



MEKELLE UNIVERSITY
COLLEGE OF BUSINESS AND ECONOMICS
DEPARTMENT OF MANAGEMENT

**Risk Identification and Management
in Infrastructure Engineering Projects in Ethiopia**

A master thesis submitted for partial fulfilment to the
award of Master of Business Administration (MBA)

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RISK IDENTIFICATION AND MANAGEMENT IN
INFRASTRUCTURE ENGINEERING PROJECTS IN
ETHIOPIA

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**MEKELLE UNIVERSITY, COLLEGE OF BUSINESS AND
ECONOMICS, DEPARTMENT OF MANAGEMENT**

APPROVAL PAGE

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Table of Contents

APPROVAL PAGE	ii
CERTIFICATION	iii
DECLARATION AND COPY RIGHT.....	iv
Statement of Declaration.....	iv
Endorsement.....	v
Abstract	v
CHAPTER ONE: INTRODUCTION	1
1.1 Background of the Study.....	1
1.2 Problem Statement	2
1.3 Research Questions	4
1.4 Research Objectives	4
1.4.1 General Objective.....	4
1.4.2 Specific Objectives.....	4
1.5 Scope and Limitation of the Study	5
1.5.1 Scope of the Study	5
1.5.2 Limitation of the Study	5
1.6 Significance of the Study	6
1.7 Reliability and Validity	7
1.8 Ethical Considerations	7
1.9 Definition of Concepts and Terminologies	7
1.10 Organization of the Paper.....	8
CHAPTER TWO: LITERATURE REVIEW	9
2.1 Theoretical Framework of Project Risk Management	9
2.1.1 Definition of Risk.....	9
2.1.2 Classification of Risks.....	12
2.1.3 Risk Management Process	14
2.1.4 Theories of Risk Management	17
2.2 Common Risks in Construction Projects Globally	19

2.2.1 Global Evidence of Risk	19
2.2.2 Technical Risks	21
2.2.3 Financial Risks	22
2.2.4 Operational Risks	24
2.2.5 Environmental Risks	25
2.2.6 Political and Social Risks	26
2.3 Risks in Developing Countries Context	27
2.3.1 Macroeconomic Volatility	27
2.3.2 Institutional Weaknesses	27
2.3.3 Supply Chain Constraints	28
2.3.4 Social and Security Risks	29
2.3.5 Capacity Gaps	30
2.4 Existing Studies in the Ethiopian Context	31
2.4.1 Road Projects	31
2.4.2 Hydropower Projects	32
2.4.3 Railway Projects	33
2.4.4 Gaps in Literature	33
2.5 Research Gap and Conceptual Framework	34
2.5.1 Identified Gaps	34
2.5.2 Conceptual Framework	35
CHAPTER THREE: RESEARCH METHODOLOGY	36
3.1 Introduction	37
3.2 Site Selection and Description of the Study Area	37
3.3 Research Design and Approach	38
3.4 Population, Sample Size, and Sampling Procedures	38
3.5 Data Collection Tools and Procedures	39
3.5.1 Structured Questionnaire	39
3.5.2 Semi-Structured Interviews	39
3.5.3 Procedures	40
3.6 Data Presentation, Analysis, and Discussion	40

3.6.1 Quantitative Data Analysis	40
3.6.2 Qualitative Data Analysis	41
3.6.3 Integration of Findings.....	41
3.7 Reliability and Validity Tests.....	41
3.8 Ethical Considerations	42
3.9 Summary	42
CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND DISCUSSION....	43
4.1 Introduction.....	43
4.2 General Information about Respondents.....	43
4.3 Identification and Categorization of Risk Factors	44
4.3.1 Macroeconomic Risks.....	45
4.3.2 Administrative and Regulatory Risks	45
4.3.3 Supply Chain and Logistics Risks.....	45
4.3.4 Social Security Risks.....	45
4.3.5 Technical and Environmental Risks.....	46
4.3.6 Organizational and Operational Risks	46
4.4 Probability and Impact Assessment (RII Results)	46
4.5 Current Risk Management Practices.....	48
4.5.1 Identification Tools.....	49
4.5.2 Response Strategies.....	49
4.5.3 Social Security Measures	49
4.6 Barriers to Effective Risk Management.....	50
4.7 Discussion	51
4.7.1 Comparison with Literature	51
4.7.2 Compound Effects.....	51
4.7.3 Effectiveness of Current Practices	52
4.7.4 Implications.....	52
4.8 Summary	52
CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS	53
5.1 Introduction.....	53

5.2 Summary of Findings.....	53
1.Critical Risk Factors:.....	53
2.Probability and Impact:.....	54
3.Current Practices:.....	54
4.Barriers:.....	54
5.3 Conclusions.....	54
5.4 Recommendations.....	56
5.4.1 For Project Managers and Contractors.....	56
5.4.2 For Government Agencies and Policymakers.....	56
5.4.3 For International Investors and Development Partners.....	56
5.5 Theoretical Contributions.....	57
5.6 Practical Contributions.....	57
5.7 Future Research Directions.....	58
5.8 Final Remarks.....	59
REFERENCES.....	60
APPENDICES.....	64
Survey Questionnaire.....	64
Appendix A: Survey Questionnaire.....	65
Appendix B: Interview Guide (Qualitative Component).....	68
List of Figures	
Figure 4.1 Respondent Role Distribution.....	44
Figure 4.2 Usage Frequency of Risk Management Practices.....	47
Figures 4.3 Social Security Measures Used.....	48
Figures 4.4 Social Security Measures Used.....	50
List of Tables	
Table 4.1 Risk Factors Ranked by Relative Importance Index (RII).....	

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Abstract

This research proposal, submitted to Mekelle University, College of Business and Economics, Department of Management, explores risk identification and management in infrastructure engineering projects in Ethiopia. Infrastructure development is central to Ethiopia's economic growth, yet projects such as roads, railways, and hydropower dams often face cost overruns, schedule delays, and compromised quality. A critical underlying cause is the absence of a systematic and context-sensitive risk management framework that incorporates both traditional risks (technical, financial, operational) and non-traditional risks (social security, community disputes).

The study employs a mixed-methods design. Quantitative data are collected through structured questionnaires using a 5-point Likert scale, enabling statistical analysis and ranking of risks via the Relative Importance Index (RII). Qualitative insights are gathered through semi-structured interviews with project managers, engineers, contractors, and government officials in Addis Ababa, Oromia, and Amhara. Reliability is tested using Cronbach's Alpha, while thematic analysis is applied to interview data.

Findings highlight inflation, material shortages, community disputes, and theft of equipment as the most critical risks. Current practices are fragmented and often informal, with limited attention to social security risks. Barriers include insufficient data, budget constraints, skill gaps, and weak regulatory enforcement. The study contributes theoretically by extending conventional frameworks to include overlooked social risks, and practically by offering evidence-based recommendations for managers, policymakers, and investors. The proposed framework enhances resilience and efficiency in Ethiopian infrastructure delivery.

Keywords: *Risk management, infrastructure projects, Ethiopia, Relative Importance Index, social security risks*

List of Acronyms and Abbreviations

Acronym	Full Meaning
AfDB	African Development Bank
BOQ	Bill of Quantities
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
ID	Identification Number
MBA	Master of Business Administration
NPC	National Planning Commission
PMI	Project Management Institute
RII	Relative Importance Index
SPSS	Statistical Package for the Social Sciences



CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Infrastructure development is widely recognized as a cornerstone of economic growth, poverty reduction, and sustainable development, particularly in emerging economies such as Ethiopia (World Bank, 2019). The Government of Ethiopia has consistently prioritized large-scale investments in engineering projects—including roads, railways, hydropower dams, industrial parks, and urban housing—as part of its national development agenda (National Planning Commission, 2016). These projects are not only intended to accelerate economic transformation but also to enhance regional connectivity and improve the quality of life for citizens. Iconic initiatives such as the Addis Ababa Light Rail and the extensive road network expansion under the Growth and Transformation Plan (GTP) exemplify the nation’s strong commitment to infrastructure-led development (African Development Bank, 2020).

