, on four project performance dimensions: time (schedule delay), cost (cost overrun), quality (defects/non-compliance), and safety (accidents/hazards), employing a 5-point Likert scale from 1 (negligible impact) to 5 (critical impact) with an option for "NA = not applicable / no experience." In Section D (barriers to collaborative risk management), respondents identified and prioritized 30 potential barriers, drawn from literature as referenced in Table 2.3, to implementing collaborative risk management, again using a 5-point Likert scale ranging from 1 (not a barrier) to 5 (critical barrier). Finally, section e (suggestions and open-ended questions) provided an opportunity for respondents to offer qualitative insights, list top critical risks, and suggest improvements or key elements pertinent to the proposed framework.

Before full-scale administration, the questionnaire was pilot-tested with a small group of experienced construction professionals (not part of the final sample) to assess its clarity, comprehensiveness, relevance of questions, and the time required for completion. Feedback from the pilot test was used to refine the instrument, ensuring that questions were unambiguous and the terminology was appropriate for the target respondents. The final questionnaire was then distributed to professionals identified through AACRA, consulting firms, and contracting companies involved in asphalt road projects in Addis Ababa. Ethical considerations, including ensuring voluntary participation, anonymity, and confidentiality of responses, were strictly adhered to, as outlined in the introductory part of the survey instrument.

3.6.3 Semi-structured Interviews

To complement the quantitative data from the questionnaire survey and to gain deeper insights into the complexities of collaborative risk management, semi-structured interviews were conducted.

This qualitative instrument aimed to explore the underlying reasons for the observed trends in the survey data, understand the contextual nuances of risk management practices and barriers, and gather expert opinions on the essential components of a practical collaborative risk management framework.

To ensure consistency across interviews while simultaneously allowing the necessary flexibility for probing emergent themes, an interview guide was meticulously developed. The structure of this guide was carefully aligned with the key research objectives, prominent themes identified from the comprehensive literature review, and the insights gleaned from the initial analysis of survey responses.

The guide commenced with an introductory section, which served to explain the purpose of the interview, outline pertinent ethical considerations, such as confidentiality, voluntary participation, and permission for recording, and clearly state the expected duration of the discussion. Subsequent sections were dedicated to exploring current risk management practices (Objective 1), involving a detailed discussion of the survey findings regarding the implementation levels of various practices, the underlying reasons for their high or low adoption, and existing hurdles to improvement. The guide then proceeded to address the impact of risk factors on project performance (Objective 2), wherein interviewees were prompted to elaborate on the most impactful risks identified in the survey, their practical manifestations, and the perceived effectiveness of current management approaches. Following this, a section focused on barriers to collaborative risk management (Objective 3), thoroughly exploring the nature of cultural, relational, and practical obstacles and how these typically manifest in real-world project environments.

A significant portion of the guide was then devoted to the development of a collaborative risk management framework (Objective 4); this involved eliciting specific suggestions from participants regarding critical risks to prioritize, essential processes and tools, key underlying principles, practical implementation mechanisms, appropriate stakeholder roles, and critical success factors integral to the proposed new framework. Finally, the interview concluded by allowing for any final comments from the interviewee and expressing gratitude for their valuable participation and insights.

Participants for the semi-structured interviews were selected purposively from the pool of survey respondents who indicated willingness to participate further, or were identified through

professional networks as having significant experience and diverse perspectives. The selection aimed to include a representative mix of stakeholders (from AACRA, consulting firms, and contracting companies) with substantial experience in asphalt road construction projects in Addis Ababa. Interviews were conducted either face-to-face or via online conferencing tools, depending on the preference and availability of the interviewee, and typically lasted between 45 to 60 minutes. With informed consent from each participant, interviews were audio-recorded to ensure accurate transcription and facilitate thorough thematic analysis. This qualitative approach allowed for rich, detailed narratives that were invaluable in interpreting the quantitative results and in shaping the proposed collaborative risk management framework.

3.7 Data Analysis Techniques

This section delineates the systematic procedures employed for analyzing the data collected through the mixed-methods research approach adopted in this study. The analysis aimed to transform raw data into meaningful insights to address the research objectives and answer the research questions. Consistent with the sequential explanatory research design, quantitative data analysis was conducted first, followed by qualitative data analysis, which served to elaborate, clarify, and provide deeper contextual understanding of the initial quantitative findings. The combined analytical outcomes then informed the development of the proposed collaborative risk management framework. Both Microsoft Excel and Python programming, executed within the Google Colab environment, were utilized to facilitate various stages of data processing, computation, and analysis.

3.7.1 Quantitative Data Analysis

The quantitative data, primarily gathered through the structured questionnaire survey, underwent a rigorous analytical process to identify patterns, relationships, and priorities concerning risk management practices, risk factor impacts, and barriers to collaboration.

Initially, descriptive statistics were computed using Microsoft Excel and Python libraries (such as Pandas) to characterize the sample. This involved calculating frequencies and percentages for respondents' demographic and professional background information, including their primary role, organization type, years of experience in construction and asphalt road projects, highest educational qualification, and familiarity with risk management concepts, as detailed in Section

4.2. This step was crucial for understanding the composition of the sample and contextualizing the subsequent findings.

For the assessment of current risk management practices (Objective 1), the impact of risk factors on project performance (Objective 2), and the barriers hindering collaborative risk management (Objective 3), data obtained from Likert-scale questions were analyzed using the Relative Importance Index (RII) and Standard Deviation (SD). The RII was calculated for each item (practice, risk factor, or barrier) using the formula: $RII = \Sigma W / (A * N)$, where W is the weighting given to each response by the respondent (ranging from 1 to 5), A is the highest weight (i.e., 5), and N is the total number of respondents. This index provided a standardized measure to rank the items based on their perceived importance or extent of implementation, allowing for prioritization. Standard Deviation (SD) was calculated for each item using Python's Pandas library to measure the dispersion or consensus among respondents' ratings. Items were then ranked primarily based on their RII values in descending order; in cases of tied RII values, a lower SD (indicating higher consensus) resulted in a higher rank. These calculations were performed systematically using Python scripts in Google Colab.

Specifically for Objective 2, the impact of 52 potential risk factors on four project performance dimensions (Time, Cost, Quality, and Safety) was analyzed. RII and SD were calculated for each risk factor's impact on each individual dimension. Subsequently, an aggregated RII and an aggregated SD were computed for each risk factor by averaging its respective RII and SD values across the four performance dimensions. This provided an overall measure of each risk factor's perceived negative impact on project performance, as presented in Section 4.4.1.

Furthermore, to explore the interrelationships between the perceived impacts of risks on different performance dimensions, a Pearson correlation coefficient analysis was conducted. This analysis, performed using Python (Scipy library), examined the correlation between the overall impact scores for each of the four dimensions (Time, Cost, Quality, Safety). The resulting correlation matrix, visualized as a heatmap (see Figure 4.1), offered insights into how negative impacts on one dimension tended to associate with impacts on others, as discussed in Section 4.4.3.

The selection of these quantitative techniques was justified by their suitability for summarizing and prioritizing Likert-scale data (RII, SD, ranking) and for exploring relationships between variables (Pearson correlation). These methods enabled a structured and objective assessment of

the quantitative data, forming the foundation for subsequent qualitative exploration and framework development.

3.7.2 Qualitative Data Analysis

Qualitative data were collected through semi-structured interviews with 11 industry professionals to provide depth, context, and explanatory power to the quantitative findings. The analysis of this rich narrative data followed a systematic thematic analysis approach, a method well-suited for identifying, analyzing, and reporting patterns (themes) within qualitative data.

The process commenced with the verbatim transcription of the audio-recorded interviews. This was followed by an iterative process of data familiarization, where transcripts were read multiple times to gain a thorough understanding of the content. The subsequent step involved systematic coding of the data. Initial codes were generated by identifying segments of text relevant to the research questions and objectives, capturing key concepts, experiences, and opinions expressed by the interviewees. This coding was facilitated by careful review of the "Summarized Interview Results" document (presented as an appendix and referenced in Section II of Chapter 1 of this thesis), which itself represents an initial stage of synthesizing interview content.

Once initial coding was completed, codes were collated and grouped based on similarity and conceptual linkage to develop broader themes. These emergent themes were then reviewed, refined, and clearly defined to ensure they accurately represented the dataset and addressed the research objectives. For instance, themes emerged around the reactive nature of current risk management, the underlying reasons for the low implementation of advanced practices (e.g., skills gaps, cost perceptions for BIM), the critical nature of cultural and relational barriers to collaboration (e.g., lack of trust, self-interest), and specific suggestions for a collaborative framework. The "Summarized Interview Results" document (found in the initial pages of the provided OCR) illustrates how direct quotes and synthesized expert opinions were used to elaborate on survey findings, such as the moderate implementation of core strategies versus low implementation of advanced practices.

The qualitative analysis was instrumental in explaining the 'why' behind the quantitative results, validating the survey findings, and gathering nuanced expert opinions and practical suggestions that were crucial for the development of the collaborative risk management framework. This

approach ensured that the rich contextual understanding derived from stakeholder experiences was systematically integrated into the research outcomes.

3.8 Development of a Collaborative Risk Management Framework

The development of the Collaborative Risk Management Framework (CRMF), as detailed in Section 4.6 and visualized in Figure 4.2, was an evidence-based process, meticulously designed to bridge the research findings to practical solutions for asphalt road construction projects under the Addis Ababa City Road Authority (AACRA). This process involved a comprehensive synthesis of the quantitative data analyses, the rich qualitative insights derived from expert interviews, and established principles from the existing literature on risk management and collaborative practices in construction. Python programming (Google Colab) and Microsoft Excel were instrumental in organizing, analyzing, and synthesizing the large datasets that informed the various components of the framework.

The framework's architecture was built upon several foundational pillars and guiding principles (Section 4.6.2), such as proactive and continuous engagement, shared understanding, transparency, trust-building, and clear roles, which were directly derived from or strongly supported by both the qualitative interview data (see "Summarized Interview Results") and established best practices. These principles were specifically chosen to counteract the dominant cultural and relational barriers identified in Section 4.5.

The core components and sequential stages of the Collaborative Risk Management Framework (CRMF), as detailed in Section 4.6.3, were meticulously designed to directly address the identified gaps in current risk management practices (Section 4.3) and to provide robust mechanisms for managing the high-impact risks identified in Section 4.4. The initial phase, Stage 1 (Collaborative Framework Initiation and Planning), was specifically conceived to tackle fundamental issues such as the lack of forming effective team collaboration structures at the project's outset (Barrier D1), and furthermore, it aims to proactively foster a crucial risk-aware culture among stakeholders (Barrier D17) while beginning to build initial trust (Barrier D30). Building upon this foundation, Stage 2 (Joint Risk Identification and Qualitative Analysis) directly confronts the observed low systematicity of current risk identification practices (Practice B16) by mandating structured joint workshops and the development of a shared, live risk register, thereby also creating an avenue for

considering the integration of Building Information Modeling (BIM) for risk visualization (Practice B19) where capacity allows.

Subsequently, Stage 3 (Collaborative Quantitative Risk Analysis and Response Planning) focuses on the development of joint mitigation strategies, particularly targeting the top prioritized risks that were identified as most impactful in Objective 2; this stage emphasizes a shift from mere identification to active, collaborative response planning. The continuous and adaptive nature of the risk management process is then ensured by Stage 4 (Joint Risk Monitoring, Control, and Review), which establishes mechanisms for ongoing oversight and adjustment. Complementing these sequential stages, an overarching element of Capacity Building & Facilitation was incorporated, designed to address potential knowledge gaps and the recognized need for skilled facilitation (Barrier D28), particularly considering the varied levels of familiarity with collaborative approaches observed among stakeholders (Section 4.2.7).

Defined stakeholder roles and responsibilities within the CRMF (Section 4.6.4) and the critical success factors for its adoption (Section 4.6.5) were also synthesized from interviewee suggestions and literature. The visualization of the framework (Figure 4.2) aimed to provide a clear, conceptual, and structural overview of its interconnected components and process flow. The use of Python and Excel facilitated the systematic handling of survey data (RII rankings of risks, practices, barriers) and thematic coding of interview responses, allowing for an integrated approach where quantitative priorities directly informed the focus areas of the qualitative-driven framework design. This ensured the CRMF is not only theoretically sound but also practically grounded in the specific context and challenges of Addis Ababa's asphalt road construction projects.

3.9 Reliability and Validity of the Study

Ensuring the trustworthiness and rigor of the research findings necessitated careful attention to both the reliability and validity of the data collection instruments and analytical procedures employed in this mixed-methods study.

3.9.1 Reliability

The reliability of the quantitative data, pertaining to the consistency and stability of measurements derived from the structured questionnaire survey, was rigorously assessed. To evaluate the internal

consistency of the multi-item Likert scales employed within the survey, Cronbach's alpha (α) coefficients were calculated for each distinct section using Microsoft Excel. For Section B, "Current Risk Management Practices," which comprised 23 items, the analysis yielded a Cronbach's alpha of 0.88. The scales within Section C, "Impact of Risk Factors on Project Performance," which assessed impacts across four performance dimensions (Time, Cost, Quality, and Safety) using 52 items for each dimension, also demonstrated strong internal consistency: Impact on Time Performance ($\alpha = 0.92$), Impact on Cost Performance ($\alpha = 0.91$), Impact on Quality Performance ($\alpha = 0.89$), and Impact on Safety Performance ($\alpha = 0.90$).

Furthermore, Section D, "Barriers to Collaborative Risk Management," consisting of 30 items, yielded a Cronbach's alpha of 0.87. As all calculated alpha values substantially exceeded the widely accepted threshold of 0.70, these results indicate a high degree of internal consistency among the items within each respective scale. This suggests that the survey instrument reliably measured the intended underlying constructs, namely the extent of risk management practice implementation, the perceived impact of risk factors, and the perceived significance of barriers to collaboration.

Table 3. 1 Reliability analysis of survey scales using Cronbach's Alpha

Survey Section / Scale	No. of Items	Cronbach's Alpha (α)
Section B: Current Risk Management Practices	23	0.88
Section C: Impact of Risk Factors on Project Performance		
- Impact on Time Performance	52	0.92
- Impact on Cost Performance	52	0.91
- Impact on Quality Performance	52	0.89
- Impact on Safety Performance	52	0.90
Section D: Barriers to Collaborative Risk Management	30	0.87

3.9.2 Validity

Validity, concerning the extent to which the study accurately measures what it intends to measure, was addressed through several strategies. Content validity of the questionnaire was established by grounding the items directly in an extensive review of pertinent academic literature and established risk management principles, as detailed in Chapter 2 (and referenced in Tables 2.1, 2.2, and 2.3). Furthermore, the instrument underwent a pilot test with experienced construction professionals, whose feedback informed refinements to enhance clarity, relevance, and comprehensiveness.

Construct validity is supported by the theoretical underpinning of the measured concepts derived from established literature in construction risk management and collaborative practices. For the qualitative data, credibility was pursued through purposive sampling, selecting interviewees with significant, relevant experience in asphalt road construction projects within Addis Ababa, representing diverse key stakeholder perspectives (client, consultant, contractor). The sequential explanatory design inherently promoted validity through triangulation, whereby qualitative findings were used to elaborate, confirm, and provide deeper contextual understanding of the initial quantitative results. This convergence between the quantitative data (identifying what and how much) and the qualitative data (explaining why and how) strengthens the overall trustworthiness and validity of the research conclusions and the subsequently developed framework.

Collectively, these measures were implemented to ensure that the study's findings are both dependable and accurately reflect the phenomena of collaborative risk management within the context of asphalt road construction projects in Addis Ababa.

3.10 Ethical Considerations

The conduct of this research was meticulously guided by established ethical principles to ensure the protection and respect of all participants involved. Central to this was the principle of voluntary participation, ensuring all individuals were fully informed about the study's purpose, procedures, and their rights before agreeing to take part, as outlined in the introductory sections of both the survey instrument and the interview guide. Confidentiality and anonymity were rigorously maintained throughout the research process. For the qualitative interview phase, explicit permission was sought and obtained for audio recording, with assurances that these recordings would be used solely for research transcription and analysis and handled with utmost discretion.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the empirical findings from developing a Collaborative Risk Management Framework (CRMF) to enhance asphalt road construction project performance under the Addis Ababa City Road Authority (AACRA). It analyzes data to address gaps in understanding current practices, risk impacts, and collaborative barriers, culminating in a proposed context-specific framework.

The chapter systematically addresses four key research objectives: (1) assessing current risk management practices in Addis Ababa; (2) quantifying risk factor impacts on project performance (time, cost, quality, safety); (3) identifying and prioritizing barriers to collaborative risk management; and (4) developing the CRMF based on these findings. Results are derived from a mixed-methods sequential explanatory design (see Chapter 3), integrating quantitative survey data with qualitative expert interview insights to enrich understanding.