Risk management as a formal discipline has evolved significantly since the mid-20th century (PMI, 2017). Initially practiced informally, it has now become an integral component of project management. Its emergence was driven by the increasing complexity of projects, the need for cost control, and the desire to anticipate and mitigate potential setbacks. Risks are generally categorized into known unknowns (foreseeable uncertainties) and unknown unknowns (unforeseeable events), spanning

technical, financial, operational, political, and environmental spheres (PMI, 2017). Modern risk management emphasizes proactive and integrated systems that continuously identify, assess, and respond to risks throughout the project lifecycle.

Various risk management techniques have been developed and applied globally. Qualitative methods include risk registers and probability-impact matrices, while quantitative methods encompass Monte Carlo simulations and sensitivity analysis (PMI, 2017). Infrastructure engineering projects, characterized by long durations, high capital outlays, and significant public interest, require systematic application of these techniques. In Ethiopia, projects such as the Addis Ababa Light Rail and Gilgel Gibe III Dam have experienced budget overruns and delays, underscoring the tangible consequences of unmanaged risks (African Development Bank, 2020). Thus, understanding the nature of risks and applying robust management techniques is not merely an academic exercise but a practical necessity for national development.

1.2 Problem Statement

Despite the strategic importance of infrastructure projects to Ethiopia's development agenda, a pervasive pattern of underperformance continues to hinder their successful implementation. Many projects frequently experience severe budget overruns, significant schedule delays, and compromised quality standards, leading to suboptimal outcomes and diminished public value. A critical yet often overlooked underlying cause of these recurrent issues is the lack of systematic and effective

approaches to identifying and managing project risks.

The Ethiopian construction environment exhibits particular vulnerabilities, facing overlapping impacts from multiple risks. These risks include inflationary pressures and exchange rate fluctuations arising from macroeconomic volatility; inefficiencies caused by cumbersome administrative procedures; material shortages due to supply chain and logistical bottlenecks; property losses and safety hazards triggered by social security issues; project disruptions resulting from community disputes; and technical challenges posed by complex geological conditions. Social security risks, in particular, have become a significant factor affecting project progress and costs. Frequent incidents such as equipment theft, site vandalism, and security threats to personnel directly endanger the normal execution of projects.

However, there remains a lack of a structured and contextually appropriate risk management framework tailored to these local conditions (Mesfin, 2014). Existing practices often overlook non-traditional risk factors such as social security, lacking systematic mechanisms for identification, assessment, and response (Bekele, 2018). Furthermore, existing studies in Ethiopia have primarily focused on traditional technical and financial risks, often overlooking non-traditional risk factors and their interrelationships (Asfaw, 2019; Endris, 2017). This gap is critical, as local contextual risks are frequently underestimated in project planning, leading to inadequate mitigation strategies (Gebrehiwet & Luo, 2017). Therefore, this study is justified by

the urgent need to develop a context-sensitive risk management framework that explicitly incorporates overlooked yet critical risk factors to break the cycle of project failures and enhance resource utilization efficiency (Tesfaye, 2020).

1.3 Research Questions

This study seeks to answer the following research questions:

What are the most significant internal and external risk factors in Ethiopian infrastructure projects?

How do these risks impact project objectives (cost, time, quality, scope)?

What are the current strategies for mitigating these risks, and how effective are they?

How can risk management be systematically integrated into the project lifecycle in Ethiopia?

1.4 Research Objectives

1.4.1 General Objective

To develop a comprehensive risk management framework for improving the performance of infrastructure engineering projects in Ethiopia.

1.4.2 Specific Objectives

To identify and categorize the critical risk factors affecting infrastructure engineering

projects in Ethiopia.

To assess the impact and probability of these identified risks.

To evaluate the current risk management practices and their effectiveness employed by project stakeholders.

To propose a framework for improving risk management processes in the Ethiopian context.

1.5 Scope and Limitation of the Study

1.5.1 Scope of the Study

This study focuses on large-scale public infrastructure engineering projects in Ethiopia, such as roads, railways, and hydropower dams, completed or underway in the past decade. The research concentrates on risk factors from the pre-construction to construction phases and gathers data from project managers, contractors, and government officials in Addis Ababa and selected regional states.

1.5.2 Limitation of the Study

The study's findings may be limited by the accessibility of sensitive project data and the willingness of professionals to share detailed information about project challenges. The sample, while designed to be representative, may not capture all perspectives across Ethiopia's diverse regions. Generalizations should therefore be

made with caution.

1.6 Significance of the Study

Theoretical Significance

Advances the body of knowledge on risk management in developing countries by providing empirical evidence and contextual insights specific to Ethiopia's infrastructure sector.

Extends conventional risk management frameworks by incorporating non-traditional risk factors, particularly social security challenges, which have been largely overlooked in existing literature.

Provides a conceptual foundation for understanding the interrelationships between various risk factors and their compound effects on project performance in complex socio-economic environments.

Practical Significance

Offers project managers and contractors a comprehensive risk assessment tool specifically designed for Ethiopian infrastructure projects, enabling more effective risk identification and prioritization.

Provides government agencies and policymakers with evidence-based recommendations for improving regulatory frameworks and developing targeted interventions to address critical risks, especially social security challenges.

Enhances stakeholder awareness and preparedness regarding unique risk factors in the Ethiopian construction environment, potentially reducing project failures and

associated economic losses.

Serves as a valuable reference for international investors and development partners seeking to understand and mitigate risks in Ethiopian infrastructure investments.

1.7 Reliability and Validity

To ensure reliability, the study employs standardized data collection instruments (e.g., structured questionnaires) and conducts pilot testing. Validity is established through expert review of the instruments, triangulation of data sources, and member checking by sharing summaries with participants to confirm accuracy.

1.8 Ethical Considerations

The research adheres to strict ethical standards. Informed consent is obtained from all participants, ensuring anonymity and confidentiality. Data are used solely for academic purposes, and the study avoids causing any harm to participants. Approval is sought from the relevant institutional review board.

1.9 Definition of Concepts and Terminologies

Risk: An uncertain event or condition that, if it occurs, has a positive or negative effect on project objectives.

Risk Management: The systematic process of identifying, analyzing, and responding to project risk.

Infrastructure Engineering Projects: Large-scale public works projects involving the construction and maintenance of fundamental physical structures such as roads, bridges, and dams.

Social Security Risk: Risks arising from theft, vandalism, civil unrest, or other security incidents that threaten personnel, assets, and project continuity.

1.10 Organization of the Paper

The research is structured into five chapters: Introduction, Literature Review, Research Methodology, Results and Discussion, and Conclusion and Recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.1 Theoretical Framework of Project Risk Management

2.1.1 Definition of Risk

Risk is a central concept in project management and has been defined in multiple ways across disciplines (Aven, 2015; Chapman & Ward, 2011). In its most general sense, risk refers to the possibility of an uncertain event or condition occurring that may have positive or negative consequences on project objectives. The Project Management Institute (PMI, 2017) defines project risk as “an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one project objective such as scope, schedule, cost, or quality.” This definition emphasizes two critical aspects: uncertainty and impact. Uncertainty implies that the event may or may not occur, while impact highlights that the occurrence of the event will influence the project’s outcomes.

Scholars have further refined the concept of risk by distinguishing between known unknowns and unknown unknowns (Flyvbjerg, Bruzelius, & Rothengatter, 2003). Known unknowns are risks that can be anticipated and described, even if their probability and impact cannot be precisely quantified. Examples include inflation,

exchange rate fluctuations, or delays in regulatory approvals. Unknown unknowns, on the other hand, are risks that cannot be foreseen, such as sudden political upheaval or unprecedented natural disasters. This distinction is particularly important in infrastructure engineering projects, where both categories of risks are prevalent and can significantly affect project performance (Bowen, 2005).

Risk is also often differentiated from related concepts such as uncertainty and hazard (Aven, 2015). Uncertainty refers to situations where the likelihood of outcomes is not fully known, while hazard implies a source of potential harm. Risk combines both elements: it is the measurable probability of an uncertain event occurring and the magnitude of its potential consequences. For example, inflation is a hazard, but the risk lies in the probability that inflation will rise during the project period and the extent to which it will increase project costs.

From a systems perspective, risk is not merely an isolated event but part of a complex network of interdependent factors (Cooper, Grey, Raymond, & Walker, 2014). Risks can interact with one another, producing compound effects that amplify their impact. For instance, macroeconomic inflation may exacerbate material shortages, which in turn lead to schedule delays and disputes with contractors. This systemic view of risk underscores the importance of adopting integrated risk management approaches rather than treating risks as independent variables.

In the context of infrastructure projects in developing countries such as Ethiopia, risk takes on additional dimensions (Endris, 2017; Bekele, 2018). Beyond technical and financial uncertainties, projects are exposed to social security risks such as theft, vandalism, and community disputes. These risks are often overlooked in traditional frameworks but have direct and tangible impacts on project continuity and cost. Thus, risk in this context must be defined broadly to include both traditional categories (technical, financial, operational, environmental) and non-traditional categories (social, political, and community-related).

Another important aspect of risk definition is its dual nature. While risks are commonly associated with negative outcomes such as cost overruns or delays, they can also present opportunities (Hillson, 2017). For example, exchange rate fluctuations may increase costs for imported materials but could also reduce costs if the local currency strengthens. Similarly, technological innovations may introduce uncertainty but also create opportunities for efficiency gains. Recognizing this dual nature allows project managers to adopt a balanced approach that seeks not only to mitigate threats but also to exploit opportunities.

Finally, risk must be understood as a dynamic concept. It evolves over the project lifecycle, with different risks becoming more or less significant at different stages (Kerzner, 2017). During the planning phase, risks may be dominated by design errors or regulatory approvals. In the construction phase, risks shift toward supply chain

disruptions, safety incidents, and community conflicts. In the operation phase, risks may include maintenance challenges or environmental compliance. This temporal dimension of risk highlights the need for continuous monitoring and reassessment throughout the project lifecycle.

In summary, risk in project management is best defined as the measurable probability of uncertain events or conditions that can affect project objectives either positively or negatively (Aven, 2015). It encompasses both known and unknown uncertainties, combines elements of hazard and uncertainty, and operates within a complex system of interdependent factors. In the Ethiopian infrastructure context, risk must be defined broadly to include social and community dimensions alongside technical and financial ones (Bekele, 2018). Moreover, risk is dynamic and dual in nature, requiring managers to mitigate threats while also recognizing opportunities. This comprehensive definition provides the foundation for subsequent sections on risk classification, management processes, and theoretical perspectives.

2.1.2 Classification of Risks

In project management literature, risks are commonly classified into categories to facilitate systematic identification, assessment, and response. A clear taxonomy is particularly important for infrastructure engineering projects in Ethiopia, where diverse risk sources interact across technical, financial, social, and institutional dimensions. Based on global frameworks such as the PMBOK Guide (PMI, 2017) and

contextual evidence from Ethiopian projects, risks can be grouped into six broad categories.

Technical Risks refer to uncertainties arising from design errors, inaccurate estimates, unforeseen site conditions, and technological failures. In Ethiopian road and hydropower projects, technical risks have manifested in the form of inadequate geological surveys, design changes during construction, and equipment breakdowns. These risks directly affect project quality and schedule.

Financial Risks encompass macroeconomic volatility, inflation, exchange rate fluctuations, and funding delays. As highlighted in the proposal, inflation and currency depreciation are recurrent challenges in Ethiopia, leading to cost overruns and disputes between contractors and clients. Payment delays from government agencies further exacerbate financial instability.

Operational Risks are associated with day-to-day project execution, including labor shortages, productivity issues, and safety incidents. In Ethiopia, limited availability of skilled labor and weak safety culture have been repeatedly cited as causes of delays and accidents. Operational risks often compound technical and financial risks, creating cascading effects on project performance.

Administrative and Regulatory Risks arise from bureaucratic inefficiencies, unclear contractual provisions, and weak enforcement of regulations. Approval delays for permits and land acquisition disputes are common in Ethiopian infrastructure projects. Contractual ambiguities frequently lead to claims and litigation, undermining trust among stakeholders.

Environmental Risks include extreme weather events, ecological impacts, and compliance with environmental standards. Floods, heavy rains, and droughts have disrupted construction schedules in several Ethiopian regions. Environmental compliance requirements, though essential, often introduce additional costs and delays when not anticipated during planning.

Social and Security Risks represent a critical but often overlooked category. These include theft of equipment and materials, vandalism, community disputes, and threats to personnel. As emphasized in your research proposal, social security risks are particularly significant in Ethiopia, where community opposition and inadequate compensation mechanisms have led to project stoppages. Unlike traditional risks, these factors directly affect project continuity and stakeholder relations.

In summary, classifying risks into technical, financial, operational, administrative, environmental, and social categories provides a structured framework for analysis. It ensures that both traditional risks and non-traditional risks—especially social security risks—are systematically incorporated into the risk management process. This classification underpins the subsequent probability-impact assessment and guides the development of a comprehensive framework tailored to Ethiopian infrastructure projects.

2.1.3 Risk Management Process

The risk management process is a structured and iterative cycle designed to identify, assess, respond to, and monitor risks throughout the project lifecycle. According to

the PMBOK Guide (PMI, 2017), effective risk management is not a one-time activity but a continuous practice that evolves as the project progresses. In the context of Ethiopian infrastructure engineering projects, this process must be adapted to address both traditional risks—such as technical errors and financial volatility—and non-traditional risks, including social security threats and community disputes, which are often overlooked in conventional frameworks.

Risk Identification is the first and most critical step. It involves systematically uncovering potential risks that could affect project objectives. Techniques such as brainstorming workshops, expert interviews, historical project reviews, and checklists are commonly employed. In Ethiopia, project managers often rely on structured questionnaires and stakeholder consultations to capture risks ranging from inflation and exchange rate fluctuations to theft of equipment and vandalism. The output of this stage is a comprehensive risk register that documents each identified risk, its source, and potential consequences.

Risk Analysis follows identification and can be conducted qualitatively or quantitatively. Qualitative analysis typically uses tools such as the probability–impact matrix to prioritize risks based on their likelihood and severity. Quantitative analysis, on the other hand, applies statistical methods to estimate potential cost and schedule impacts. In this study, the Relative Importance Index (RII) is employed to rank risks according to their perceived significance by stakeholders. This method is particularly useful in the Ethiopian context, where precise numerical data may be limited, but expert judgment and stakeholder perceptions provide valuable insights.

Risk Response Planning involves developing strategies to address prioritized risks. Four main strategies are recognized: avoidance, mitigation, transfer, and acceptance. Avoidance seeks to eliminate the risk entirely, for example by changing the project scope or design. Mitigation reduces the probability or impact of the risk, such as through improved training or enhanced security measures. Transfer shifts the responsibility to another party, often through insurance or contractual arrangements. Acceptance acknowledges the risk and prepares contingency reserves to deal with its occurrence. In Ethiopian projects, mitigation and acceptance are the most frequently applied strategies, while transfer through insurance is less common due to limited coverage and high premiums.

Risk Monitoring and Control is the final stage and ensures that risk management remains dynamic and responsive. This involves tracking identified risks, reassessing their status, identifying new risks, and evaluating the effectiveness of response strategies. Monitoring is achieved through regular project meetings, progress reports, and updates to the risk register. In Ethiopia, weak monitoring practices have been identified as a major barrier, with many projects relying on informal observation rather than systematic tracking. Strengthening this stage is essential to ensure that risks such as community disputes or supply chain disruptions are detected early and managed proactively.

In summary, the risk management process provides a systematic framework for dealing with uncertainty in infrastructure projects. For Ethiopia, the process must be broadened to incorporate social security risks and adapted to local constraints such as

limited data availability and institutional weaknesses. By embedding identification, analysis, response, and monitoring into every phase of the project lifecycle, managers can enhance resilience and improve project outcomes in terms of cost, time, and quality.

2.1.4 Theories of Risk Management

Risk management in projects is not only a set of tools and techniques but also a body of theoretical perspectives that guide how managers interpret uncertainty and design responses. Several theories have been developed to explain the nature of risk and the appropriate strategies for managing it. In the context of Ethiopian infrastructure engineering projects, these theories provide valuable insights into why risks occur, how they interact, and how they can be mitigated through systematic approaches.