Accordingly, Section 4.2 details respondent demographics. Section 4.3 assesses current risk management practices (Objective 1). Section 4.4 analyzes risk factor impacts (Objective 2). Section 4.5 examines barriers to collaboration (Objective 3). Finally, Section 4.6 synthesizes these findings to propose the CRMF (Objective 4), representing the study's primary practical contribution.

4.2 Respondent Profile

This section details the profiles of the survey participants. Understanding these characteristics is crucial for contextualizing the study's findings and assessing the representativeness of the sample in relation to the target population involved in asphalt road construction projects in Addis Ababa. The profile includes information on the respondents' primary roles, organizational affiliations, years of experience in the construction industry and specifically with asphalt road projects, educational qualifications, and their familiarity with formal risk management concepts and collaborative approaches.

4.2.1 Current Primary Role/Position of Respondents

The diverse professional engagement of respondents in asphalt road construction projects is a key aspect of this study, ensuring a wide spectrum of perspectives. To capture this, participants were asked to identify their current primary role or position. The distribution of these roles is presented in Figure 4.1.

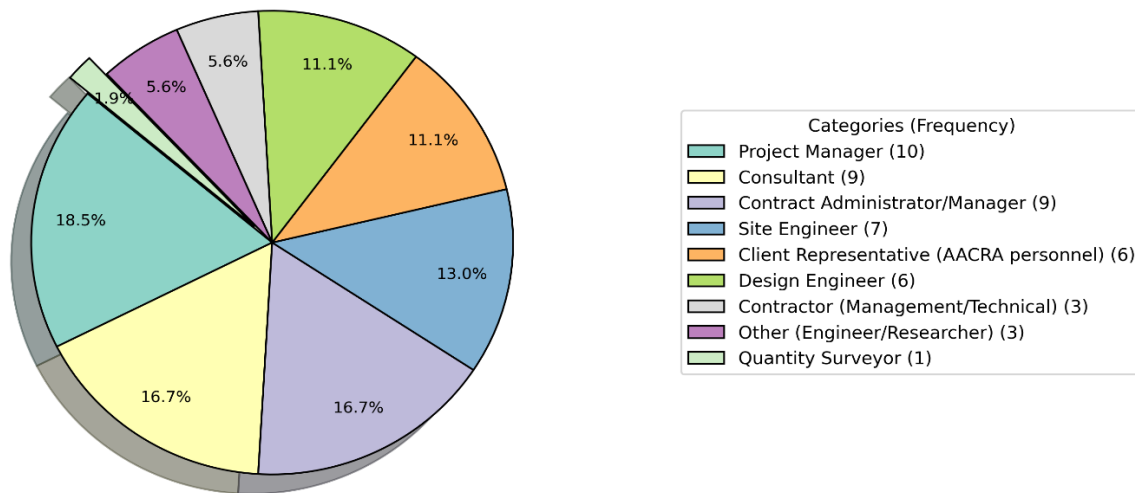


Figure 4. 1 Distribution of respondents by primary role/position

The data in Figure 4.1 indicates that Project Managers constituted the largest group of respondents, accounting for 18.52% of the sample. This was closely followed by Consultants and Contract Administrators/Managers, each representing 16.67% of the participants. Site Engineers (12.96%), Client Representatives (AACRA personnel) (11.11%), and Design Engineers (11.11%) also formed significant portions of the respondent base. Roles such as Contractor (Management/Technical) and Other (Engineer/Researcher) were represented by 5.56% each, while Quantity Surveyors were the least represented group at 1.85%. This varied representation across key project roles suggests that the survey has captured insights from individuals involved in different facets and stages of asphalt road construction projects. Such diversity is valuable for a study focusing on collaborative risk management, as it allows for the collection of a rich tapestry of experiences and viewpoints concerning risk perception, management practices, and inter-stakeholder collaboration. The significant presence of managerial and engineering roles underscores the relevance of the collected data to the practical and strategic aspects of project execution and risk oversight.

4.2.2 Type of Organization of Respondents

The organizational context in which respondents operate provides further insight into their perspectives on risk management and collaboration. Participants were asked to identify the type of organization they primarily work for. The distribution of respondents across various organizational types is detailed in Figure 4.2.

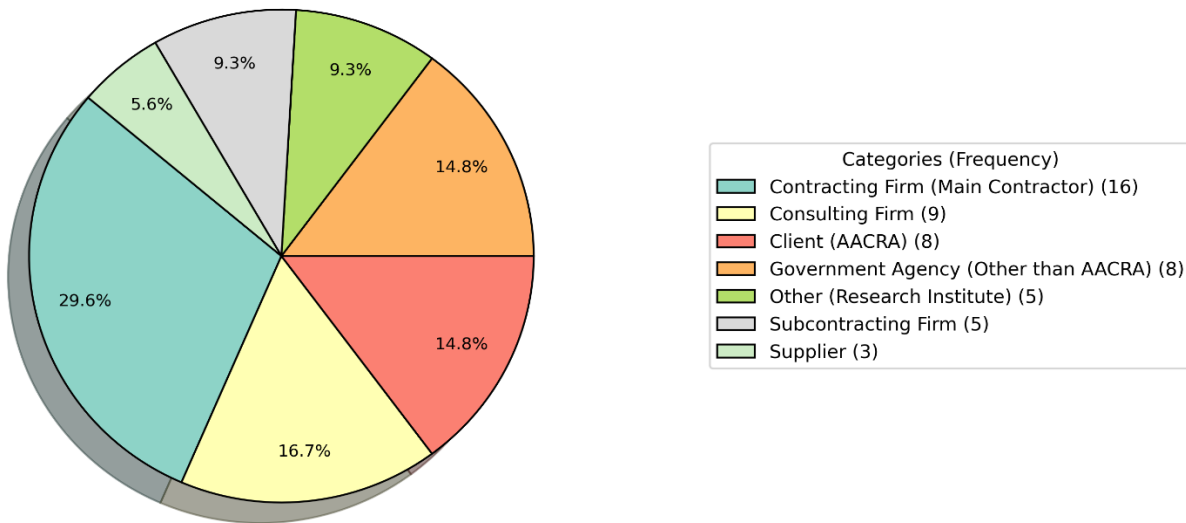


Figure 4. 2 Distribution of Respondents by Organization Type

As shown in Figure 4.2, professionals from Contracting Firms (Main Contractor) formed the largest group, comprising 29.63% of the total respondents. This significant representation from the contracting sector is crucial, as contractors are often at the forefront of project execution and risk bearing. Consulting Firms were the next most represented group at 16.67%. Notably, an equal proportion of respondents (14.81% each) hailed from Client organizations (specifically AACRA) and other Government Agencies (Other than AACRA), ensuring that client-side and broader public-sector perspectives are well-captured. Individuals from Other (Research Institute) and Subcontracting Firms each accounted for 9.26% of the sample, bringing in academic/research and specialized contractor viewpoints. Suppliers were the least represented group at 5.56%. This distribution indicates a comprehensive inclusion of key stakeholder organizations involved in the lifecycle of asphalt road projects in Addis Ababa. The strong representation from contractors, consultants, and client/government bodies is particularly beneficial for a study examining collaborative risk management, as these entities are primary parties in project partnerships and risk

allocation processes. The inclusion of research institutes and subcontractors further enriches the dataset with diverse operational and strategic insights.

4.2.3 Respondents' Years of Experience in the Construction Industry

The level of experience of the respondents within the broader construction industry is an important indicator of their accumulated knowledge and exposure to various project challenges, including risk-related issues. Participants were asked to specify their total years of experience in the construction sector. The distribution of this experience is presented in Figure 4.3. The existing categories from the survey ("Less than 5 years", "5 - 10 years", "11 - 15 years", "16 - 20 years", and "More than 20 years") are suitable for direct use in the figure

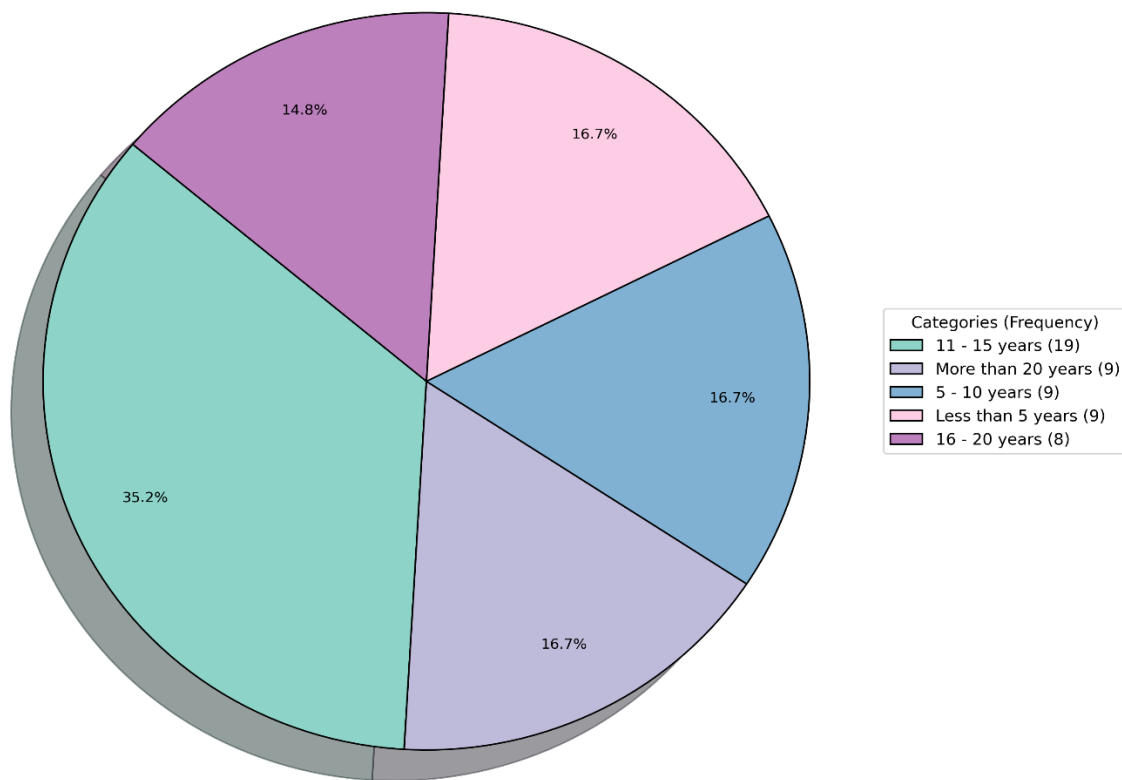


Figure 4. 3 Distribution of respondents by years of experience in the construction industry

The data in Figure 4.3 reveals a substantial level of experience among the respondents. The largest cohort, representing 35.19% of the sample, reported having "11 - 15 years" of experience in the construction industry. Interestingly, there was an equal distribution among those with "More than 20 years," "5 - 10 years," and "Less than 5 years" of experience, with each category accounting for 16.67% of the respondents. Professionals with "16 - 20 years" of experience constituted 14.81%

of the sample. This distribution indicates that the study has captured a wide range of experience levels, from relatively newer professionals to highly seasoned veterans. The significant representation of individuals with over a decade of experience (summing those in "11-15 years", "16-20 years", and "More than 20 years" categories, which collectively account for 66.67%) suggests that the findings will be heavily informed by individuals with substantial practical knowledge and long-term perspectives on industry practices and risk evolution. The inclusion of those with less experience also ensures that contemporary challenges and perhaps newer approaches are considered. This blend of experience levels is advantageous for a comprehensive understanding of risk management practices across different career stages and perspectives.

4.2.4 Respondents' Years of Experience in Asphalt Road Construction Projects

While general construction experience is valuable, expertise specifically within asphalt road construction projects is particularly pertinent to this research, as it reflects direct engagement with the unique risks and operational contexts of such projects. Respondents were therefore asked to indicate their years of experience specifically in asphalt road construction. Figure 4.4 shows this distribution.

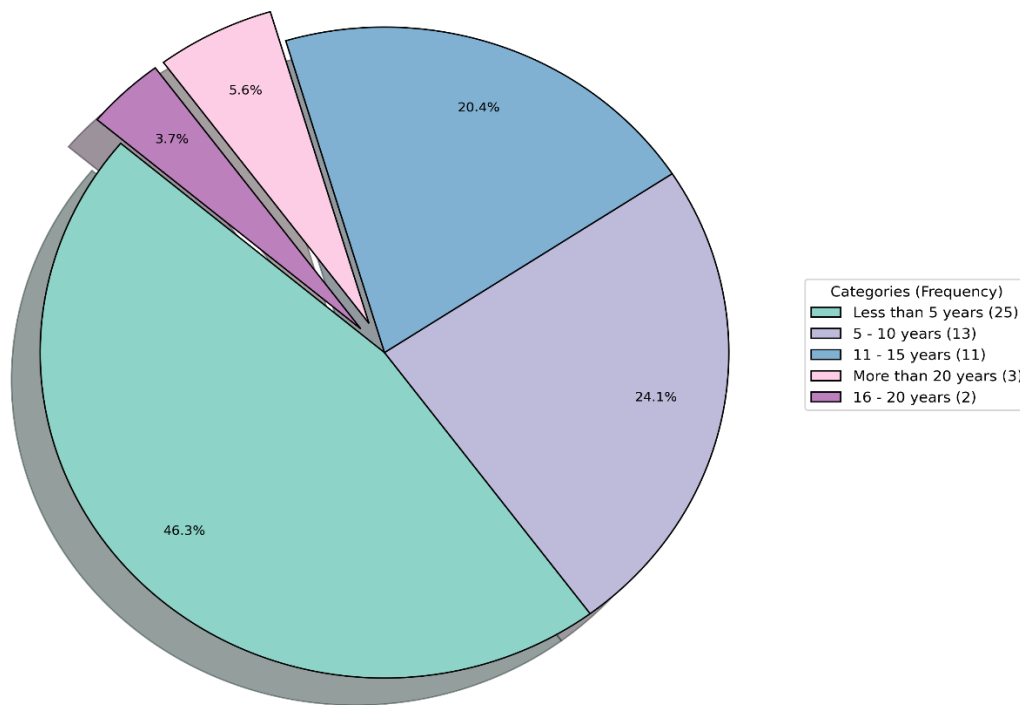


Figure 4. 4 Distribution of Respondents by Years of Experience in Asphalt Road Projects

As illustrated in Figure 4.4, a significant portion of the respondents (46.30%) reported having "Less than 5 years" of specific experience in asphalt road construction projects. This suggests a considerable number of professionals relatively new to this specialized sub-sector, or whose primary experience lies in other construction areas despite their overall industry tenure. The next largest group, 24.07%, indicated "5 - 10 years" of experience in asphalt roads, followed by 20.37% with "11 - 15 years." A smaller proportion of respondents possessed extensive specific experience, with 5.56% having "More than 20 years" and 3.70% having "16 - 20 years" in this domain. While many respondents have substantial general construction experience (as seen in Table 4.3), the distribution of specific asphalt road experience indicates a skew towards those with less than a decade in this particular field. This composition is noteworthy, as it may reflect industry trends, the specialized nature of asphalt road projects, or career progression paths. The insights gathered will thus be shaped by a mix of individuals with deep, long-term asphalt road expertise and those who bring perspectives perhaps influenced by more recent engagement or broader construction backgrounds. This blend can be valuable in identifying both established and emerging risk perceptions and collaborative practices.

4.2.5 Highest Educational Qualification of Respondents

The educational background of respondents can influence their theoretical understanding of project management principles, risk assessment methodologies, and collaborative frameworks. To ascertain this, participants were asked about their highest educational qualification. The distribution of these qualifications is presented in Figure 4.5. Standard academic categories such as Diploma, BSc/BA Degree, MSc/MA Degree, PhD, and Other are used for this classification, as per the survey.

Figure 4.5 shows that the majority of respondents (50.00%) hold a BSc/BA Degree as their highest educational qualification. This is followed by a significant proportion (35.19%) who have attained an MSc/MA Degree. A smaller group (7.41%) reported "Other (PostDoc)" qualifications. Respondents with a PhD and those with a Diploma each constituted 3.70% of the sample. This educational profile indicates that the vast majority of participants (85.19% holding at least a BSc/BA degree) possess a strong formal educational foundation, which is typical for professionals in engineering and management roles within the construction sector.