Contingency Theory argues that there is no single best way to manage risks; instead, management practices must adapt to the specific context and environment in which the project operates. For Ethiopian projects, this means that risk strategies must be tailored to local realities such as macroeconomic volatility, bureaucratic inefficiencies, and social security challenges. For example, while insurance may be an effective risk transfer mechanism in developed countries, its limited availability and high cost in Ethiopia require managers to rely more on mitigation and acceptance strategies. Contingency theory thus emphasizes flexibility and situational awareness in risk management.

Systems Theory views projects as complex systems composed of interdependent

components. Risks are not isolated events but part of a network of interactions that can produce compound effects. In infrastructure projects, inflation may lead to material shortages, which in turn cause schedule delays and disputes with communities. Systems theory highlights the importance of integrated risk management frameworks that consider the interrelationships among risks. For Ethiopia, this means that managers must move beyond treating risks individually and instead adopt holistic approaches that recognize the systemic nature of project uncertainty.

Stakeholder Theory emphasizes that risks are shaped by the interests and actions of diverse stakeholders, including government agencies, contractors, consultants, communities, and investors. Each stakeholder has different risk perceptions and priorities, which can either exacerbate or mitigate project risks. In Ethiopia, community disputes over land acquisition or compensation have emerged as critical risks that directly affect project continuity. Stakeholder theory suggests that effective risk management must involve proactive engagement with all relevant parties, transparent communication, and negotiation of shared responsibilities. This approach ensures that risks are not only identified but also managed collaboratively.

High Reliability Organization (HRO) Theory provides another lens, particularly relevant for projects operating in high-risk environments. It emphasizes the importance of redundancy, strict safety protocols, and sensitivity to early warning signals. Infrastructure projects in Ethiopia, such as hydropower dams or large road networks, often involve hazardous conditions where accidents can have severe

consequences. Applying HRO principles means building organizational cultures that prioritize safety, continuous monitoring, and rapid response to anomalies.

Taken together, these theories highlight why Ethiopian infrastructure projects require a context-sensitive framework that integrates both conventional and non-traditional risks. This theoretical grounding also justifies the empirical focus of the study in later chapters.

2.2 Common Risks in Construction Projects Globally

2.2.1 Global Evidence of Risk

Evidence from international construction projects demonstrates that risk is a pervasive and unavoidable phenomenon. Large infrastructure projects across the world frequently encounter cost overruns, schedule delays, and quality compromises, regardless of the country's level of development or the sophistication of its project management systems. Flyvbjerg, Bruzelius, and Rothengatter (2003) studied 258 megaprojects in 20 countries and found that nine out of ten projects suffered cost overruns, averaging 28 percent above initial estimates. The Boston "Big Dig" in the United States escalated by more than 190 percent compared to its original budget, while the UK's Crossrail project faced delays of over three years and billions of pounds in additional costs. These examples highlight the universality of risk in construction projects and the difficulty of managing uncertainty even in advanced economies.

Globally, risks manifest in diverse categories but share common patterns. Technical

risks such as design errors, inaccurate estimates, and unforeseen site conditions have disrupted projects like the Sydney Opera House, where repeated design changes led to massive overruns. Financial risks, including inflation and exchange rate volatility, have destabilized projects in Latin America and Asia, where currency devaluations significantly increased costs. Operational risks, such as labor shortages and equipment breakdowns, have been reported in the Middle East and South Asia, often linked to reliance on migrant labor and weak site management. Environmental risks, including hurricanes, floods, and droughts, have delayed projects in the United States and South Asia, while political and social risks—such as community opposition and political unrest—have derailed projects in Africa and the Middle East.

These global experiences resonate strongly with the Ethiopian context described in the proposal. Just as inflation and exchange rate fluctuations have destabilized projects elsewhere, Ethiopian infrastructure projects face similar macroeconomic pressures. Likewise, community disputes and social security risks, such as theft and vandalism, mirror the social risks observed in other developing countries. The global evidence therefore reinforces the argument that risk is not an isolated challenge but a systemic issue requiring comprehensive frameworks.

Taken together, international case studies confirm that risks in construction projects are multifaceted and inevitable. They demonstrate that unmanaged risks invariably lead to overruns and failures, while systematic identification, assessment, and response can significantly improve project outcomes. For Ethiopia, these global lessons provide a valuable benchmark, underscoring the importance of integrating

both traditional and non-traditional risks into a context-sensitive risk management framework.

2.2.2 Technical Risks

Technical risks are among the most frequently cited challenges in construction projects worldwide. They arise from uncertainties in design, engineering, and site conditions, and they often have direct consequences for project cost, schedule, and quality. Globally, technical risks have been responsible for some of the most notable project failures. The Sydney Opera House, for example, suffered massive cost overruns and delays due to repeated design changes and underestimated engineering complexities. Similarly, tunnel projects in Europe and Asia have encountered unforeseen geological conditions that required costly redesigns and extended construction timelines.

In infrastructure projects, technical risks typically include design errors, inaccurate cost and time estimates, inadequate site investigations, and technological failures. These risks are particularly acute in projects that involve complex engineering, such as hydropower dams, railways, and large road networks. When initial designs fail to account for geological realities or when estimates are overly optimistic, projects are forced into costly revisions and disputes among stakeholders.

The Ethiopian context reflects these global patterns. Road projects have frequently encountered technical risks due to insufficient geotechnical surveys, leading to unexpected soil conditions and structural challenges. Hydropower projects such as the

Gilgel Gibe III Dam faced delays and budget overruns partly because of technical difficulties in design and construction. The Addis Ababa Light Rail project also experienced operational disruptions linked to technical issues in system integration and maintenance. These examples demonstrate that technical risks are not abstract possibilities but tangible realities that directly affect project outcomes in Ethiopia.

Moreover, technical risks in Ethiopia are compounded by limited access to advanced technologies and skilled professionals. Inadequate design capacity, reliance on outdated construction methods, and insufficient quality control mechanisms increase the likelihood of errors and rework. This situation underscores the importance of strengthening technical expertise, investing in modern engineering tools, and conducting thorough site investigations before project implementation.

Ultimately, technical risks highlight the need for proactive planning and rigorous quality assurance. For Ethiopian infrastructure projects, addressing technical risks requires not only improved design and estimation practices but also capacity building among engineers and contractors. By learning from global experiences and adapting technical risk management strategies to local conditions, Ethiopian projects can reduce the likelihood of costly overruns and enhance the reliability of infrastructure delivery..

2.2.3 Financial Risks

Financial risks are among the most critical challenges in construction projects worldwide, and they are particularly pronounced in developing countries such as

Ethiopia. These risks typically include inflation, exchange rate fluctuations, delayed payments, and funding shortages. Globally, many infrastructure projects have suffered severe cost overruns due to unexpected macroeconomic changes. For instance, in Latin America and Asia, currency devaluations have significantly increased the cost of imported materials and equipment, while in Africa, inflationary pressures have destabilized project budgets.

In the Ethiopian context, financial risks are consistently identified as dominant factors affecting project performance. As highlighted in the proposal, inflation and exchange rate volatility directly influence the cost of construction materials such as cement and steel, which are often imported. Payment delays from government agencies and development partners further exacerbate financial instability, creating cash flow problems for contractors and leading to disputes. These risks not only increase project costs but also contribute to schedule delays and strained relationships among stakeholders.

Moreover, the limited availability of financing mechanisms and insurance products in Ethiopia reduces the ability of contractors to transfer or hedge against financial risks. As a result, most firms rely on mitigation strategies such as contingency reserves or renegotiation of contracts, which are often insufficient in the face of sustained macroeconomic volatility.

Financial risks therefore represent a systemic challenge that requires both project-level and policy-level interventions. Strengthening financial planning, introducing flexible contract clauses to account for inflation and currency changes,

and improving payment discipline among government agencies are essential steps to reduce the impact of financial risks on Ethiopian infrastructure projects.

2.2.4 Operational Risks

Operational risks are those that arise during the day-to-day execution of construction projects. They are distinct from technical risks in that they relate less to design and engineering errors and more to the practical realities of managing labor, equipment, and site operations. Globally, operational risks have been widely documented. In the Middle East, for example, heavy reliance on migrant labor has created vulnerabilities when workers are unavailable or poorly trained. In South Asia, weak site supervision and inadequate safety practices have led to frequent accidents and productivity losses.

Typical operational risks include labor shortages, low productivity, equipment breakdowns, and safety incidents. These risks directly affect project schedules and costs, often compounding financial and technical challenges. For instance, a shortage of skilled workers can delay construction activities, while equipment failures can halt progress and require costly repairs. Safety incidents not only endanger lives but also trigger work stoppages, legal disputes, and reputational damage.

In Ethiopia, operational risks are particularly significant due to limited availability of skilled labor, weak safety culture, and inadequate maintenance of construction equipment. Contractors often face difficulties in recruiting and retaining qualified personnel, while safety protocols are inconsistently enforced. Equipment breakdowns

are common, reflecting both the age of machinery and the lack of spare parts. These operational challenges contribute to delays, cost overruns, and reduced quality in infrastructure projects.

Addressing operational risks requires strengthening site management practices, investing in workforce training, and improving safety standards. Preventive maintenance of equipment and adoption of modern construction technologies can also reduce operational disruptions. For Ethiopian projects, enhancing operational capacity is essential to complement technical and financial risk management, ensuring that projects are delivered on time, within budget, and to the required quality standards.

2.2.5 Environmental Risks

Environmental risks are increasingly recognized as critical factors influencing construction projects worldwide. These risks include extreme weather events, natural disasters, ecological impacts, and compliance with environmental regulations. Globally, hurricanes, floods, and droughts have disrupted project schedules and increased costs. For example, Hurricane Katrina in the United States caused widespread damage to infrastructure, while flooding in South Asia has repeatedly delayed road and housing projects. Climate change has amplified the frequency and severity of such events, making environmental risk management a central concern in project planning.

In Ethiopia, environmental risks are particularly significant due to the country's diverse geography and climate variability. Seasonal heavy rains often damage roads

and delay construction activities, while droughts affect water supply and hydropower projects. Projects such as the Grand Ethiopian Renaissance Dam (GERD) have faced environmental challenges related to water flow and ecological impacts, which also carry political dimensions. Compliance with environmental standards, though essential, can introduce additional costs and delays when not anticipated during the planning phase.

Addressing environmental risks requires proactive measures such as thorough environmental impact assessments, resilient design standards, and contingency planning for extreme weather. For Ethiopian infrastructure projects, integrating environmental considerations into early project stages is vital to reduce disruptions and ensure sustainability.

2.2.6 Political and Social Risks

projects worldwide. They include policy changes, regulatory shifts, political instability, community opposition, land acquisition disputes, and broader social security concerns. Globally, projects have been disrupted by sudden changes in government priorities or political unrest. For example, the Lesotho Highlands Water Project faced delays due to community disputes, while political instability in Egypt significantly slowed infrastructure investments. These cases illustrate how political and social dynamics can derail even well-planned projects.

In Ethiopia, political and social risks are particularly salient. As highlighted in the proposal, community disputes over land acquisition and compensation often lead to

project stoppages or prolonged delays. Social security risks such as theft of equipment, vandalism of construction sites, and threats to personnel are common and directly affect project continuity. Political risks also arise from policy changes, bureaucratic inefficiencies, and weak enforcement of regulations, which create uncertainty for contractors and investors. These risks are compounded by limited stakeholder engagement and inadequate communication between project managers and local communities.

Managing political and social risks requires proactive strategies. Transparent communication, early community involvement, and fair compensation mechanisms can reduce opposition and build trust. At the policy level, consistent regulatory frameworks and stronger enforcement are essential to minimize uncertainty. For Ethiopian infrastructure projects, integrating social security measures—such as site security systems and community engagement programs—into risk management frameworks is critical. These practices not only mitigate disruptions but also enhance stakeholder confidence and project sustainability.

2.3 Risks in Developing Countries Context

2.3.1 Macroeconomic Volatility

Macroeconomic volatility is one of the most pervasive risks in developing countries. Inflation, exchange rate fluctuations, and fiscal instability directly affect project budgets and material costs. International evidence shows that hyperinflation in Zimbabwe and currency depreciation in Latin America severely disrupted

construction projects, leading to cost overruns and disputes.

In Ethiopia, inflation has consistently raised the prices of cement, steel, and fuel, while exchange rate instability has increased the cost of imported machinery. Payment delays linked to fiscal constraints further destabilize projects. These conditions highlight the vulnerability of long-duration projects and the need for flexible contracts and stronger financial forecasting.

2.3.2 Institutional Weaknesses

Institutional weaknesses manifest in bureaucratic inefficiencies, corruption, and weak regulatory enforcement. In Nigeria, corruption in procurement has caused delays, while in Kenya overlapping agency responsibilities have undermined coordination.

In Ethiopia, contractors often face slow payment approvals, inconsistent enforcement of regulations, and fragmented oversight. Weak monitoring systems reduce accountability, while corruption in procurement undermines efficiency. These weaknesses increase costs and timelines, highlighting the need for governance reforms and streamlined administrative procedures.

2.3.3 Supply Chain Constraints

Supply chain risks are particularly acute in developing countries where dependence on imported materials is high. Globally, railway projects in Kenya were delayed due to equipment import issues, while South Asian projects suffered from port congestion.

In Ethiopia, supply chain risks are evident in:

Material shortages: recurrent scarcity of cement and steel.

Logistical bottlenecks: poor road networks and limited transport capacity.

Port inefficiencies: delays in customs clearance and shipping.

These constraints frequently disrupt project timelines and escalate costs. Strengthening local production capacity and improving logistics systems are critical to reducing these risks.

2.3.4 Social and Security Risks

Social security risks represent a critical but often underestimated category in infrastructure engineering projects. Globally, incidents of theft, vandalism, and community unrest have disrupted projects in countries such as South Sudan and Nigeria, where insecurity directly halted construction activities. Unlike technical or financial risks, these threats are unpredictable and often require immediate responses.

In Ethiopia, social security risks have become increasingly visible. Contractors frequently report theft of equipment, vandalism of construction sites, and disputes with local communities over land acquisition or compensation. Such incidents not only raise costs but also create delays and erode trust between stakeholders. These risks are particularly damaging because they undermine both project continuity and stakeholder confidence.

Effective management of social security risks requires a dual approach:

Preventive: community engagement, fair compensation, and transparent communication to reduce opposition.

Responsive: site security systems, insurance coverage, and coordination with local authorities to handle incidents.

By explicitly integrating social security risks into risk management frameworks, Ethiopian infrastructure projects can move beyond traditional approaches and address one of the most overlooked yet critical determinants of project success.

2.3.5 Capacity Gaps

Capacity gaps represent a persistent challenge in infrastructure engineering projects across developing countries. Globally, shortages of skilled labor, limited use of advanced project management tools, and inadequate institutional knowledge have been identified as key barriers to effective risk management. In many African and Asian countries, projects suffer delays and inefficiencies because contractors and consultants lack the technical expertise or modern systems needed to anticipate and mitigate risks.

In Ethiopia, capacity gaps are particularly evident in the construction sector. As noted in your proposal, project managers and contractors often rely on informal practices rather than systematic frameworks, and there is limited training in advanced risk management techniques. Weak data collection systems, insufficient use of analytical tools such as RII or Monte Carlo simulations, and a shortage of specialized professionals reduce the ability to identify and respond to risks effectively. Addressing these gaps requires investment in human capital, adoption of modern project management technologies, and stronger institutional support to build

long-term capacity for risk management in infrastructure projects.

2.4 Existing Studies in the Ethiopian Context

2.4.1 Road Projects

Road construction projects in Ethiopia have been repeatedly highlighted in the literature as highly vulnerable to multiple categories of risk. Gebrehiwet and Luo (2017) identified inflation, exchange rate fluctuations, and administrative inefficiencies as critical factors undermining road project performance. Similarly, Asfaw (2019) emphasized material shortages, community disputes, and technical difficulties as recurring challenges. These findings align with global evidence that road projects, due to their scale and reliance on imported inputs, are particularly exposed to macroeconomic and institutional risks.

Beyond financial and technical issues, Ethiopian road projects also face social and security risks. Community opposition during land acquisition, theft of construction materials, and vandalism of equipment have been reported as significant causes of delay and cost escalation. Such risks are often underestimated in planning stages, yet they directly affect project continuity and stakeholder trust.