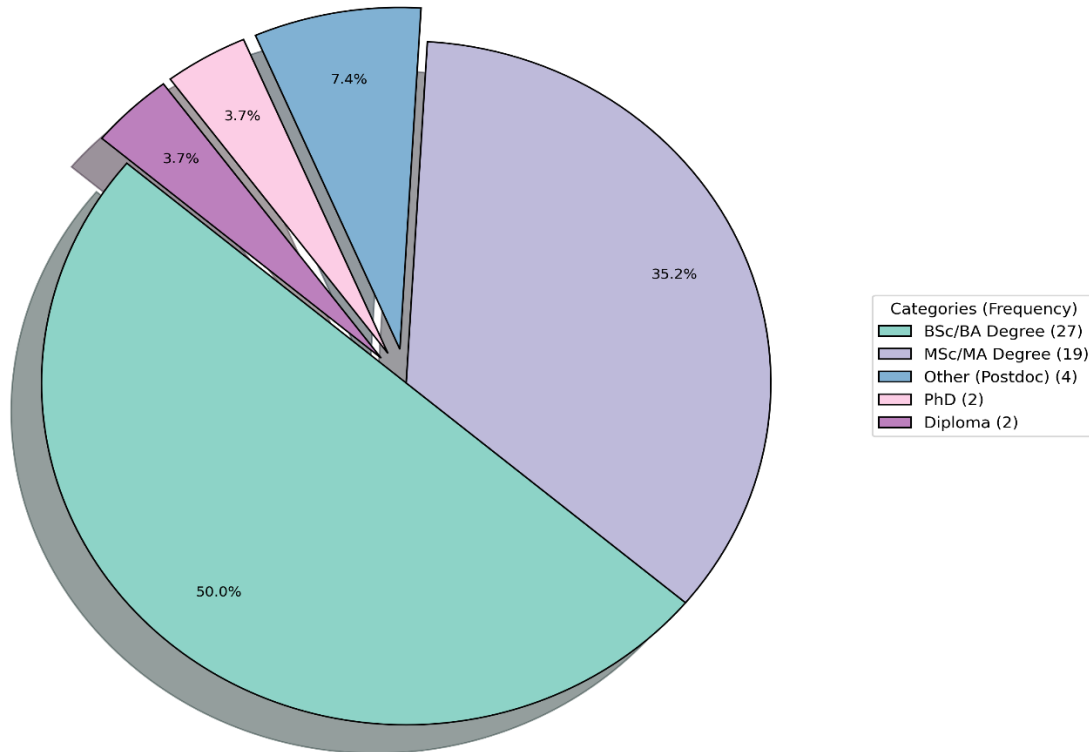


Figure 4. 5 Distribution of Respondents by Highest Educational Qualification

The substantial number of individuals with postgraduate qualifications (MSc/MA, PhD, and PostDoc, collectively 46.3%) suggests a high level of specialized knowledge within the respondent pool. This advanced educational attainment can be an asset in understanding and implementing complex concepts such as formal risk management and collaborative strategies. The prevalence of degree-level and higher qualifications implies that respondents are likely equipped with analytical skills and a theoretical grounding relevant to the study's focus on developing a structured risk management framework.

4.2.6 Familiarity with Formal Risk Management Concepts and Processes

The extent to which professionals are familiar with formal risk management concepts and processes is fundamental to the effective identification, analysis, evaluation, treatment, and monitoring of risks in construction projects. Participants were asked to rate their familiarity on a scale. The distribution of their self-assessed familiarity is presented in Figure 4.6.

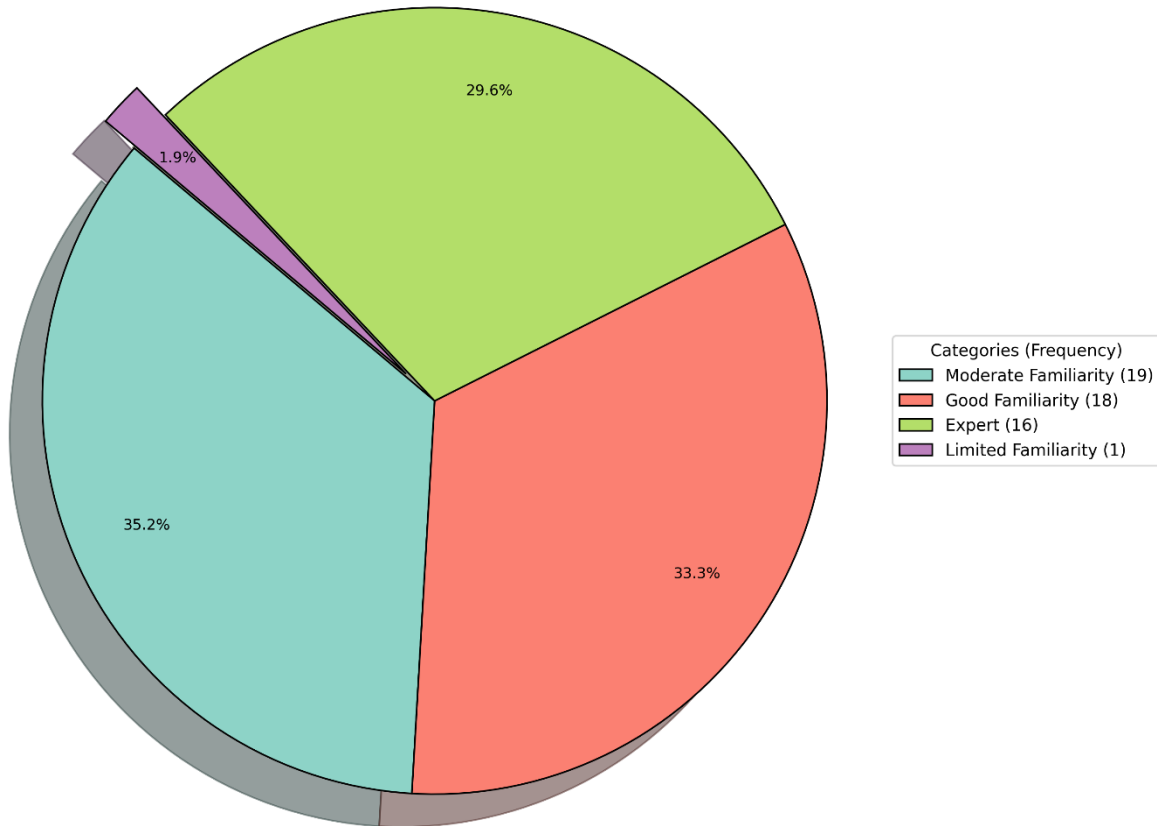


Figure 4. 6 Respondents' Familiarity with Formal Risk Management Concepts and Processes

The data in Figure 4.6 indicates a generally high level of familiarity with formal risk management concepts among the respondents. The largest group (35.19%) reported "Moderate Familiarity," closely followed by those with "Good Familiarity" (33.33%). A significant portion, 29.63%, considered themselves "Expert" in this area. Only a very small fraction (1.85%) indicated "Limited Familiarity," and no respondents reported "None." Cumulatively, nearly all respondents (98.15%) possess at least moderate familiarity, with over 60% reporting good to expert-level understanding. This high level of awareness of formal risk management principles is a positive indicator, suggesting that the professional community involved in Addis Ababa's asphalt road projects is, by and large, cognizant of established risk management frameworks. Such familiarity is a prerequisite for the successful implementation of any risk management strategy, including collaborative approaches. It implies that the respondents are likely to understand the terminology, processes, and objectives discussed in the survey and are equipped to provide informed opinions on current practices and potential improvements.

4.2.7 Familiarity with Collaborative Approaches in Construction Projects

Beyond formal risk management, understanding respondents' familiarity with collaborative approaches (such as partnering and joint risk management) is crucial for assessing the readiness and potential for implementing a collaborative risk management framework. Participants rated their familiarity with these approaches, and the results are shown in Figure 4.7.

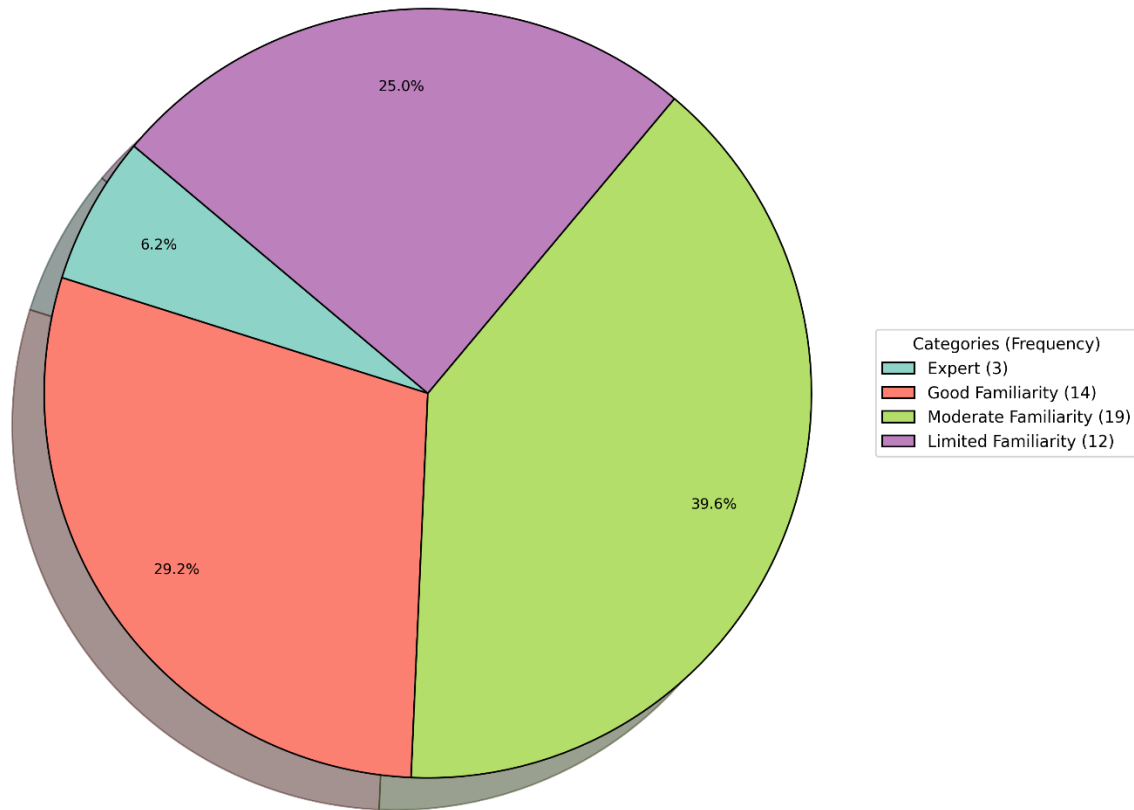


Figure 4. 7 Respondents' Familiarity with Collaborative Approaches in Construction Projects

As detailed in Figure 4.7, the level of familiarity with collaborative approaches presents a more varied picture compared to formal risk management. The most common response was "Moderate Familiarity," reported by 35.19% of participants. "Good Familiarity" was indicated by 25.93%, while 22.22% reported "Limited Familiarity." Notably, 11.11% of respondents stated they had "None" familiarity with collaborative approaches, and a smaller group (5.56%) considered themselves "Expert." While a majority (66.68%) reported at least moderate familiarity, the combined proportion of those with limited familiarity (33.33%) is substantial. This suggests that while many professionals have some understanding of collaborative methods, there is a significant segment of the industry that may be less aware or unexposed to these practices. This finding has

important implications for the development and implementation of a collaborative risk management framework, highlighting a potential need for awareness-building, training, and clear articulation of the benefits and processes involved in such approaches to ensure broader acceptance and effective participation.

In summary, the respondent profile for this study (Section 4.2) reveals a diverse and experienced group of professionals engaged in Addis Ababa's asphalt road construction sector. Participants predominantly hold key managerial, consulting, and engineering roles, primarily within contracting firms, consulting entities, and client/government organizations. While there is substantial overall construction industry experience, with a majority possessing over a decade in the field, specific experience in asphalt road projects is more varied, with a notable segment having less than five years in this specialization. The respondents are highly educated, with the vast majority holding bachelor's degrees or higher qualifications. Furthermore, a strong familiarity with formal risk management concepts is evident across the sample. However, familiarity with collaborative approaches, while present, is less uniform, with a considerable number of respondents indicating limited or no exposure to such practices. This demographic composition, characterized by a blend of extensive general experience, varied specific expertise, high educational attainment, and differing levels of familiarity with key concepts, provides a robust and relevant basis for investigating current risk management practices, their impacts, and the barriers and opportunities for enhancing collaborative risk management in the targeted context.

4.3 Assessment of Current Risk Management Practices

This section addresses the first specific objective of the study, which is to assess the current risk management practices employed in asphalt road construction projects in Addis Ababa. The assessment combines quantitative findings derived from survey responses with qualitative insights gathered from expert interviews. By examining the extent to which various risk management practices are implemented, this section aims to provide a comprehensive understanding of the prevailing operational landscape, identify areas of strength and weakness, and lay the groundwork for understanding the context in which a collaborative risk management framework might be introduced.

4.3.1 Extent of Implementation of Risk Management Practices

To quantitatively assess the current risk management practices, respondents were asked to rate the extent to which 23 distinct risk management practice criteria (B1-B23), derived from established literature (as indicated in Table 2.1 of the literature review), are implemented in the asphalt road construction projects they have been involved with in Addis Ababa. The ratings were provided on a 5-point Likert scale, and the Relative Importance Index (RII) and Standard Deviation (SD) were calculated for each criterion to determine its perceived level of implementation and the consistency of responses. The results, including the rank, RII, and SD for each practice, are presented in Table 4.8.

The RII values presented in Table 4.8 range from 0.459 to 0.604. This generally indicates a moderate to fair extent of implementation for most listed risk management practices. The practice "Degree to which specific risk management strategies are developed and implemented for identified risks" (B13) ranked highest with an RII of 0.604, suggesting a moderate level of application. This was closely followed by the "Effectiveness of remedial risk management techniques" (B11) with an RII of 0.589. These top-ranked items suggest that when risks are identified, or issues arise, there is some degree of strategic response and remedial action, though the implementation is not perceived as consistently high.

Conversely, the practices perceived as least implemented include the "Level of utilization of Building Information Modeling (BIM) for risk management purposes" (B19), which ranked lowest with an RII of 0.459, and the "Systematicity of risk identification and classification processes" (B16) with an RII of 0.478. These lower RII values, falling below the 0.5 mark, suggest a low extent of application for these more advanced or systematic approaches. The "Contribution of current risk management to effective decision-making" (B23) also scored relatively low (RII=0.485), implying that the current practices may not be fully translating into optimized decision-making processes. Overall, the quantitative findings point towards a scenario where basic or reactive risk management activities see moderate implementation, while more systematic, proactive, or technologically advanced practices are less prevalent.

Table 4. 1 Extent of Implementation of Current Risk Management Practices

Rank	Practice Criterion	RII	SD
1	B13: Degree to which specific risk management strategies are developed and implemented	0.604	1.157
2	B11: Effectiveness of remedial risk management techniques	0.589	1.156
3	B20: Consideration of critical recommended actions to reduce overrun/delay	0.574	1.010
4	B21: Addressing challenges encountered during project risk management	0.567	0.927
5	B7: Presence and quality (maintained and updated) of a project risk register	0.567	1.060
6	B2: Consideration of risk impact on diverse project objectives	0.552	1.063
7	B15: Degree of cooperative approach to risk allocation in contracts	0.544	0.960
8	B6: Consideration of risk across the different lifecycles of construction	0.537	0.928
9	B18: Extent of collaboration between stakeholders in risk assessment processes	0.537	1.025
10	B5: Clarity and implementation of risk response mechanisms	0.537	1.025
11	B14: Level of risk management maturity within the involved organizations	0.537	1.113
12	B17: Degree of integration between risk management and overall stakeholder management	0.526	0.996
13	B8: Conducting regular meetings among stakeholders to identify/discuss risks	0.522	1.089
14	B1: Existence and application of a systematic risk management process	0.522	1.106
15	B10: Effectiveness of preventive risk management techniques	0.515	1.002
16	B12: Extent of proactive risk management by contractors	0.515	1.092
17	B3: Effectiveness of risk identification techniques used	0.515	1.109
18	B4: Effectiveness of risk analysis techniques used (qualitative/quantitative)	0.507	1.041
19	B9: Provision of training for project team members on risk assessment/analysis	0.507	1.059
20	B22: Consideration of risk quantification in terms of impact and probability	0.493	1.059
21	B23: Contribution of current risk management to effective decision-making	0.485	1.057
22	B16: Systematicity of risk identification and classification processes	0.478	0.878
23	B19: Level of utilization of BIM for risk management purposes	0.459	1.127

4.3.2 Qualitative Findings - Elaboration on Current Practices

To provide depth and context to the quantitative findings, insights from semi-structured interviews with 11 industry professionals were analyzed. The interviewees elaborated on why certain risk management practices are implemented to varying degrees.