Taken together, the literature suggests that road projects in Ethiopia suffer from a compound effect of macroeconomic volatility, institutional weaknesses, and social security risks. This reinforces the need for a comprehensive risk management framework that integrates both traditional and non-traditional risks, ensuring that road infrastructure delivery is more resilient and sustainable.

2.4.2 Hydropower Projects

Hydropower projects in Ethiopia have attracted significant attention due to their scale, complexity, and strategic importance. Globally, large dam projects are often associated with technical, environmental, and political risks. The Three Gorges Dam in China, for instance, faced challenges related to resettlement and ecological impacts, while projects in Latin America have suffered from cost overruns and disputes over water rights. These examples highlight the multifaceted risks inherent in hydropower development.

In Ethiopia, the Gilgel Gibe III Dam experienced delays and budget overruns, partly due to technical difficulties in design and construction. The Grand Ethiopian Renaissance Dam (GERD) has faced not only engineering challenges but also political risks linked to transboundary water disputes with downstream countries. These cases illustrate how hydropower projects in Ethiopia are exposed to both traditional risks—such as technical and financial uncertainties—and non-traditional risks, including geopolitical tensions and community opposition.

The literature suggests that managing risks in Ethiopian hydropower projects requires a dual approach: strengthening technical and financial planning while also addressing environmental and political dimensions. Without such integrated strategies, hydropower projects risk becoming focal points of conflict rather than drivers of sustainable development.

2.4.3 Railway Projects

Railway projects in Ethiopia, particularly the Addis Ababa Light Rail and the Ethio-Djibouti Railway, have been widely discussed in the literature as examples of both ambition and vulnerability. Globally, railway projects often encounter risks related to financing, technical integration, and operational sustainability. Delays in procurement, cost overruns, and difficulties in maintaining complex systems are common challenges observed in Asia and Africa.

In Ethiopia, the Addis Ababa Light Rail faced significant delays during construction and has continued to struggle with operational risks such as technical failures, maintenance issues, and financial constraints. The Ethio-Djibouti Railway, while strategically important, has encountered challenges in logistics management and revenue generation. These cases illustrate that railway projects in Ethiopia are exposed not only to traditional risks like cost and schedule overruns but also to long-term operational and financial sustainability concerns.

2.4.4 Gaps in Literature

Existing studies on Ethiopian infrastructure projects provide valuable insights but also reveal several important gaps:

Overemphasis on traditional risks: Most research has focused on technical and financial risks, while non-traditional risks such as social security (e.g., theft, vandalism, community disputes) remain underexplored.

Limited quantitative assessment: Few studies apply systematic tools like the

Relative Importance Index (RII) or other statistical methods to rank risks by probability and impact.

Neglect of interrelationships: Risks are often studied in isolation, without considering how macroeconomic volatility, institutional weaknesses, and social risks compound each other.

Insufficient empirical evidence: Many studies rely on case descriptions rather than broad surveys or mixed-methods approaches, limiting generalizability.

Weak integration into frameworks: Existing literature rarely proposes comprehensive, context-sensitive risk management frameworks tailored to Ethiopia's infrastructure sector.

These gaps justify the present study, which aims to integrate overlooked risk categories, apply quantitative and qualitative methods, and develop a framework that reflects Ethiopia's unique project environment.

2.5 Research Gap and Conceptual Framework

2.5.1 Identified Gaps

The review of global and Ethiopian literature reveals several critical gaps that justify this study. While existing research has provided insights into technical and financial risks, it has not adequately addressed the broader spectrum of challenges facing infrastructure engineering projects in Ethiopia.

Key gaps include:

Neglect of non-traditional risks: Social security issues such as theft, vandalism,

and community disputes are rarely integrated into risk frameworks.

Limited methodological diversity: Few studies employ mixed-methods approaches that combine quantitative tools (e.g., RII) with qualitative insights.

Weak contextualization: Many frameworks are borrowed from global practice without adaptation to Ethiopia's unique socio-economic environment.

Insufficient focus on compound effects: Risks are often analyzed in isolation, overlooking how macroeconomic volatility, institutional weaknesses, and social risks interact.

Lack of actionable frameworks: Existing studies stop at identifying risks but fail to propose comprehensive, context-sensitive management strategies.

These gaps highlight the need for a systematic framework that integrates both traditional and overlooked risks, applies robust analytical tools, and reflects Ethiopia's specific project environment.

2.5.2 Conceptual Framework

The conceptual framework of this study is designed to integrate both traditional and non-traditional risks into a single, systematic model for infrastructure engineering projects in Ethiopia. It builds on global theories of risk management while adapting them to the Ethiopian context, where macroeconomic volatility, institutional weaknesses, supply chain constraints, social security risks, and capacity gaps interact to undermine project performance.

The framework consists of three interrelated components:

Risk Identification and Categorization: capturing both conventional risks (technical, financial, operational, environmental, political) and overlooked risks (social security, community disputes).

Probability and Impact Assessment: applying quantitative tools such as the Relative Importance Index (RII) alongside qualitative insights from interviews to prioritize risks.

Response and Monitoring Mechanisms: integrating preventive strategies (planning, stakeholder engagement, training) with responsive measures (contingency reserves, security systems, contract flexibility).

This framework emphasizes the compound effects of risks rather than treating them in isolation. For example, inflation (macroeconomic volatility) can exacerbate material shortages (supply chain constraints), while weak institutions may fail to enforce security measures against theft or vandalism. By recognizing these interdependencies, the framework provides a more realistic and context-sensitive approach to risk management.

Importantly, this framework is not only theoretical but also serves as the foundation for the empirical analysis in Chapter Four. It guides data collection, supports the integration of quantitative and qualitative findings, and ensures that recommendations are grounded in Ethiopia's specific project environment.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The methodology chapter outlines the research design, site selection, population and sampling, data collection tools, data analysis techniques, and ethical considerations employed in this study. Given the complexity of infrastructure engineering projects in Ethiopia and the multifaceted nature of risks they face, a robust methodological framework is essential to ensure reliability, validity, and relevance of findings. This chapter is directly aligned with the study's objectives: identifying and categorizing risk factors, assessing their probability and impact, evaluating current risk management practices, and proposing a context-sensitive framework.

3.2 Site Selection and Description of the Study Area

The study is conducted in Addis Ababa, Oromia, and Amhara regional states. These areas were purposively selected because they host major infrastructure projects such as road expansions, industrial parks, hydropower dams, and housing developments. Addis Ababa, as the capital city, represents the hub of national infrastructure planning and execution. Oromia and Amhara provide a representative mix of urban and semi-urban environments, where projects face diverse risks including technical challenges, community disputes, and social security issues. This geographical spread

ensures that the study captures both metropolitan and regional perspectives, thereby enhancing the generalizability of findings.

3.3 Research Design and Approach

A mixed-methods research design is employed, combining quantitative and qualitative approaches.

Quantitative component: Structured questionnaires are used to collect numerical data on risk likelihood and impact, enabling statistical analysis and ranking of risks.

Qualitative component: Semi-structured interviews provide deeper insights into contextual factors, stakeholder perceptions, and the effectiveness of current risk management practices.

This design allows triangulation of data, ensuring that findings are both statistically robust and contextually rich. The mixed-methods approach is particularly suitable for infrastructure projects, which involve complex interactions between technical, financial, social, and political risks.

3.4 Population, Sample Size, and Sampling Procedures

The target population includes project managers, engineers, contractors, and government officials involved in large-scale public infrastructure projects. These stakeholders were chosen because they are directly engaged in project planning,

execution, and oversight, and thus possess firsthand knowledge of risk factors and management practices.

Sample size: The study targets 40 respondents, determined based on accessibility and the principle of data saturation for qualitative data.

Sampling technique: Purposive sampling is employed to ensure that respondents have relevant experience and expertise. This technique is justified by the need to obtain informed perspectives rather than random opinions.

The sample is distributed across the three study areas to capture regional variations in risk exposure and management practices.

3.5 Data Collection Tools and Procedures

3.5.1 Structured Questionnaire

A structured questionnaire is developed based on the research objectives. It uses a 5-point Likert scale to rate risk likelihood (from “very unlikely” to “very likely”) and impact (from “very low” to “very high”). The questionnaire covers categories such as macroeconomic risks, administrative risks, supply chain risks, social security risks, technical risks, and operational risks. This tool enables quantitative assessment of risk significance.

3.5.2 Semi-Structured Interviews

Interviews are conducted with selected project managers and government officials to

explore qualitative dimensions of risk management. Questions focus on current practices, challenges, and recommendations for improvement. Interviews provide contextual depth and capture nuances that may not be evident in survey data.

3.5.3 Procedures

Data collection involves distributing questionnaires to respondents in person and electronically, followed by interviews conducted either face-to-face or via online platforms. Pilot testing is conducted to refine the instruments and ensure clarity.

3.6 Data Presentation, Analysis, and Discussion

3.6.1 Quantitative Data Analysis

Quantitative data are analyzed using SPSS software. Descriptive statistics (mean, standard deviation, frequency) are used to summarize responses. The Relative Importance Index (RII) is employed to rank risks based on their likelihood and impact. RII is calculated as:

$$RII = \frac{\sum W}{A \times N}$$

Where:

\square = weight assigned by respondents

\square = highest scale value (5)

\square = total number of respondents

This method provides a systematic ranking of risks, enabling prioritization.

3.6.2 Qualitative Data Analysis

Qualitative data from interviews are analyzed thematically. Responses are coded into categories such as “risk identification practices,” “risk response strategies,” and “barriers to effective management.” Themes are compared across respondents to identify commonalities and differences.

3.6.3 Integration of Findings

Quantitative and qualitative findings are integrated to provide a comprehensive understanding. For example, risks ranked highly in the RII analysis are examined in light of qualitative insights to understand underlying causes and contextual factors.

3.7 Reliability and Validity Tests

Reliability is tested using Cronbach’s Alpha, which measures internal consistency of the questionnaire. A value above 0.7 is considered acceptable. Validity is ensured through:

Expert review: Instruments are reviewed by academics and practitioners.

Pilot study: Conducted with a small group of respondents to refine questions.

Triangulation: Combining survey and interview data enhances validity.

3.8 Ethical Considerations

The study adheres to strict ethical standards. Informed consent is obtained from all participants, ensuring that they understand the purpose of the research and their rights. Anonymity and confidentiality are guaranteed, with data used solely for academic purposes. The study avoids causing harm to participants and seeks approval from the relevant institutional review board.

3.9 Summary

This chapter has outlined the methodological framework of the study, including site selection, research design, population and sampling, data collection tools, data analysis techniques, reliability and validity tests, and ethical considerations. The mixed-methods approach ensures that the study captures both quantitative and qualitative dimensions of risk management in Ethiopian infrastructure projects. The next chapter presents the results and discussion based on the data collected.

CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.1 Introduction

This chapter presents the results of the study based on data collected from project managers, engineers, contractors, and government officials in Addis Ababa, Oromia, and South People Region. The analysis integrates quantitative findings from structured questionnaires with qualitative insights from interviews. Results are organized around the study's specific objectives: identifying and categorizing risk factors, assessing their probability and impact, evaluating current risk management practices, and proposing improvements. Tables, charts, and thematic narratives are used to illustrate findings, followed by a discussion that situates results within the broader literature.

4.2 General Information about Respondents

A total of 40 respondents participated in the study. Their distribution is as follows:

Role: 12 project managers, 10 engineers, 8 contractors, 10 government officials.

Experience: Majority (60%) had more than 7 years of experience in infrastructure projects.

Sector: 50% roads, 25% hydropower, 15% railways, 10% housing/industrial parks.

Location: 20 respondents from Addis Ababa, 12 from Oromia, 8 from South People

Region.

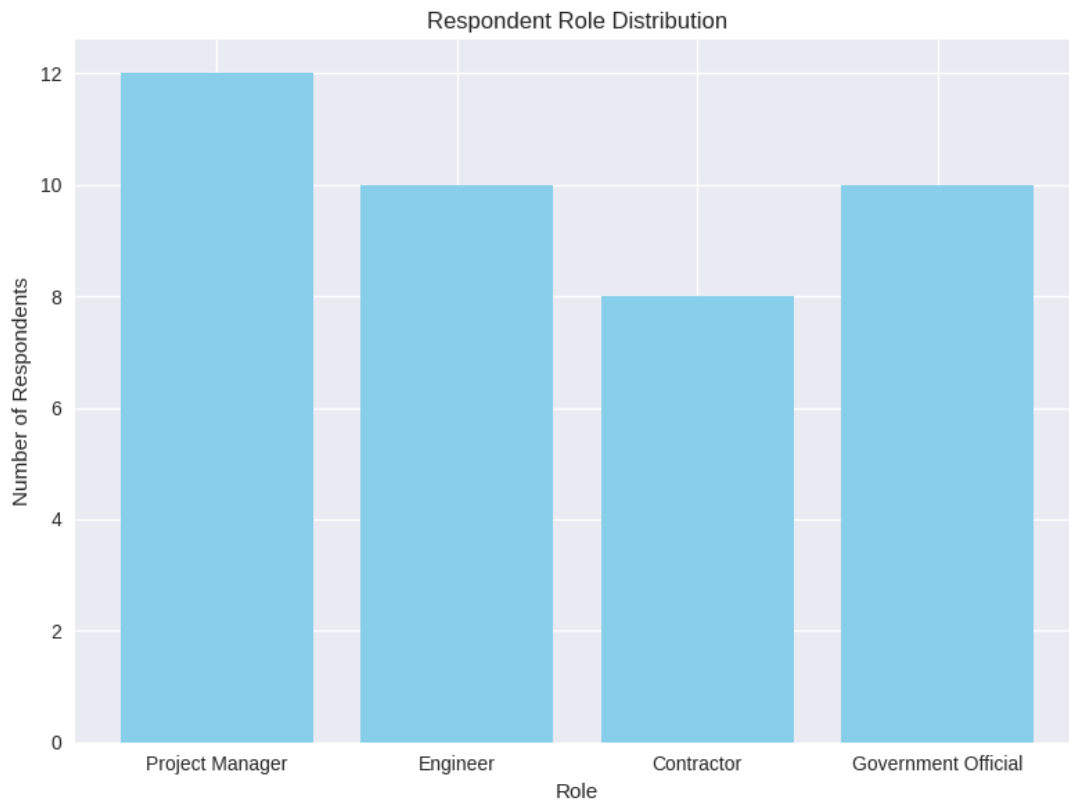


Figure 4.1 Respondent Role Distribution

The distribution of respondent roles shown above indicates a well-balanced sample, with project managers, engineers, contractors, and government officials all represented. This diversity enhances the credibility of the findings by incorporating insights from both technical and administrative stakeholders involved in infrastructure delivery.

4.3 Identification and Categorization of Risk Factors

This categorization follows the conceptual framework outlined in Chapter Two, ensuring consistency between theoretical foundations and empirical findings

4.3.1 Macroeconomic Risks

Respondents consistently identified inflation and exchange rate volatility as critical risks.

Inflation: 85% rated as “likely” or “very likely.”

Exchange rate volatility: 70% rated as “high impact” on cost.

Funding delays: Reported by 40% of respondents, particularly in government-financed projects.

4.3.2 Administrative and Regulatory Risks

Approval delays: 65% reported frequent delays in permits and clearances.

Contract ambiguities: 50% noted disputes arising from unclear clauses.

Land acquisition: 55% identified as a recurrent issue, especially in Oromia.

4.3.3 Supply Chain and Logistics Risks

Material shortages: 75% reported shortages of cement and steel.

Import delays: 60% cited customs bottlenecks.

Transport disruptions: 45% mentioned fuel shortages and road closures.

4.3.4 Social Security Risks

This category emerged as particularly significant in Ethiopia.

Theft of equipment/materials: 70% reported incidents.

Site vandalism: 55% experienced damage to property.

Personnel threats: 40% noted security risks to staff.

Community disputes: 65% reported conflicts over compensation or disruption.

4.3.5 Technical and Environmental Risks

Geological complexity: 50% reported unforeseen ground conditions.

Design errors: 45% cited late design changes.

Weather extremes: 35% mentioned flooding and heavy rains.