Regarding the moderately implemented core strategies, such as "developing and implementing specific risk management strategies for identified risks" (B13) and the "effectiveness of remedial risk management techniques" (B11), the interview data confirmed their importance but also highlighted inconsistencies in application. A strong consensus emerged that while these practices are recognized as important, their execution is often reactive rather than proactive. One senior project manager stated, "We do develop strategies, but it's often reactive once a risk becomes a major issue, rather than a proactive, systematic part of planning. Remedial actions are common, but their effectiveness varies greatly depending on early identification and resources." Interviewees frequently attributed this moderate and sometimes inconsistent application to project-specific pressures, a lack of standardized organizational procedures across different entities (client, consultant, contractor), and varying levels of experience and risk awareness among project teams.

For the practices identified as having low implementation, such as the "utilization of Building Information Modeling (BIM) for risk management purposes" (B19) and the "systematicity of risk identification and classification processes" (B16), qualitative data provided clear explanations. The use of BIM specifically for risk management was overwhelmingly described as nascent or non-existent. A consultant engineer mentioned, "BIM is slowly coming in for design and clash detection, but using it actively for risk visualization, simulation, or management is still very rare. There's a skills gap and a cost perception." This points to both a technological/skills barrier and an economic consideration. Similarly, the systematicity of risk identification (B16) was perceived as weak by most interviewees. An AACRA official noted, "Risk identification often relies heavily on the past experience of senior staff, which is valuable, but it's not always a formal, documented, or comprehensive process across all projects. Classification can also be quite subjective." Other reasons cited by interviewees for the lower implementation levels of such advanced or systematic practices included a lack of dedicated training in risk management, insufficient time allocated for thorough risk assessment during pre-construction phases, and a generally less mature risk culture within the industry.

4.3.3 Discussion of Current Risk Management Practices

The combined quantitative and qualitative findings paint a consistent picture of current risk management practices in Addis Ababa's asphalt road construction projects. The moderate implementation of reactive or core risk response strategies (B13, B11) aligns with literature suggesting that in many developing construction industries, risk management is often event-driven rather than embedded as a continuous, proactive process (Ahmed et al., 2023; Ferede et al., 2020). The interviewees' emphasis on reactive measures supports this.

The low implementation of more systematic elements, such as comprehensive risk identification and classification (B16) and the use of advanced tools like BIM for risk management (B19), is also a common theme in studies of construction industries in similar economic contexts (Darko et al., 2020; Kivrak & Udan, 2023). The literature (as referenced in Chapter 2, e.g., Bahamid and Doh, 2017) often points to a lack of awareness, skills, and resources as barriers to adopting more mature risk management practices. The interview findings regarding BIM skills gaps, cost perceptions, and the informal nature of risk identification directly corroborate these established points. The identified criteria for assessing current risk management practices in Table 2.1 (e.g., "Existence and application of a systematic risk management process," "Effectiveness of risk identification and analysis techniques used") show RII values that suggest these are not strongly implemented, which is consistent with the broader challenges identified in Ethiopian construction (Belay et al., 2021).

The implications of these findings for project performance are significant. A reactive approach and a lack of systematic risk identification can lead to risks being overlooked until they materialize, often resulting in project delays, cost overruns, and compromised quality, as suggested by the literature on project performance (Aarthipriya et al., 2020). The low utilization of BIM for risk management (B19) means that potential benefits in terms of early risk detection, visualization, and simulation are not being realized. Furthermore, if risk identification (B16) is informal and subjective, the foundation for all subsequent risk management steps (analysis, response, monitoring) is weakened. The relatively low perceived contribution of current risk management practices to effective decision-making (B23) further underscores the need for improvement. These gaps highlight a critical need for a more structured, integrated, and collaborative approach to risk management. A framework that promotes systematic processes, enhances stakeholder collaboration from early stages, and encourages the adoption of suitable tools and techniques could

address these deficiencies and thereby improve overall project performance in Addis Ababa's asphalt road construction sector.

4.4 Impact of Risk Factors on Project Performance

This section addresses the second specific objective of the research, focusing on quantifying the perceived negative impact of various risk factors on key project performance dimensions—namely Time, Cost, Quality, and Safety—within the context of asphalt road construction projects in Addis Ababa. Identifying the risks with the most significant detrimental effects is paramount for prioritizing mitigation efforts and informing the development of a targeted and effective collaborative risk management framework. The analysis integrates quantitative data from survey responses concerning 52 potential risk factors (C1-C52) with qualitative insights derived from expert interviews, thereby providing a multi-faceted understanding of the risk landscape and its consequences for project outcomes.

4.4.1 Overall Impact of Risk Factors

To determine the overall criticality of each risk factor across all performance dimensions, an aggregated approach was used. The Relative Importance Index (RII) and Standard Deviation (SD) for each risk factor's impact were averaged across the four dimensions (Time, Cost, Quality, Safety), drawing from the Objective2_Aggregated_RII_SD_Ranking.csv file. This aggregated RII provides a measure of the overall perceived negative impact of each risk factor on project performance. Table 4.9 presents the ranking of all 52 risk factors based on their aggregated RII and SD.

Table 4. 2 Ranking of Risk Factors Based on Aggregated Impact on Overall Performance

Rank	Risk Factor	Aggregated RII	Aggregated SD
1	C36: Accidents on site / Safety risks	0.788	0.934
2	C12: Poor site management	0.788	0.968
3	C32: Frequent breakdown of equipment	0.782	1.001
4	C8: Adverse economic conditions (currency fluctuation, etc.)	0.772	0.930
5	C30: Escalation of material prices	0.769	0.933
6	C31: Poor labor productivity	0.768	1.000
7	C5: Shortage of cash flow / Financial constraints	0.767	0.932
8	C1: Inflation and price increases	0.763	0.936
9	C17: Poor resource management (labor, materials, equipment)	0.761	1.048
10	C4: Unforeseeable fluctuation in material and labor prices	0.759	0.994
11	C37: Poor quality of work / Quality defects	0.752	0.939
12	C23: Delay in preparation/approval of drawings	0.750	0.861
13	C26: Changes in scope of work	0.749	0.963
14	C47: Environmental risks (pollution, erosion, habitat loss)	0.749	1.005
15	C41: Work interruptions (disputes, external events)	0.747	1.052
16	C42: Lack of space at site	0.747	1.067
17	C48: Legal Risks (lawsuits, contractual disputes, permit issues)	0.746	1.058
18	C40: Unavailability of utility at site (electricity, water)	0.745	0.963
19	C28: Shortage of construction materials	0.744	0.896
20	C29: Delay in delivery of material and equipment	0.744	0.994
21	C18: Corruption and bribery	0.744	1.072
22	C11: Inadequate planning and scheduling	0.744	1.029
23	C2: Inaccurate cost estimates	0.743	1.065
24	C9: Financial failure of the contractor	0.743	1.129
25	C27: Incorrect estimation of time and cost	0.742	1.030
26	C3: Variations and changes in work	0.739	1.015

27	C13: Poor communication between project team members	0.738	1.000
28	C24: Incomplete designs / specifications	0.738	0.977
29	C14: Slow decision making by owner/client	0.733	1.045
30	C50: Delay in obtaining permits and approvals	0.733	1.065
31	C46: Social risks (community issues, displacement, protests)	0.731	1.053
32	C33: Rework and mistakes	0.731	1.025
33	C43: Difficulty accessing the site	0.731	1.060
34	C45: Changes in government laws and regulations	0.730	1.100
35	C16: Lack of management skill among key personnel	0.729	1.021
36	C49: Lack of peace/security, labor strikes, riots, protests	0.729	1.017
37	C44: Political instability / Uncertain political conditions	0.729	1.038
38	C6: Delay in payments	0.729	1.027
39	C7: Lack of access to foreign currency	0.726	0.997
40	C39: Delay in possession of site / Delays in acquiring Right-of-Way	0.724	1.039
41	C51: Unpredicted extreme weather (floods, earthquakes, etc.)	0.724	1.042
42	C10: Owner bankruptcy	0.724	1.005
43	C52: Force Majeure / Acts of God	0.723	1.061
44	C15: Poor coordination within contractor's team/with stakeholders	0.723	1.051
45	C22: Defective design / Design errors	0.721	0.991
46	C35: Adverse weather conditions / Climatic conditions	0.720	1.054
47	C21: Lack of support for risk management from top management	0.720	1.062
48	C20: Resistance to change / sticking to old methods	0.718	0.984
49	C38: Technology shortage	0.718	1.072
50	C34: Unforeseen site conditions (soil, utilities, etc.)	0.716	0.999
51	C19: Lack of policy/procedures for risk management	0.714	1.034
52	C25: Insufficient inspections on the project site	0.707	1.082

The aggregated results in Table 4.9 highlight the risks perceived by respondents as having the most pervasive negative impact on overall project performance. The top ten most critical risks, based on aggregated RII, are: "Accidents on site / Safety risks" (C36, Agg. RII=0.788), "Poor site management" (C12, Agg. RII=0.788), "Frequent breakdown of equipment" (C32, Agg. RII=0.782), "Adverse economic conditions (currency fluctuation, etc.)" (C8, Agg. RII=0.772), "Escalation of material prices" (C30, Agg. RII=0.769), "Poor labor productivity" (C31, Agg. RII=0.768), "Shortage of cash flow / Financial constraints" (C5, Agg. RII=0.767), "Inflation and price increases" (C1, Agg. RII=0.763), "Poor resource management (labor, materials, equipment)" (C17, Agg. RII=0.761), and "Unforeseeable fluctuation in material and labor prices" (C4, Agg. RII=0.759). These risks encompass safety issues, operational inefficiencies (site management, equipment, labor, resource management), and significant financial/economic factors. Their high overall impact scores underscore their critical nature and the need for focused management attention.

4.4.2 Impact of Risk Factors on Specific Performance Dimensions

To gain a more granular understanding of how risks affect specific project objectives, their perceived negative impact was analyzed for each of the four performance dimensions separately using the RII and SD metrics.

Regarding the impact on project time performance (schedule delay), the analysis of survey data identified the specific risk factors perceived by respondents to have the highest negative impact. Table 4.10 presents the top five risks affecting time performance. Ranked highest, based on its Relative Importance Index (RII) score, was "Adverse economic conditions (currency fluctuation, etc.)" (C8, RII=0.848). Following this were "Inflation and price increases" (C1) and "Slow decision making by owner/client" (C14), which were perceived as almost equally impactful, both achieving an RII of 0.841 (with C1 having a slightly lower standard deviation of 0.762 compared to 0.855 for C14, indicating marginally higher consensus on its impact). The fourth most significant risk factor affecting time performance was identified as "Escalation of material prices" (C30, RII=0.833), and the fifth was "Unavailability of utility at site (electricity, water)" (C40, RII=0.830). These top-ranked risks collectively underscore the considerable vulnerability of project schedules in Addis Ababa's asphalt road construction sector to external macroeconomic

pressures, delays introduced through client-side decision-making processes, and disruptions caused by the lack of essential site utilities.

Table 4. 3 Top 5 Risk Factors Impacting Time Performance

Rank	Code	Risk Factor Description	RII	SD
1	C8	Adverse economic conditions (currency fluctuation, etc.)	0.848	0.910
2	C1	Inflation and price increases	0.841	0.762
3	C14	Slow decision making by owner/client	0.841	0.855
4	C30	Escalation of material prices	0.833	0.746
5	C40	Unavailability of utility at site (electricity, water)	0.830	0.763

Turning to cost performance, the analysis identified the risk factors perceived by respondents as the most significant drivers of cost overruns in Addis Ababa's asphalt road projects. The top five risks impacting cost are shown in Table 4.11. The highest perceived impact on cost was attributed to "Unforeseeable fluctuation in material and labor prices" (C4), which achieved the top rank with a Relative Importance Index (RII) of 0.852. Following closely was "Changes in scope of work" (C26, RII=0.848), ranked second. The third most impactful risk factor on cost was "Incorrect estimation of time and cost" (C27, RII=0.841). Tied for the fourth and fifth positions, both with an RII of 0.837, were "Poor quality of work / Quality defects" (C37) and "Shortage of cash flow / Financial constraints" (C5) (with C37 having a slightly lower standard deviation, indicating marginally higher agreement among respondents). These top five factors collectively highlight that project budgets are under significant pressure from market instability affecting input prices, challenges in defining and controlling project scope and estimates, the financial consequences of rework due to quality issues, and the financial health and liquidity of the contracting parties.

Table 4. 4 Top 5 Risk Factors Impacting Cost Performance

Rank	Code	Risk Factor Description	RII	SD
1	C4	Unforeseeable fluctuation in material and labor prices	0.852	0.851
2	C26	Changes in scope of work	0.848	0.845
3	C27	Incorrect estimation of time and cost	0.841	0.877
4	C37	Poor quality of work / Quality defects	0.837	0.779
5	C5	Shortage of cash flow / Financial constraints	0.837	0.803

Regarding the impact on project quality, the analysis identified the risks perceived to most significantly threaten the achievement of specified standards and potentially lead to defects or non-compliance. Table 4.12 displays the top five risks impacting quality. The highest perceived negative impact on quality was associated with "Adverse economic conditions (currency fluctuation, etc.)" (C8), which ranked first with a Relative Importance Index (RII) of 0.826. Tied for the second and third ranks were "Delay in delivery of material and equipment" (C29) and "Lack of space at site" (C42), both achieving an RII of 0.822 (with C29 having a lower standard deviation, indicating slightly more consensus). Similarly, "Lack of management skill among key personnel" (C16) and "Poor quality of work / Quality defects" (C37) were ranked fourth and fifth respectively, both with an RII of 0.819 (C16 having the lower standard deviation). This grouping of top risks suggests that achieving quality objectives in Addis Ababa's asphalt road projects is significantly challenged by economic pressures that might force compromises, logistical constraints affecting material availability and site operations, the capability of management personnel, and direct failures in workmanship leading to defects.

Table 4. 5 Top 5 Risk Factors Impacting Quality Performance

Rank	Risk Factor	RII	SD
1	C36: Accidents on site / Safety risks	0.819	0.976
2	C32: Frequent breakdown of equipment	0.811	0.940
3	C12: Poor site management	0.807	0.990
4	C17: Poor resource management (labor, materials, equipment)	0.763	1.199
5	C31: Poor labor productivity	0.730	1.067

Finally, the analysis of risks perceived to most negatively impact project safety, considering the potential for accidents and hazards, clearly pointed towards site-level operational and management factors. The top five risks affecting safety are listed in Table 4.13. Based on the survey data, the risk factor with the highest perceived impact on safety was "Accidents on site / Safety risks" (C36), ranking first with a Relative Importance Index (RII) of 0.819. This was followed by "Frequent breakdown of equipment" (C32, RII=0.811) and "Poor site management" (C12, RII=0.807). The fourth most impactful risk on safety was perceived to be "Poor resource management (labor, materials, equipment)" (C17, RII=0.763), and the fifth was "Poor labor productivity" (C31, RII=0.730). These results strongly emphasize the direct and significant influence of inherent site hazards, the condition and reliability of construction machinery, the effectiveness of site supervision and control, the adequacy of resource allocation, and workforce performance and behavior on maintaining a safe working environment during asphalt road construction projects in Addis Ababa.

Table 4. 6 Top 5 Risk Factors Impacting Safety Performance

Rank	Risk Factor	RII	SD
1	C36: Accidents on site / Safety risks	0.819	0.976
2	C32: Frequent breakdown of equipment	0.811	0.940
3	C12: Poor site management	0.807	0.990
4	C17: Poor resource management (labor, materials, equipment)	0.763	1.199
5	C31: Poor labor productivity	0.730	1.067

Comparing these dimensional impacts reveals important nuances. Economic factors like "Adverse economic conditions" (C8) rank highly for Time and Quality impact, but less so for Cost and Safety. Conversely, "Accidents on site" (C36) dominate the Safety ranking but appear lower in the overall aggregated list (though still rank 1st). "Poor site management" (C12) ranks highly for both overall impact and safety impact. This variance underscores that risk prioritization may need to be adjusted depending on the specific performance objective deemed most critical for a particular project or stakeholder.

4.4.3 Correlation Between Impact Dimensions

To explore the interrelationships between the perceived impacts on different performance dimensions, a Pearson correlation analysis was conducted on the overall impact scores for each dimension. The correlation matrix, visualized as a heatmap in Figure 4.1, provides insights into how negative impacts on one dimension tend to associate with impacts on others.

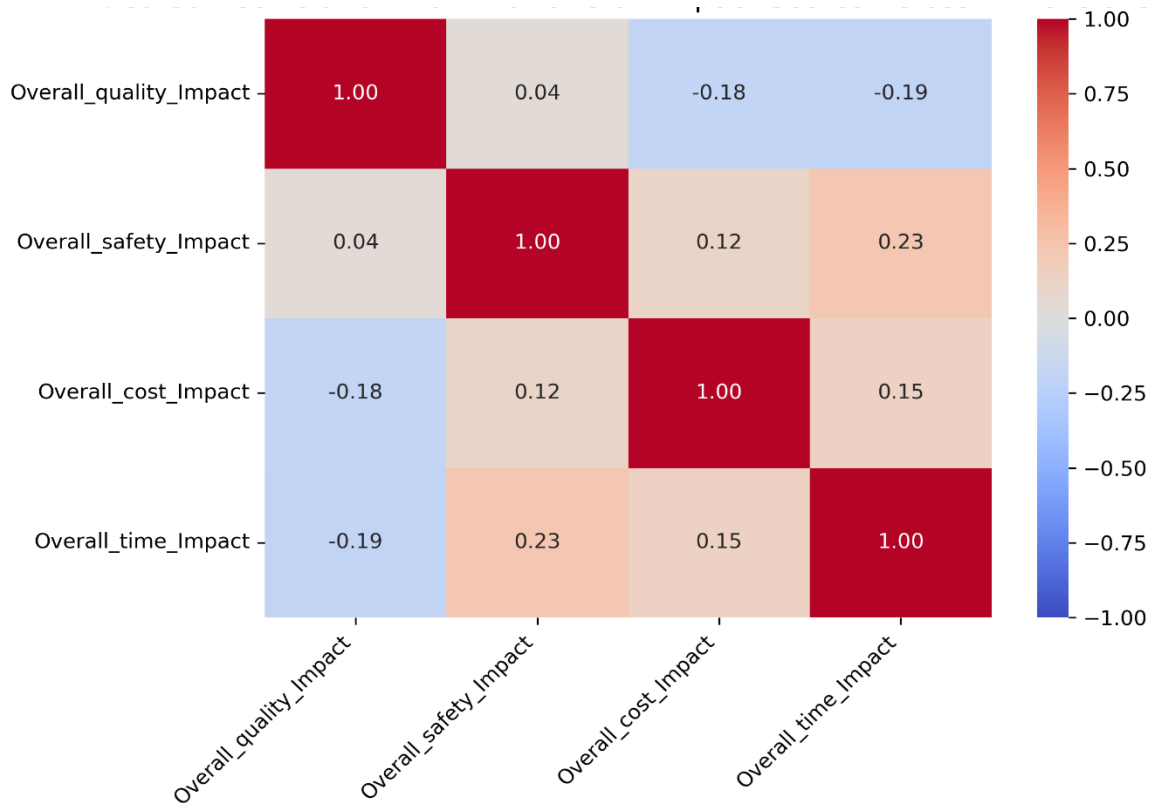


Figure 4. 8 Pearson correlation matrix of overall risk impacts across performance dimensions

Interpreting the correlation matrix (Figure 4.1), we observe varying degrees of association between the perceived impacts on the four performance dimensions. The correlations are generally positive but weak to moderate, suggesting that risks perceived to negatively impact one dimension are somewhat likely to be perceived as negatively impacting others, but the relationships are not overwhelmingly strong. For instance, the correlation between the perceived overall impact on Cost and Time is relatively low ($r=0.15$), as is the correlation between Cost and Quality ($r=-0.18$, indicating a very weak negative relationship in this sample's perception, which might seem counterintuitive and warrants careful interpretation). The correlation between Time impact and Quality impact is also negative and weak ($r=-0.19$). The strongest positive correlations appear between Safety impact and both Time impact ($r=0.23$) and Cost impact ($r=0.12$), although these are still considered weak associations. The weakest positive link is between Safety and Quality ($r=0.04$). These weak correlations might suggest that respondents perceive risk impacts somewhat distinctly for each dimension, or that the interplay is complex and not captured by simple linear relationships based on overall perceived impact ratings. The specific example highlighted in the

structure, a weak positive correlation between Overall_safety_Impact and Overall_time_Impact ($r=0.23$), suggests a slight tendency for risks seen as detrimental to safety to also be viewed as causing time delays, aligning with intuitive understanding, though the statistical link is not strong based on this overall impact data.

4.4.4 Qualitative Findings - Elaboration on Risk Impacts

The qualitative interviews provided valuable context and validation for the high-impact risks identified through the survey. Interviewees consistently confirmed the severe consequences of the top-ranked risks.

Regarding overall high-impact risks, "Accidents on site/Safety risks" (C36) were frequently described as having significant ripple effects. A contractor explained, "A serious accident doesn't just impact safety; it stops work, affects morale, invites investigations, and can lead to significant delays and cost overruns." This highlights the multidimensional impact beyond just the safety metric. Similarly, "Poor site management" (C12) and "Frequent breakdown of equipment" (C32) were cited as fundamental problems. A site engineer commented, "Ineffective site management directly leads to wastage, delays, quality issues, and can exacerbate equipment problems. When old or poorly maintained equipment breaks down, especially critical machinery, the entire schedule can be thrown off."

Elaborating on specific dimensional impacts, the high impact of financial and economic risks on Cost performance was strongly emphasized. Referring to "unforeseeable fluctuation in material and labor prices" (C4) and "changes in scope of work" (C26), a quantity surveyor stated, "The price of bitumen and other imported materials can skyrocket with currency fluctuations, making initial cost estimates almost meaningless sometimes. And scope changes, especially late ones, are notorious for budget blowouts." For Time performance, the severe impact of "adverse economic conditions (currency fluctuation)" (C8) and "inflation and price increases" (C1) was consistently echoed. An experienced project manager elaborated, "Delays in accessing foreign currency for materials or equipment parts can halt progress for weeks or months. General inflation also puts pressure on the entire supply chain, leading to slower deliveries and contractor cash flow issues which cause delays." Interviewees repeatedly linked these high-impact financial and economic risks (C1, C4, C8) to the broader Ethiopian economic context, citing challenges like foreign exchange shortages, reliance on imported materials, and persistent inflation as major drivers of

project uncertainty and performance issues. They often perceived these external economic risks as poorly managed due to their complexity and limited control by project stakeholders.

4.4.5 Discussion of Risk Factor Impacts

The findings regarding the impact of risk factors on project performance in Addis Ababa's asphalt road projects largely align with, and provide specific context to, the broader literature. The identification of financial and economic risks (C1, C4, C8, C5, C7, C30), scope changes (C26), poor site management (C12), equipment issues (C32), and safety accidents (C36) as having high negative impacts resonates with studies conducted both in Ethiopia and internationally (Belay et al., 2021; Ahmed et al., 2023; Tessema et al., 2022; Chekol and Henry, 2024). For instance, the high ranking of price fluctuations (C4, C1, C30) and foreign currency issues (C7, C8) confirms the vulnerability of Ethiopian projects reliant on imported materials and subject to macroeconomic volatility, as highlighted by Ahmed et al. (2023) and Belay et al. (2021). Poor site management (C12) and planning/scheduling issues (C11) are frequently cited contributors to delays and cost overruns globally (Iqbal et al., 2015).

The significance of these top-ranked risks in the specific context of Addis Ababa cannot be overstated. The heavy reliance on imports for key materials like bitumen makes projects extremely sensitive to price escalations (C30, C4) and currency fluctuations (C8). Chronic foreign exchange shortages (C7) create direct bottlenecks impacting time. Rapid urbanization and ongoing development might contribute to frequent scope changes (C26) and challenges in site management (C12), including site access and space constraints (C42, C43). The emphasis on safety risks (C36) reflects the hazardous nature of road construction and perhaps varying levels of safety standard enforcement.

The implications of these high-impact risks for project success and stakeholder satisfaction are profound. Persistent delays (driven by C8, C1, C14, etc.) erode public trust and postpone economic benefits. Cost overruns (driven by C4, C26, C27, etc.) strain public finances and contractor viability. Quality defects (linked to C8, C29, C37, etc.) lead to premature infrastructure deterioration and increased lifecycle costs. Safety incidents (C36) have tragic human costs and significant project disruptions. Addressing these critical risks is therefore essential for achieving project objectives and satisfying diverse stakeholder expectations.

The correlation analysis (Section 4.4.3) suggests that the impacts across different dimensions might not be as tightly coupled in the respondents' overall perception as sometimes assumed, or that the relationships are complex. While a safety issue clearly impacts time and cost according to interviews, the overall correlation analysis based on perceived impact ratings showed only weak links. This could imply that while a severe instance of one risk (like a major accident) impacts multiple dimensions, the *average* perceived impact across many risks might be viewed more dimension-specifically by respondents. However, the qualitative data strongly reinforces the practical interdependencies: economic issues impact time, cost, *and* quality (due to material compromises); poor site management impacts time, cost, quality, *and* safety. This highlights the need for a holistic risk management approach that recognizes these practical interconnections, even if statistical correlations based on perception ratings are weak. A collaborative framework should facilitate discussion around these interdependencies to ensure mitigation strategies consider the potential cross-dimensional effects.

4.5 Barriers Hindering the Effective Implementation of Collaborative Risk Management

This section addresses the third specific objective of the study: to identify and prioritize the barriers hindering the effective implementation of collaborative risk management (CRM) approaches in asphalt road construction projects within Addis Ababa. Understanding these obstacles is crucial, as any proposed collaborative framework must incorporate strategies to overcome them. This analysis integrates quantitative findings from the survey, where respondents rated the significance of potential barriers, with qualitative insights from expert interviews that provide context and deeper understanding of how these barriers manifest in practice.

4.5.1 Quantitative Findings - Identification and Prioritization of Barriers

Respondents were asked to rate the extent to which 30 potential factors (D1-D30), identified from the literature (as referenced in Table 2.3), act as barriers to implementing CRM in their experience with Addis Ababa's asphalt road projects. Using a 5-point Likert scale (where 1=Not a Barrier, 5=Critical Barrier), the Relative Importance Index (RII) and Standard Deviation (SD) were calculated for each potential barrier. This allows for ranking the barriers based on their perceived significance and the level of agreement among respondents. Table 4.14 presents the full ranking.

Table 4. 7 Ranking of Barriers Hindering Implementation of Collaborative Risk Management

Rank	Barrier Description	RII	SD
1	D17: Lack of a general risk-aware culture among stakeholders	0.907	0.719
2	D30: Lack of trust and commitment among stakeholders	0.904	0.637
3	D20: Lack of clear and open communication channels between stakeholders	0.904	0.637
4	D5: Tendency for Client/Contractor to focus only on their own interests	0.867	0.777
5	D18: Absence of strong collaborative relationships and ethos among project stakeholders	0.781	0.937
6	D26: Lack of practical experience and insufficient history/learning from past efforts	0.767	0.986
7	D16: Belief that collaboration in risk management is only suitable for small projects	0.763	1.199
8	D19: Inappropriate contractual frameworks and risk allocation practices	0.759	0.939
9	D11: The Client's desire to overly control the project, limiting contractor input	0.756	0.945
10	D22: Failure to integrate risk management into overall project management processes	0.752	0.910
11	D24: Lack of clear policy and procedures for collaborative risk management	0.748	1.013
12	D27: Lack of cooperation and commitment among construction team members towards collaboration	0.748	1.067
13	D13: Perception that Joint Risk Management (JRM) requires excessive resource investment	0.748	1.247
14	D7: Inability or unwillingness of parties to adapt to changes collaboratively	0.744	1.220
15	D2: Lack of understanding among stakeholders on how to collaborate effectively	0.741	0.861
16	D23: Resource constraints (financial limitations, lack of skilled personnel)	0.741	1.176
17	D25: Lack of proper risk models suitable for a collaborative context	0.737	1.096
18	D6: Lack of a long-term outlook or perspective among project parties	0.733	1.028
19	D3: Lack of a culture of collaboration within participating organizations/parties	0.733	1.213

20	D8: Client's focus on strict contractual conditions, hindering flexibility	0.730	1.084
21	D21: Inconsistent risk management attitudes across different organizational levels	0.726	1.104
22	D12: Contractor's extensive focus primarily on profit, potentially ignoring shared risks	0.722	1.280
23	D10: Strict funding conditions by financial institutions clashing with JRM use	0.719	1.108
24	D14: Belief that collaboration in risk management requires complex formal approach	0.715	1.057
25	D29: Involvement of people with little or no experience in collaborative risk management	0.711	1.076
26	D9: Tough economic times leading to reduced willingness for joint efforts in risk management	0.704	1.094
27	D4: Lack of understanding of the benefits of collaborative relationships	0.704	1.161
28	D15: Belief that JRM suitability depends heavily on project size/scale	0.700	0.841
29	D28: Lack of a clear structure or designated facilitator for collaborative processes	0.696	1.128
30	D1: Lack of forming effective team collaboration structures at project start	0.674	1.202

The quantitative results presented in Table 4.14 clearly indicate that certain barriers are perceived as significantly more critical than others. The top four barriers, all with RII values above 0.85, are predominantly cultural and relational in nature. "Lack of a general risk-aware culture among stakeholders" (D17) ranked highest with an RII of 0.907, followed immediately by "Lack of trust and commitment among stakeholders" (D30) and "Lack of clear and open communication channels between stakeholders" (D20), both tied with an RII of 0.904. The fourth most significant barrier was the "Tendency for Client/Contractor to focus only on their own interests" (D5, RII=0.867). This strong emphasis on cultural, trust, communication, and behavioral aspects suggests that these non-technical factors are seen as the primary impediments to effective CRM implementation in the context of Addis Ababa's asphalt road projects. Barriers related to specific beliefs about CRM (e.g., D16, D13), contractual issues (D19), and experience/policy gaps (D26, D24) follow, while structural issues like forming teams at the start (D1) or having a facilitator (D28) were perceived as comparatively less significant barriers.

4.5.2 Qualitative Findings - Understanding the Nature of Barriers

Insights from the qualitative interviews provide crucial context for understanding why the top-ranked barriers identified in the survey are perceived as so critical. The interview data strongly echoed the quantitative findings, particularly regarding the dominance of cultural and relational issues.

The top-ranked barrier, "Lack of a general risk-aware culture among stakeholders" (D17), was frequently elaborated upon. Interviewees described a prevalent mindset where risk is viewed reactively or as something to be contractually transferred rather than proactively and collectively managed. A consultant highlighted this perspective: "Risk is often seen as something to be transferred or avoided, not collectively managed. There isn't a widespread proactive mindset to identify and discuss risks openly from the outset." This lack of a foundational risk-aware culture was seen as intrinsically linked to the second and third-ranked barriers: "Lack of trust and commitment among stakeholders" (D30) and "Lack of clear and open communication channels" (D20). Multiple interviewees explained that without trust, parties are unwilling to share critical information about potential risks honestly or commit fully to joint mitigation efforts. A contractor representative remarked, "If there's no trust, parties won't share information about risks honestly. Communication often becomes formal and defensive, especially when problems arise, rather than open and solution-oriented."

The fourth-ranked barrier, the "Tendency for Client/Contractor to focus only on their own interests" (D5), was also a recurring theme in interviews. An AACRA engineer admitted, "Often, contractual obligations and protecting one's own interests overshadow the collective project goals, making true collaboration on risk difficult." This self-interest focus was frequently attributed to traditional contracting models that foster adversarial relationships, pressure to meet individual organizational targets, and a lack of mechanisms or incentives to prioritize shared project success over individual gains, particularly when dealing with risks. These barriers collectively create an environment where genuine collaboration on risk management struggles to take root, despite recognition of its potential benefits.

4.5.3 Discussion of Barriers to Collaborative Risk Management

The findings from both the survey and interviews strongly converge, indicating that cultural and relational factors represent the most significant barriers to implementing effective Collaborative Risk Management (CRM) in Addis Ababa's asphalt road projects. The high ranking of "Lack of a general risk-aware culture" (D17), "Lack of trust and commitment" (D30), "Lack of clear and open communication" (D20), and "Tendency to focus on own interests" (D5) aligns closely with the literature on CRM barriers, particularly in developing or fragmented construction industries (as discussed in Chapter 2, referencing Table 2.3 and sources like Bahamid and Doh, 2017; Marinelli and Salopek, 2019; Philemon et al., 2018; Xia et al., 2018). While technical barriers like lack of experience (D26), resource constraints (D23), or inadequate contractual frameworks (D19) were also recognized (and supported by literature like Fikru, 2023; Kivrak & Udan, 2023; Adetola & Goulding, 2016), they were perceived as less critical overall than the foundational issues of culture, trust, and communication in this specific context.

The dominance of these "softer" barriers has significant implications for framework development. It suggests that merely introducing new processes or tools for CRM may be insufficient if the underlying cultural and relational dynamics are not addressed. The framework must actively incorporate mechanisms designed to foster a shared risk-aware culture, build trust among stakeholders (client, consultant, contractor), and establish clear, open, and regular communication protocols specifically for risk discussion.

Furthermore, the interplay between these barriers is evident. As suggested by the qualitative findings, a lack of trust (D30) can directly inhibit open communication (D20) and reinforce the tendency for parties to focus on their own interests (D5) as a defensive measure. Similarly, a weak risk-aware culture (D17) provides infertile ground for trust and open communication about risks to develop. Addressing these barriers likely requires an integrated approach rather than tackling each in isolation. For instance, structured joint risk workshops (as suggested in the interview insights, Section V) could simultaneously improve communication, build shared understanding (countering D2 and D4), and, over time, foster trust and a more collaborative culture. Therefore, the proposed collaborative framework needs to be strategically designed to counteract these dominant, interconnected cultural and relational barriers as a primary objective.

4.6 Developing a Collaborative Risk Management Framework

4.6.1 Introduction to Framework Development

This section culminates the research findings by proposing a Collaborative Risk Management Framework (CRMF) tailored for asphalt road construction projects under the Addis Ababa City Road Authority (AACRA). The development process synthesizes the empirical evidence gathered in the preceding sections, specifically the assessment of current risk management practices (Section 4.3), the identified high-impact risk factors and their effects on project performance (Section 4.4), the critical barriers hindering collaborative approaches (Section 4.5), and the rich contextual insights derived from qualitative interviews with industry professionals (Summarized Interview Results, Section V). The primary aim is to translate these synthesized findings into a structured, actionable, and contextually relevant framework. The design emphasizes an evidence-based approach, directly addressing the identified gaps, risks, and barriers within the Addis Ababa context. This approach aligns with the need for context-specific solutions in construction management, while also judiciously integrating established principles from general construction industry best practices in collaborative risk management, validated through local stakeholder input.

4.6.2 Foundational Pillars and Guiding Principles for the CRMF

The effectiveness of the proposed CRMF hinges on the adoption of several foundational pillars and guiding principles, derived significantly from the qualitative data reflecting stakeholder beliefs on essential elements for success. A core principle is Proactive and Continuous Engagement, mandating early and ongoing involvement of all key stakeholders from the project's inception phase, rather than initiating collaboration only after contracts are signed or problems arise, a practice supported by calls for early stakeholder integration in risk management (Xia et al., 2018). Closely related is the need for Shared Understanding and Objectives, which involves establishing common project goals beyond individual organizational targets and fostering a collective understanding of potential risks and their impacts, crucial for any collaborative endeavor (Kapogiannis and Sherratt, 2018). Transparency and Open Communication emerged as crucial, requiring clear, honest, and regular information flow regarding risks, challenges, and progress among all parties, a cornerstone of effective collaborative risk management (Marinelli and Salopek, 2019).

Furthermore, building Trust and a No-Blame Culture is paramount (Marinelli and Salopek, 2019), necessitating an environment where risks and issues can be discussed openly without immediate fear of reprisal or finger-pointing. This directly counteracts the significant barrier of mistrust (D30) identified in Section 4.5. The framework promotes Joint Decision-Making and Fair Risk Allocation, moving away from adversarial risk transfer towards collaborative problem-solving and equitable risk distribution, potentially adopting a 'best party to manage the risk' philosophy (Adetola and Goulding, 2016), as suggested by interviewees. Essential for operationalizing collaboration are Clear Roles, Responsibilities, and Accountability, ensuring that each stakeholder understands their specific and shared duties within the CRMF process, a fundamental of project management (PMI, 2017). Finally, the principle of Adaptability and Learning is embedded, acknowledging the dynamic nature of construction projects and incorporating flexibility and formal mechanisms for capturing and utilizing lessons learned for continuous improvement across projects (Hopkin, 2018). These principles collectively aim to dismantle the dominant cultural and relational barriers identified, such as the lack of a risk-aware culture (D17), mistrust (D30), poor communication (D20), and the tendency to focus on self-interest (D5), thereby creating fertile ground for effective collaboration, as these barriers are widely recognized as detrimental (Xia et al., 2018).

4.6.3 Core Components and Processes of the Proposed CRMF

Based on the identified gaps, risks, barriers, and guiding principles, the proposed CRMF is structured into four sequential stages, supported by an overarching element. Each component is designed to address specific findings from this research.

A. Stage 1. Collaborative framework Initiation and Planning

This initial stage focuses on establishing the collaborative foundation before significant project work commences, a critical step for setting up successful project collaboration (Marinelli and Salopek, 2020). Key activities include the early assembly of core stakeholders, ideally involving AACRA, selected consultant representatives, and potential main contractor representatives even in pre-award planning phases, or the full project team immediately post-award. This assembly facilitates the joint definition of project objectives explicitly incorporating a risk perspective. Crucially, formal communication protocols and collaborative ground rules are established and agreed upon by all parties, which helps in fostering a cooperative environment (Osipova, 2015).

An initial high-level risk awareness workshop is conducted to align understanding and set the tone for proactive risk management. This stage directly addresses the identified barrier D1 (Lack of forming effective team collaboration structures at project start) and proactively begins to foster the required risk-aware culture (D17) and build initial trust (D30).

B. Stage 2 Joint Risk Identification and Qualitative Analysis

Building upon the foundation laid in Stage 1, this stage involves the systematic and collaborative identification and initial assessment of risks, following established risk management processes (ISO 31000:2018). Structured joint risk identification workshops, facilitated to ensure participation from all key stakeholders (AACRA, Consultant, Contractor), are central to this stage. These workshops directly address the identified gaps in current practices regarding systematic risk identification (B16, B1) and respond to strong interviewee preference for such joint sessions. A key output is the development of a comprehensive, shared project risk register, maintained as a live document accessible to relevant parties; this provides the potential structure for integrating BIM for risk visualization (addressing the gap B19), a tool noted for its potential in risk management (Darko et al., 2020), should capacity and technology adoption allow. Following identification, risks are qualitatively assessed using agreed-upon scales for likelihood and potential impact across key performance dimensions (time, cost, quality, safety). This process culminates in the prioritization of risks based on this qualitative assessment, guiding subsequent analysis and response planning efforts.

C. Stage 3: Collaborative Quantitative Risk Analysis and Response Planning

This stage focuses on deeper analysis of prioritized risks and the collaborative development of mitigation strategies. Activities include conducting quantitative risk analysis (e.g., sensitivity analysis, Monte Carlo simulation), as recommended for complex projects (Naderpour et al., 2019), where feasible and deemed valuable for high-impact risks, providing a more robust basis for decision-making. A core activity is the joint development of risk response strategies (avoid, mitigate, transfer, accept) for these prioritized risks, with a strong emphasis shifting from unilateral risk transfer to collaborative mitigation efforts (Hopkin, 2018). This requires clear allocation of responsibilities for implementing the agreed-upon response actions. The framework explicitly prompts the development of specific collaborative strategies for the top prioritized risks identified in this research (Objective 2), such as joint scenario planning and transparent handling of price

escalation for financial/economic volatility (C1, C4, C8, C30); agreed site management protocols and joint maintenance planning for poor site management and equipment breakdown (C12, C32); collaborative safety planning and joint audits for safety risks (C36); and transparent processes and robust collaborative change management for payment delays and scope changes (C6, C26). This stage directly addresses Objective 2 by concentrating effort on high-impact risks and promotes the principles of fair risk allocation and shared mitigation, as suggested by interviewees and supported by literature on partnering (Adetola and Goulding, 2016).

D. Stage 4: Joint Risk Monitoring, Control, and Review

Risk management is a continuous process (ISO 31000:2018), and this stage ensures its ongoing relevance and effectiveness throughout the project lifecycle. Key activities include regular joint risk review meetings, strategically scheduled (e.g., at key project milestones or monthly), involving all core stakeholders. The shared risk register is continuously updated based on these reviews and ongoing project developments. Crucially, the effectiveness of implemented response actions is monitored, and processes are in place to identify new or emerging risks. The framework includes provisions for clear escalation paths to address unresolved collaborative issues or significant deviations in risk status. Finally, documenting lessons learned related to risk management successes and failures is formalized to contribute to organizational learning and future project improvements, an essential component of mature risk management (Ferede et al., 2020). This stage ensures the RM process is adaptive, aligning with best practices and interviewee suggestions for ongoing communication and learning from experience, while also addressing the need for effective remedial actions (B11) and implementation of specific strategies (B13).

E. Stage 5: Overarching Element - Capacity Building & Facilitation

Underpinning the successful execution of all stages is the overarching element of capacity building and facilitation. Recognizing the varying levels of familiarity with formal and collaborative risk management observed in the study, this element includes activities like targeted training for all stakeholders (AACRA, consultants, contractors) on the CRMF principles, processes, tools, and collaborative behaviors, as training is crucial for effective RM implementation (Iqbal et al., 2015). Furthermore, acknowledging the potential barrier D28 (Lack of clear structure/facilitator), the framework suggests considering the role of a dedicated or appropriately trained existing team member to act as a risk facilitator, particularly in the early stages, to guide the process and mediate

discussions, as facilitation is key in collaborative settings (Maseko, 2021). This element directly addresses interview suggestions for capacity building and supports the effective implementation of the entire framework.

4.6.4 Stakeholder Roles, Responsibilities, and Empowerment within the CRMF

The successful implementation of the CRMF necessitates clearly defined, yet collaborative, roles and responsibilities for the key stakeholders involved in AACRA's asphalt road projects, a principle highlighted by Xia et al. (2018). AACRA, as the client and authority, assumes the critical role of champion and primary driver for the framework. This includes mandating its use, actively facilitating a collaborative environment, ensuring fair processes, leading efforts to address systemic or external risks beyond the immediate control of other parties (e.g., certain regulatory issues, major utility coordination), and demonstrating commitment from its leadership. Client leadership is often cited as a critical success factor (Boateng et al., 2020).

Consultants are expected to leverage their technical expertise in risk assessment and analysis methodologies. Their role involves facilitating risk workshops (if designated), ensuring objective assessment of risks and proposed responses, advising on appropriate mitigation strategies, and potentially monitoring the implementation and effectiveness of these strategies. They act as a key technical resource within the collaborative structure.

Contractors (including key Subcontractors) are integral participants expected to engage actively and openly in all CRMF stages. Their crucial contribution includes sharing site-specific risk knowledge and operational insights gained from direct execution experience. They must commit to implementing agreed-upon mitigation measures falling within their remit and play a vital role in contributing to and upholding the project's safety culture.

Beyond these specific roles, Shared Responsibilities bind all parties together. This includes a collective commitment to open and honest communication, proactive trust-building actions, adherence to the agreed-upon CRMF processes, shared diligence in proactive risk identification throughout the project lifecycle, and ultimately, contributing collaboratively towards shared project success rather than focusing solely on individual organizational objectives (countering

barrier D5). Empowering each stakeholder to fulfill these roles, as advocated by collaborative models (Kapogiannis and Sherratt, 2018), is essential for the framework's viability.

4.6.5 Critical Success Factors for CRMF Adoption and Effectiveness

The translation of this proposed CRMF from a blueprint into effective practice depends heavily on several Critical Success Factors (CSFs), largely echoing the insights gathered from experienced interviewees and general literature on change implementation. Foremost among these is Strong Leadership and Commitment, unequivocally required from AACRA's highest levels and mirrored by the top management of the consultant and contractor organizations involved (Boateng et al., 2020; Xia et al., 2018). Without this visible and sustained commitment, the framework risks becoming a superficial exercise. Secondly, demonstrating Tangible Benefits is crucial for buy-in; stakeholders need to see how adopting CRMF leads to improved project outcomes (e.g., reduced delays, better cost control, fewer disputes) compared to previous practices.

Simplicity and Practicality are essential; the framework must be understandable and implementable by project teams without imposing an excessive administrative burden that detracts from core project delivery tasks. Furthermore, successful adoption relies on Integration with Existing Processes, ensuring that collaborative risk management is woven into, rather than layered on top of, existing project management routines like progress meetings and reporting. Interviewees also suggested the value of Pilot Projects; initiating the CRMF on a few selected projects first allows for refinement based on practical experience and helps build confidence and demonstrate value before wider rollout. Lastly, underpinning all activities are Effective Facilitation and Communication Channels, ensuring that the mechanisms for joint discussion and information sharing function smoothly and efficiently (Maseko, 2021). The proposed framework design attempts to enable these CSFs through defined roles (leadership), structured yet adaptable processes (simplicity, integration), and emphasis on communication protocols and joint meetings (facilitation, communication).

4.6.6 Visualizing the Proposed Collaborative Risk Management Framework

To provide a clear overview of the interconnected components and flow of the proposed CRMF, a schematic diagram is presented in Figure 4.2. This flowchart illustrates the four primary stages of the framework (Initiation & Planning; Joint Risk ID & Qualitative Analysis; Collaborative

Quantitative Analysis & Response Planning; Joint Monitoring, Control & Review), along with the key activities within each stage. It also visually represents the Foundational Pillars, Critical Success Factors, Key Stakeholder Roles, and the Overarching Element of Capacity Building & Facilitation, indicating how these elements support and interact with the core process flow. The feedback loops representing continuous improvement and the handling of emerging risks are also depicted, emphasizing the dynamic and iterative nature of the proposed framework. This visual serves as the culmination of the research synthesis, presenting the developed framework at a conceptual and structural level based directly on the study's findings.

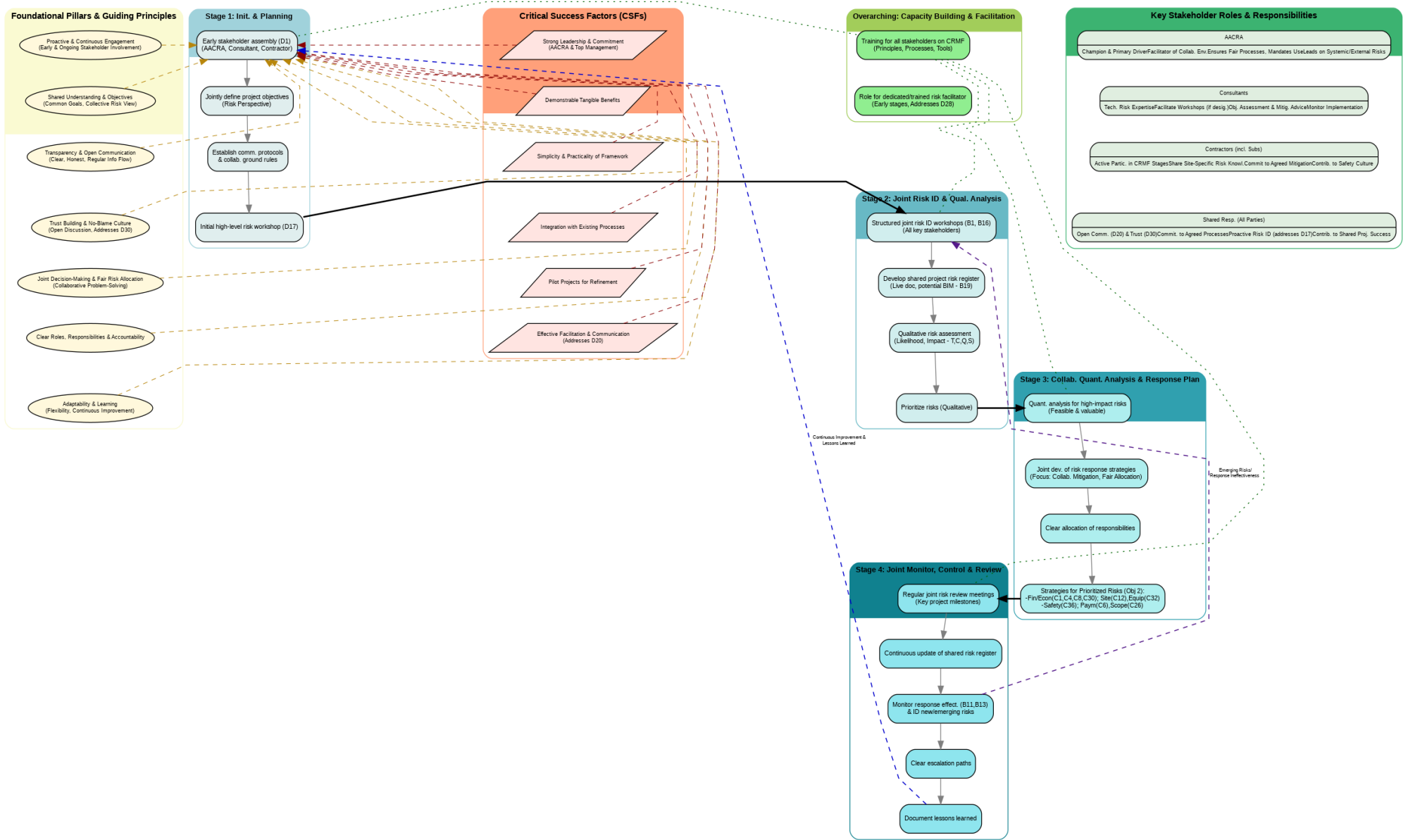


Figure 4. 9 Proposed Collaborative Risk Management Framework for asphalt road projects

4.6.7 Discussion - Rationale, Integration, and Potential of the Proposed CRMF

The specific design of the proposed Collaborative Risk Management Framework, as detailed in the preceding sections and visualized in Figure 4.2, is explicitly grounded in the findings of this research. It directly addresses the identified gaps in current risk management practices (Objective 1, Section 4.3 findings); for example, the low systematicity of risk identification (B16) and lack of a consistent process (B1), issues also noted in other developing country contexts (Bahamid and Doh, 2017), are tackled through the mandated structured joint risk identification workshops and the development of a shared risk register in Stage 2. The framework also provides a structured approach for considering remedial actions and specific strategies (B11, B13), aspects found to be only moderately implemented currently.

The framework incorporates targeted strategies for the high-impact risks identified as most critical to project performance in Addis Ababa (Objective 2, Section 4.4 findings). Stage 3 explicitly calls for collaborative response planning focused on risks like financial/economic volatility (C1, C4, C8, C30), poor site management (C12), equipment breakdown (C32), and safety (C36), moving beyond mere identification to active, joint mitigation planning. This proactive and targeted response planning is essential for mitigating the severe impacts observed (Aarthipriya et al., 2020; Ahmed et al., 2023).

Crucially, the design is intended to overcome the significant barriers to collaboration identified (Objective 3, Section 4.5 findings). The foundational principles emphasizing trust-building (P4), transparency (P3), and open communication (P3), embedded throughout the framework's stages (especially Stage 1 setup and Stage 4 reviews), are designed to counteract the dominant cultural and relational barriers identified (D17, D30, D20, D5), which are commonly cited as impediments to collaboration (Marinelli and Salopek, 2019; Philemon et al., 2018). The requirement for early engagement (Stage 1) tackles barrier D1, while the overarching element of capacity building addresses potential knowledge gaps (Kivrak and Udan, 2023) and the need for facilitation (D28).

Furthermore, the framework integrates key qualitative suggestions from interviewees, such as the emphasis on early stakeholder engagement (Stage 1), the use of specific tools like joint workshops and a shared risk register (Stage 2, Stage 4), and the clarification of distinct yet collaborative stakeholder roles (Section 4.6.4). The potential contribution of this CRMF to enhancing the performance of asphalt road construction projects in Addis Ababa is significant. By fostering a

proactive, systematic, and collaborative approach, it aims to improve risk identification, develop more effective and jointly owned mitigation strategies, reduce adversarial relationships (Osipova, 2015), and ultimately lead to better outcomes in terms of time, cost, quality, safety, and overall stakeholder satisfaction (Friday et al., 2018).

It must be acknowledged, however, that this framework provides a strategic and operational blueprint. Its successful implementation and the realization of its potential benefits are contingent upon fulfilling the critical success factors discussed, particularly the sustained leadership and commitment from AACRA and all participating organizations, a common prerequisite for the success of such initiatives (Boateng et al., 2020). This detailed framework sets the stage for the final chapter, which will offer overarching conclusions from the study, specific recommendations for implementation tailored to AACRA, and suggestions for future research avenues

4.7 Chapter Summary and Key Findings

This chapter presented and discussed the empirical findings derived from the mixed-methods approach employed in this study, addressing the four specific research objectives aimed at developing a collaborative risk management framework for asphalt road construction projects under the Addis Ababa City Road Authority (AACRA).

Regarding the first objective, the assessment of current risk management practices (Section 4.3) revealed a landscape characterized by moderate implementation of core, often reactive, risk management strategies. Quantitative analysis using the Relative Importance Index (RII) indicated that practices such as developing specific risk management strategies for identified risks (B13) and the effectiveness of remedial techniques (B11) were perceived as moderately applied. However, more systematic, proactive, or technologically advanced practices, notably the systematicity of risk identification and classification processes (B16) and the utilization of Building Information Modeling (BIM) for risk management purposes (B19), were found to be significantly less implemented ($RII < 0.5$). Qualitative insights corroborated this, highlighting that current practices are often reactive, inconsistent across entities, and influenced by project-specific pressures, with systematic identification and advanced tool usage hindered by skill gaps, cost perceptions, lack of dedicated training, and an informal risk culture.

Addressing the second objective, the analysis of risk factor impacts on project performance (Section 4.4) identified several critical risks perceived to have the most significant negative effects. Based on aggregated RII scores across time, cost, quality, and safety dimensions, the most critical risks overall included accidents on site/safety risks (C36), poor site management (C12), frequent breakdown of equipment (C32), adverse economic conditions (C8), and escalation of material prices (C30). Analysis by dimension revealed nuances; for instance, financial and economic factors (C4, C8, C1, C26, C27) were particularly dominant in driving cost and time impacts, while operational and safety factors (C36, C12, C32) were paramount for safety performance. While quantitative correlations between the impacts on different dimensions appeared weak, qualitative data strongly confirmed the practical interdependencies and ripple effects of these high-impact risks, frequently linking financial/economic risks to the specific Ethiopian context of import reliance, foreign exchange volatility, and inflation.

The third objective focused on identifying and prioritizing barriers hindering the implementation of collaborative risk management (Section 4.5). The findings strongly indicated the dominance of cultural and relational barriers. Quantitative analysis ranked the lack of a general risk-aware culture among stakeholders (D17) as the most critical barrier, followed closely by a lack of trust and commitment (D30) and lack of clear and open communication channels (D20), and the tendency for parties to focus only on their own interests (D5). These significantly outweighed technical or procedural barriers, such as inappropriate contractual frameworks (D19) or resource constraints (D23), although these were also recognized. Qualitative interviews extensively validated these findings, explaining how a lack of trust inhibits honest information sharing, how adversarial relationships stem from traditional contracting models, and how a prevalent reactive mindset prevents proactive, collective risk management.

Culminating the research, the fourth objective involved the development of a context-specific Collaborative Risk Management Framework (CRMF), detailed in Section 4.6 and visualized in Figure 4.2. This proposed framework is directly synthesized from the findings related to the previous three objectives and incorporates valuable stakeholder suggestions from the qualitative interviews. It is built upon foundational principles emphasizing proactive engagement, shared understanding, transparency, trust-building, joint decision-making, fair risk allocation, clear roles, and adaptability. The CRMF proposes a four-stage process (Initiation & Planning; Joint Risk ID & Qualitative Analysis; Collaborative Quantitative Analysis & Response Planning; Joint

Monitoring, Control & Review), supported by an overarching element of Capacity Building & Facilitation. The framework's components, including structured joint workshops, a shared risk register, and defined stakeholder responsibilities, are explicitly designed to address the identified gaps in current practices, provide mechanisms for managing the critical risks, and strategically counteract the dominant cultural and relational barriers identified within the AACRA project environment.

In essence, this chapter has diagnosed the current state of risk management, quantified the key threats to project performance, identified the primary obstacles to collaboration, and subsequently proposed a tailored framework as a potential solution. The successful implementation of this CRMF, contingent upon critical success factors like leadership commitment and stakeholder buy-in, holds significant potential for enhancing the performance of asphalt road construction projects in Addis Ababa. The following chapter will present the overall conclusions drawn from these findings, offer specific recommendations for AACRA regarding the implementation of the proposed framework, and suggest avenues for future research.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusions

This study embarked with the general objective of developing a collaborative risk management framework for enhanced performance of asphalt road construction projects in Addis Ababa under the Addis Ababa City Road Authority (AACRA). To achieve this, the research systematically assessed current risk management practices, quantified the perceived impact of risk factors on project performance, and identified the barriers hindering collaborative risk management in this specific context.

Based on the comprehensive analysis and discussion presented in Chapter Four, the following key conclusions are drawn:

- The study revealed that current risk management practices in asphalt road construction projects in Addis Ababa are implemented to a moderate or fair extent. While some basic strategies are developed and remedial techniques are applied, more systematic, proactive, and advanced practices such as systematic risk identification and classification, risk quantification, provision of dedicated training, and integration with decision-making processes are significantly less implemented. This indicates that prevailing approaches are often reactive rather than proactive, potentially contributing to project performance issues.
- Numerous risk factors are perceived to have a significant negative impact on the performance of asphalt road construction projects in Addis Ababa across the dimensions of time, cost, quality, and safety. The most critical risks, based on their aggregated impact, include Accidents on site / Safety risks, Poor site management, Frequent breakdown of equipment, and key Financial/Economic risks such as adverse economic conditions, escalation of material prices, shortage of cash flow, and inflation. These high-impact risks necessitate focused management attention. While the perceived impacts on different dimensions show weak to moderate correlations, qualitative data suggests practical interdependencies, where issues like poor site management can simultaneously affect time, cost, quality, and safety.

- The most significant impediments to the effective implementation of collaborative risk management are cultural and relational rather than purely technical or procedural. The study identified the lack of a general risk-aware culture among stakeholders as the most critical barrier, followed closely by the lack of trust and commitment and the lack of clear and open communication channels. The tendency for parties to focus only on their own interests also ranks highly. These findings highlight that existing relationships and organizational cultures often impede the necessary transparency, information sharing, and joint problem-solving required for effective collaboration in risk management.
- Recognizing the inadequacy of existing practices and the dominance of cultural/relational barriers in addressing the high-impact risks, the study concludes that a context-specific Collaborative Risk Management Framework (CRMF) is essential for enhancing project performance. The research successfully developed such a framework, synthesized from the empirical findings and incorporating stakeholder insights. The proposed CRMF is designed to be proactive, systematic, and collaborative, built upon foundational principles emphasizing trust, transparency, shared understanding, joint decision-making, and clear roles. Its structured stages, including joint workshops and a shared risk register, are intended to directly address the identified gaps in practices and barriers to collaboration, while focusing on collaborative responses to the most critical risks.

In conclusion, addressing the performance challenges in asphalt road construction projects in Addis Ababa requires a shift from current moderate and reactive risk management approaches towards a more systematic, proactive, and collaborative model. The primary obstacle to this shift lies in fostering a culture of trust, open communication, and shared responsibility among stakeholders. The proposed Collaborative Risk Management Framework provides a tailored structure and set of principles designed to overcome these specific challenges and leverage collective intelligence for improved project outcomes.

5.2 Recommendations

Based on the empirical findings regarding current risk management practices, the impact of identified risk factors, the critical barriers to collaboration, and the components of the developed Collaborative Risk Management Framework (CRMF), the following recommendations are

provided for the Addis Ababa City Road Authority (AACRA) and other key stakeholders involved in asphalt road construction projects:

- The study concluded that a context-specific CRMF is essential for enhancing project performance [5.1]. It is recommended that AACRA formally endorses and integrates the proposed CRMF, detailed in Section 4.6 and visualized in Figure 4.2, into its standard project management procedures for asphalt road construction projects [4.6, 4.7]. This involves establishing the foundational pillars and guiding principles [4.6.2], structuring projects according to the four sequential stages (Initiation & Planning; Joint Risk Identification & Qualitative Analysis; Collaborative Quantitative Analysis & Response Planning; Joint Monitoring, Control & Review) [4.6.3], and operationalizing the overarching element of Capacity Building & Facilitation [4.6.3].
- The research identified specific risk factors with the highest aggregated negative impact on project performance, including accidents on site/safety risks (C36), poor site management (C12), frequent breakdown of equipment (C32), adverse economic conditions (C8), and escalation of material prices (C30) [4.4.1, 4.7, 5.1]. It is recommended that during Stage 3 of the CRMF, explicit collaborative strategies are developed and implemented to mitigate these top-ranked risks [4.6.3]. For instance, joint scenario planning for economic volatility and joint maintenance planning for equipment reliability should be integral components of project risk response [4.6.3].
- The study emphatically concluded that cultural and relational factors, such as lack of a risk-aware culture (D17), lack of trust and commitment (D30), lack of clear communication (D20), and focus on self-interest (D5), are the most significant impediments to effective CRM [4.5.1, 4.7, 5.1]. AACRA, as the client and authority, should lead efforts to foster a risk-aware culture, build trust among stakeholders through transparent practices and open communication channels, and promote a shared responsibility ethos [4.6.2, 4.6.5, 4.6.7]. Capacity building initiatives (Stage 5) should specifically target behavioral aspects of collaboration alongside technical skills [4.6.3].
- The assessment revealed that while some core strategies are moderately implemented, systematic identification (B16), classification (B16), and the application of advanced techniques (B4, B19) are significantly less implemented [4.3.1, 4.7]. It is recommended that AACRA mandates and supports the systematic execution of risk identification,

analysis, and classification processes as defined in Stage 2 of the CRMF [4.6.3]. Targeted training (Stage 5) on risk assessment methodologies and the potential use of relevant technologies like Building Information Modeling (BIM) for risk visualization should be provided to project teams [4.6.3].

- The success of the CRMF is heavily contingent upon strong leadership and sustained commitment from AACRA and the top management of consulting and contracting firms [4.6.5, 4.6.7]. Visible advocacy for the framework, allocation of necessary resources, and active participation in collaborative processes are essential for its successful adoption and effectiveness [4.6.5].
- To facilitate phased implementation and garner buy-in, it is recommended to pilot the CRMF on a selection of asphalt road construction projects first [4.6.5]. This allows for refinement of the framework based on practical experience before a broader rollout, while demonstrating its tangible benefits [4.6.5, 4.6.7].

5.3 Recommendation for Future Research Works

Building upon the findings and limitations of this study, the following areas are recommended for future research to further advance the understanding and practice of collaborative risk management in asphalt road construction projects in Addis Ababa and similar contexts:

- This study focused on developing the framework [5.1]; future research should undertake longitudinal studies to evaluate the actual implementation of the proposed CRMF on pilot projects [4.6.5] and assess its long-term effectiveness in enhancing project performance (time, cost, quality, safety) and improving stakeholder relationships [4.6.7].
- The study's geographical scope was limited to Addis Ababa. Future research should explore the applicability and necessary adaptations of the developed CRMF to asphalt road construction projects in other regions within Ethiopia or in comparable developing country contexts, considering their unique socio-economic, regulatory, and operational environments.
- While this study identified cultural and relational barriers as most critical [4.5.1, 5.1], future qualitative research could provide a more in-depth understanding of the root causes and specific manifestations of the lack of risk-aware culture, mistrust, and poor

communication among stakeholders [4.5.2, 4.7]. This could inform the development of more targeted behavioral and organizational interventions.

- Research could focus on developing methodologies to quantify the tangible economic benefits (e.g., cost savings from reduced overruns, increased efficiency) derived from implementing collaborative risk management approaches compared to traditional practices in this specific context [4.6.7].
- Future research could investigate the feasibility, challenges, and benefits of integrating specific technologies, such as Building Information Modeling (BIM) or advanced quantitative risk analysis techniques (e.g., Monte Carlo simulation), into the collaborative risk management process in the Ethiopian construction industry [4.3.1, 4.6.3, 4.7].
- Given the dynamic nature of the construction industry and external economic conditions, future research could track changes in the criticality and impact of the identified high-impact risk factors over time and assess how the CRMF needs to adapt to address evolving risks effectively.

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APPENDICES

Appenice A. Questionnaire Survey



ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

School of Civil Engineering and Architecture

Department of Civil Engineering

Construction Engineering and Management Program

Subject: Survey on Collaborative Risk Management for Asphalt Road Construction Projects in Addis Ababa

Dear Respondent,

My name is Sisay Alemayehu, and I am an MSc candidate in Construction Engineering and Management at Adama Science and Technology University (ASTU). As part of my thesis requirement, I am conducting research titled: "**Developing a Collaborative Risk Management Framework for Enhanced Performance of Asphalt Road Construction Projects in Addis Ababa.**"

The **general objective** of this study is to develop a practical collaborative risk management framework tailored to enhance the performance of asphalt road construction projects managed under the Addis Ababa City Road Authority (AACRA).

This survey aims to gather valuable information regarding:

1. Current risk management practices in Addis Ababa's asphalt road projects.
2. The impact of various risk factors on project performance (time, cost, quality, safety).
3. Barriers hindering the effective implementation of collaborative risk management.

Your professional experience and insights are crucial to the success of this research. The information you provide will contribute significantly to understanding the current situation and developing a framework that can benefit future road construction projects in Addis Ababa.

Confidentiality and Voluntary Participation

Your participation in this survey is entirely voluntary. All responses will be kept strictly confidential and anonymous. The data collected will be used solely for academic purposes for this thesis and will be reported in an aggregated format, ensuring that no individual or organization can be identified.

Estimated Time

Completing this survey is estimated to take approximately **20-25 minutes**.

Instructions

Please answer all questions based on your knowledge and experience with asphalt road construction projects in Addis Ababa, particularly those involving AACRA. For sections with rating scales, please circle or tick the number that best reflects your assessment.

If you have any questions regarding this survey or the research project, please feel free to contact me:

- **Name:** Sisay Alemayehu
- **Phone:** +251911121975

Thank you very much for your time and valuable contribution to this important study.

Section A: Respondent's Profile

This section collects general information about your professional background.

1. What is your current primary role/position? (Please select one)

- Project Manager
- Site Engineer
- Design Engineer
- Contract Administrator/Manager
- Quantity Surveyor
- Consultant
- Contractor (Management/Technical)
- Client Representative (e.g., AACRA personnel)
- Regulatory Official
- Other (Please specify): _____

2. What type of organization do you primarily work for? (Please select one)

- Client (AACRA)
- Consulting Firm
- Contracting Firm (Main Contractor)
- Subcontracting Firm
- Government Agency (Other than AACRA)
- Supplier
- Other (Please specify): _____

3. How many years of experience do you have in the construction industry?

- Less than 5 years
- 5 - 10 years
- 11 - 15 years
- 16 - 20 years
- More than 20 years

4. **How many years of experience do you have specifically with asphalt road construction projects?**
- Less than 5 years
 - 5 - 10 years
 - 11 - 15 years
 - 16 - 20 years
 - More than 20 years
5. **What is your highest educational qualification?**
- Diploma
 - BSc/BA Degree
 - MSc/MA Degree
 - PhD
 - Other (Please specify): _____
6. **Have you been involved in asphalt road construction projects under the Addis Ababa City Road Authority (AACRA)?**
- Yes
 - No (*If No, thank you for your time. The rest of the survey focuses on AACRA projects.*)
7. **(If Yes to Q6) Approximately how many AACRA asphalt road projects have you been involved in? _____**
8. **How would you rate your familiarity with formal Risk Management concepts and processes? (1=None, 5=Expert)**
- 1 2 3 4 5
9. **How would you rate your familiarity with Collaborative Approaches (e.g., partnering, joint risk management) in construction projects? (1=None, 5=Expert)**
- 1 2 3 4 5

Section B: Current Risk Management Practices (Addresses Specific Objective 1)

This section assesses the extent to which various risk management practices are currently employed in asphalt road construction projects you have been involved with in Addis Ababa (esp. AACRA projects).

Please rate the extent to which the following practices are implemented using the scale below:

Scale:

- 1 = Very Low Extent / Never Applied
- 2 = Low Extent / Rarely Applied
- 3 = Moderate Extent / Sometimes Applied
- 4 = High Extent / Often Applied
- 5 = Very High Extent / Always Applied

No.	Risk Management Practice Criterion (Based on Table 2.1)	Rating (1-5)
B1	Existence and application of a systematic risk management process (incl. identification, analysis, evaluation, treatment, monitoring).	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B2	Consideration of risk impact on diverse project objectives (e.g., cost, time, schedule, quality).	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B3	Effectiveness of risk identification techniques used (e.g., brainstorming, checklists, expert interviews).	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B4	Effectiveness of risk analysis techniques used (qualitative and/or quantitative).	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B5	Clarity and implementation of risk response mechanisms (avoidance, mitigation, transfer, acceptance).	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B6	Consideration of risk across the different lifecycles of construction projects (pre-construction, construction, post-construction).	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B7	Presence and quality (maintained and updated) of a project risk register.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B8	Conducting regular meetings among stakeholders specifically to identify and discuss significant risks.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B9	Provision of training for project team members on risk assessment and analysis.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B10	Effectiveness of preventive risk management techniques (e.g., proper scheduling, learning from past projects).	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

B11	Effectiveness of remedial risk management techniques (e.g., close supervision, coordination during issues).	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B12	Extent of proactive risk management by contractors.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B13	Degree to which specific risk management strategies are developed and implemented for identified risks.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B14	Level of risk management maturity within the involved organizations.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B15	Degree of cooperative approach to risk allocation in contracts.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B16	Systematicity of risk identification and classification processes.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B17	Degree of integration between risk management and overall stakeholder management.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B18	Extent of collaboration between stakeholders (client, contractor, consultant) in risk assessment processes.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B19	Level of utilization of Building Information Modeling (BIM) specifically for risk management purposes.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B20	Consideration of critical recommended actions (by stakeholder category) to reduce cost overrun and delay.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B21	Addressing the challenges encountered during project risk management implementation.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B22	Consideration of risk quantification in terms of impact and probability/likelihood.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
B23	Contribution of current risk management practices to effective decision-making and efficient communication.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

Section C: Impact of Risk Factors on Project Performance (Addresses Specific Objective 2)

This section assesses the perceived impact of various risk factors on key performance dimensions (Time, Cost, Quality, Safety) of asphalt road construction projects in Addis Ababa (esp. AACRA projects).

Please rate the level of negative impact each risk factor typically has on the specified project performance dimensions, using the scale below:

Scale:

- 1 = Negligible Impact (Almost no effect)
- 2 = Minor Impact (Slight effect, easily manageable)
- 3 = Moderate Impact (Noticeable effect, requires management attention)
- 4 = Significant Impact (Substantial effect, major challenge to manage)
- 5 = Critical Impact (Severe effect, often leads to project failure in that dimension)
- NA = Not Applicable / No Experience

No.	Risk Factor Description	Impact on TIME (Schedule Delay)	Impact on COST (Cost Overrun)	Impact on QUALITY (Defects/Non-compliance)	Impact on SAFETY (Accidents/Hazards)
C1	Inflation and price increases	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C2	Inaccurate cost estimates	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C3	Variations and changes in work	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C4	Unforeseeable fluctuation in material and labor prices	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C5	Shortage of cash flow / Financial constraints	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C6	Delay in payments	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C7	Lack of access to foreign currency	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C8	Adverse economic conditions (currency fluctuation, etc.)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C9	Financial failure of the contractor	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C10	Owner bankruptcy	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C11	Inadequate planning and scheduling	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C12	Poor site management	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C13	Poor communication between project team members	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C14	Slow decision making by owner/client	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA

C15	Poor coordination within contractor's team/with stakeholders	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C16	Lack of management skill among key personnel	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C17	Poor resource management (labor, materials, equipment)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C18	Corruption and bribery	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C19	Lack of policy/procedures for risk management	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C20	Resistance to change / sticking to old methods	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C21	Lack of support for risk management from top management	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C22	Defective design / Design errors	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C23	Delay in preparation/approval of drawings	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C24	Incomplete designs / specifications	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C25	Insufficient inspections on the project site	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C26	Changes in scope of work	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C27	Incorrect estimation of time and cost	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C28	Shortage of construction materials	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C29	Delay in delivery of material and equipment	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA

C30	Escalation of material prices	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C31	Poor labor productivity	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C32	Frequent breakdown of equipment	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C33	Rework and mistakes	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C34	Unforeseen site conditions (soil, utilities, etc.)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C35	Adverse weather conditions / Climatic conditions	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C36	Accidents on site / Safety risks	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C37	Poor quality of work / Quality defects	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C38	Technology shortage	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C39	Delay in possession of site / Delays in acquiring Right-of-Way	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C40	Unavailability of utility at site (electricity, water)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C41	Work interruptions (disputes, external events)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C42	Lack of space at site	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C43	Difficulty accessing the site	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C44	Political instability / Uncertain political conditions	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA

C45	Changes in government laws and regulations	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C46	Social risks (community issues, displacement, protests)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C47	Environmental risks (pollution, erosion, habitat loss)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C48	Legal Risks (lawsuits, contractual disputes, permit issues)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C49	Lack of peace/security, labor strikes, riots, protests	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C50	Delay in obtaining permits and approvals	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C51	Unpredicted extreme weather (floods, earthquakes, etc.)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA
C52	Force Majeure / Acts of God	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> NA

Section D: Barriers to Collaborative Risk Management (Addresses Specific Objective 3)

This section aims to identify and prioritize barriers that hinder the implementation of effective *collaborative* risk management approaches among stakeholders (client/AACRA, consultants, contractors) in Addis Ababa's asphalt road projects.

Please rate the extent to which the following factors act as barriers to implementing collaborative risk management, using the scale below:

Scale:

- 1 = Not a Barrier
- 2 = Minor Barrier
- 3 = Moderate Barrier
- 4 = Significant Barrier
- 5 = Critical Barrier

No.	Barrier Description (Based on Table 2.3)	Rating (1-5)
D1	Lack of forming effective team collaboration structures at the project start.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D2	Lack of understanding among stakeholders on how to collaborate effectively.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D3	Lack of a culture of collaboration within participating organizations/parties.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D4	Lack of understanding of the benefits of collaborative relationships.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D5	Tendency for Client/Contractor to focus only on their own interests.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D6	Lack of a long-term outlook or perspective among project parties.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D7	Inability or unwillingness of parties to adapt to changes collaboratively.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D8	Client's focus on strict contractual conditions, hindering flexibility.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D9	Tough economic times leading to reduced willingness for joint efforts in risk mgmt.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D10	Strict funding conditions placed by financial institutions clashing with JRM use.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D11	The Client's desire to overly control the project, limiting contractor input.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

D12	Contractor's extensive focus primarily on profit, potentially ignoring shared risks.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D13	Perception that Joint Risk Management (JRM) requires excessive resource investment.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D14	Belief that collaboration in risk management requires a complex formal (contractual) approach.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D15	Belief that JRM suitability depends heavily on project size/scale (less suitable for large).	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D16	Belief that collaboration in risk management is only suitable for small projects.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D17	Lack of a general risk-aware culture among stakeholders.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D18	Absence of strong collaborative relationships and ethos among project stakeholders.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D19	Inappropriate contractual frameworks and risk allocation practices (e.g., unfair risk transfer).	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D20	Lack of clear and open communication channels between stakeholders.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D21	Inconsistent risk management attitudes across different organizational levels.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D22	Failure to integrate risk management into overall project management processes.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D23	Resource constraints (financial limitations, lack of skilled personnel with expertise in CRM).	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D24	Lack of clear policy and procedures for collaborative risk management.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D25	Lack of proper risk models suitable for a collaborative context.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D26	Lack of practical experience and insufficient history/learning from past collaborative efforts.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D27	Lack of cooperation and commitment among construction team members towards collaboration.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D28	Lack of a clear structure or designated facilitator for collaborative processes.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D29	Involvement of people with little or no experience in collaborative risk management.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
D30	Lack of trust and commitment among stakeholders.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

Section E: Suggestions and Open-Ended Questions

This section allows you to provide further insights and suggestions.

E1. In your opinion, what are the top 3 most critical risks affecting the performance (time, cost, quality, safety) of asphalt road construction projects in Addis Ababa?

1. _____
2. _____
3. _____

E2. What are your suggestions for improving collaborative risk management practices among stakeholders (AACRA, Consultants, Contractors) in these projects?

E3. What key elements or principles do you believe must be included in a Collaborative Risk Management Framework specifically designed for Addis Ababa's asphalt road projects to be effective?

E4. Do you have any other comments or observations regarding risk management or collaboration in asphalt road construction projects in Addis Ababa?

Thank you for your participation!

Your responses are invaluable to this research. Please ensure you have answered all relevant questions.

(End of Survey)

Appenice B. Semi-structured Interview

Semi-Structured Interview - Collaborative Risk Management in Addis Ababa Asphalt Road Projects

Interviewee: _____

Interviewer: Sisay Alemayehu

Date: _____

Time: _____

Location/Method: _____

1. Introduction

- "Good [morning/afternoon], thank you for taking the time to speak with me today. My name is Sisay Alemayehu, and I am an MSc candidate at Adama Science and Technology University."
- "This interview is part of my research titled 'Developing a Collaborative Risk Management Framework for Enhanced Performance of Asphalt Road Construction Projects in Addis Ababa,' specifically focusing on projects under the Addis Ababa City Road Authority (AACRA)."
- "You were previously a participant in a survey for this research. The purpose of this interview is to delve deeper into some of the key findings from that survey and to gather your expert insights, which will be invaluable for developing a practical and effective collaborative risk management framework."
- "The interview is expected to last approximately [e.g., 45-60 minutes]. Your participation is voluntary, and you can choose to skip any question or end the interview at any time."
- "All information you provide will be treated with strict confidentiality. Responses will be anonymized, and no individual or organization will be identified in the final thesis or any publications."
- "With your permission, I would like to record this interview to ensure I accurately capture your valuable insights. The recording will be used solely for transcription and analysis for this research. Is that acceptable to you?"
- "Do you have any questions before we begin?"

2. Current Risk Management Practices (Objective 1)

- "Our survey results on current risk management practices (Objective 1) indicated varying levels of implementation for different practices. For instance:"
 - "The '**Degree to which specific risk management strategies are developed and implemented for identified risks**' (B13) and the '**Effectiveness of remedial risk management techniques**' (B11) were seen as moderately applied (RII around 0.59-0.60)."
 - "From your experience, why do you think these practices are only moderately implemented? What are the common strategies or remedial techniques you see, and what makes them more or less effective in AACRA projects?"
 - "Conversely, practices like the '**Level of utilization of Building Information Modeling (BIM) specifically for risk management purposes**' (B19, RII ~0.46) and the '**Systematicity of risk identification and classification processes**' (B16, RII ~0.48) were perceived as less implemented."
 - "Could you elaborate on why these practices, particularly BIM for risk management and systematic risk identification, might have lower implementation levels in the context of Addis Ababa's asphalt road projects?"
 - "What do you see as the main hurdles to improving these less-implemented practices?"

3. Impact of Risk Factors on Project Performance (Objective 2)

- "The survey (Objective 2) highlighted several risk factors with a significant overall impact on project performance (time, cost, quality, safety). For example:"
 - '**Accidents on site/Safety risks**' (C36), '**Poor site management**' (C12), and '**Frequent breakdown of equipment**' (C32) were ranked as having the highest overall negative impact (Aggregated RII ~0.78-0.79)."
 - "In your view, what makes these particular risks so impactful across multiple project dimensions in Addis Ababa?"

- "Could you share an example or scenario where one of these risks significantly affected a project you were involved in?"
- "When looking at specific dimensions:"
 - "For **cost performance**, 'Unforeseeable fluctuation in material and labor prices' (C4, RII 0.85) and 'Changes in scope of work' (C26, RII 0.85) were top concerns."
 - "For **time performance**, 'Adverse economic conditions (currency fluctuation)' (C8, RII 0.85) and 'Inflation and price increases' (C1, RII 0.84) were highly ranked."
 - "How do these high-impact financial and economic risks typically manifest and affect day-to-day project operations and strategic decisions?"
 - "From your perspective, how well are these high-impact risks currently managed in AACRA projects?"

4. Barriers to Collaborative Risk Management (Objective 3)

- "Objective 3 of the survey focused on barriers to implementing effective collaborative risk management. The findings showed strong agreement on several key barriers:"
 - The '**Lack of a general risk-aware culture among stakeholders**' (D17, RII ~0.91) was the top-ranked barrier.
 - This was closely followed by '**Lack of trust and commitment among stakeholders**' (D30, RII ~0.90) and '**Lack of clear and open communication channels between stakeholders**' (D20, RII ~0.90)."
 - "Why do you believe these cultural and relational aspects – risk awareness, trust, commitment, and communication – are such significant barriers to collaboration in Addis Ababa's road construction sector?"
 - "Can you describe how these barriers play out in practice and hinder joint risk management efforts?"
 - Another highly rated barrier was the '**Tendency for Client/Contractor to focus only on their own interests**' (D5, RII ~0.87)."
 - "How does this focus on individual interests, rather than shared project goals, undermine collaborative risk management?"

- "What steps do you think could begin to shift this mindset towards more collaborative approaches?"

5. Developing a Collaborative Risk Management Framework (Objective 4)

- "Drawing from our discussion on current practices, risk impacts, and collaborative barriers, this final section aims to gather your suggestions for developing an effective collaborative risk management framework for asphalt road projects in Addis Ababa, specifically for AACRA projects."
 - "The survey's open-ended questions asked for the top 3 most critical risks. From your perspective today, what are the top 2-3 risks that a collaborative framework *must* prioritize addressing?"
 - "Considering the gaps in current practices (like systematic risk identification or BIM use), what specific processes or tools should be integral to a collaborative framework to improve these areas?"
 - "Given the identified barriers like lack of trust, poor communication, and limited risk-aware culture:"
 - "What key elements or principles (e.g., shared responsibilities, joint decision-making, transparent information sharing, early stakeholder involvement) do you believe must be embedded in this framework to overcome these barriers and foster genuine collaboration?"
 - "What practical mechanisms or activities (e.g., regular joint risk workshops, clear communication protocols, defined roles for collaboration) could be included in the framework to make it actionable?"
 - "What role should AACRA, consultants, and contractors respectively play within such a collaborative risk management framework to ensure its success?"
 - "Are there any successful examples of collaboration, even if informal, in past projects that we could learn from when designing this framework?"
 - "What do you see as the most critical success factor for the adoption and effective implementation of a new collaborative risk management framework within AACRA projects?"

6. Conclusion

- "We've covered a lot of ground. Before we conclude, is there anything else you would like to add regarding risk management, collaboration in asphalt road projects in Addis Ababa, or any aspects of the proposed framework that we haven't discussed?"
- "Thank you so much for your time and for sharing your invaluable insights. Your contribution is highly appreciated and will significantly contribute to this research."
- "I may follow up with a brief clarifying question via email if needed, would that be alright?"
- "Once the research is complete, I would be happy to share a summary of the findings with you, if you are interested."