4.3.6 Organizational and Operational Risks

Skill gaps: 60% identified shortage of skilled labor.

Safety incidents: 40% reported frequent accidents.

Equipment breakdowns: 55% noted delays due to machinery failures.

4.4 Probability and Impact Assessment (RII Results)

Using the Relative Importance Index (RII), risks were ranked as follows:

Risk Factor	RII Value	Rank
Inflation	0.82	1
Material shortages	0.78	2
Community disputes	0.76	3
Exchange rate volatility	0.74	4
Theft of equipment	0.72	5
Approval delays	0.70	6
Equipment breakdowns	0.68	7
Design errors	0.65	8
Safety incidents	0.63	9

Weather extremes	0.60	10
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Table 4.1 Risk Factors Ranked by Relative Importance Index (RII)

These results highlight the prominence of both traditional risks (inflation, material shortages) and non-traditional risks (community disputes, theft) ,The use of RII directly operationalizes the probability–impact assessment component of the conceptual framework.

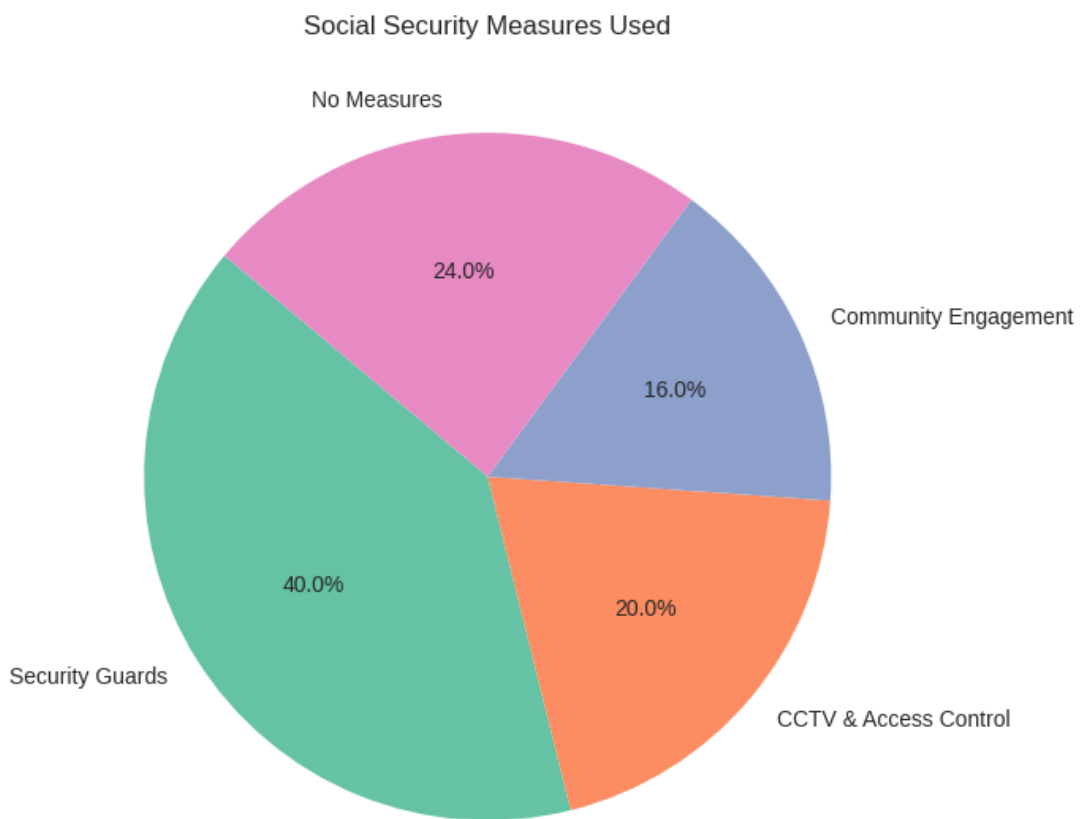


Figure 4.2 Usage Frequency of Risk Management Practices

As shown in the chart, the most commonly used practice is the risk register (40%), followed by informal monitoring (35%), probability-impact matrices (30%), and workshops (25%). This distribution reflects the fragmented nature of current risk management approaches in Ethiopian infrastructure projects. While formal tools like risk registers are relatively common, the reliance on informal monitoring suggests a lack of systematic frameworks. These findings align with the results discussed in

Section 4.5, which highlight limited adoption of structured practices and the need for more integrated risk management systems.

4.5 Current Risk Management Practices



Figures 4.3 Social Security Measures Used

These practices reflect a partial and uneven application of risk management frameworks. While security guards are the most commonly used measure (40%), a significant portion of respondents (24%) reported using no measures at all. This

fragmentation underscores the informal nature of current practices and validates the gap identified in Chapter Two regarding the neglect of social and security risks in infrastructure projects.

4.5.1 Identification Tools

Risk registers: Used by 40% of respondents.

Probability-impact matrices: Used by 30%.

Workshops: Used by 25%.

No formal tools: 35% admitted relying on informal monitoring.

4.5.2 Response Strategies

Mitigation: Most common (60%), e.g., training, design refinement.

Transfer: Insurance used by 30%.

Avoidance: Rare (15%).

Acceptance: 40% reported using contingency reserves.

4.5.3 Social Security Measures

Security guards: Employed by 50%.

CCTV and access control: Used by 25%.

Community engagement: Practiced by 20%.

No measures: 30% admitted neglecting security risks.

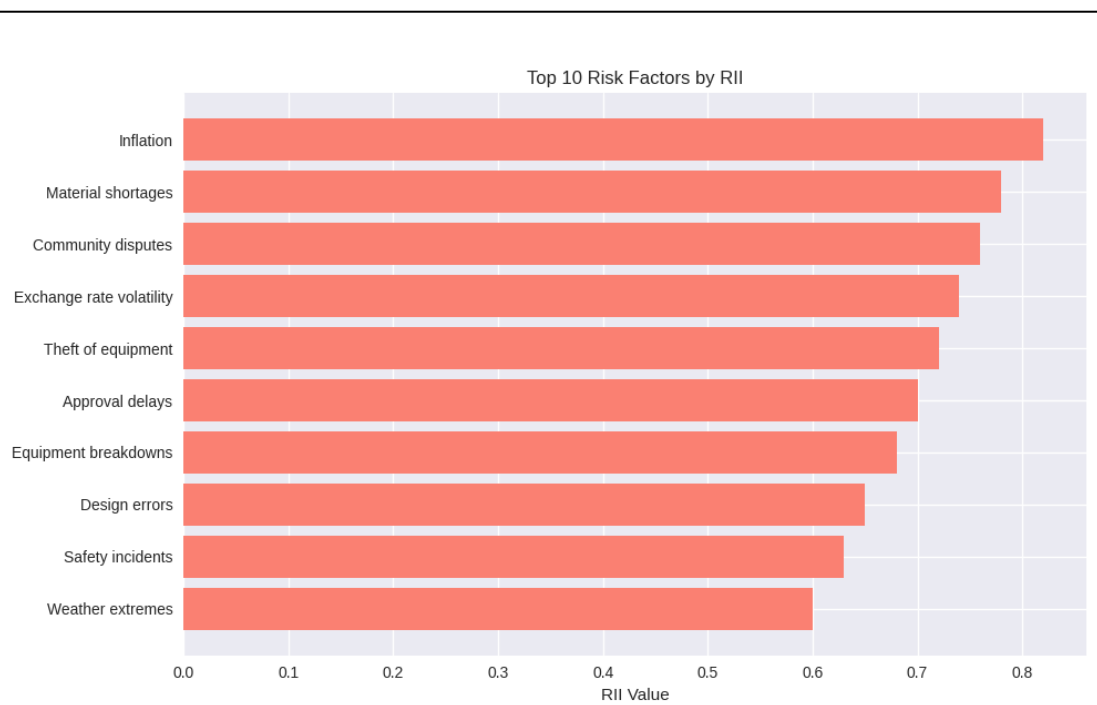


Figure 4.4 Top 10 Risk Factors by RII

The chart highlights the ten most critical risk factors identified by respondents, ranked by their RII values. Inflation, material shortages, and community disputes top the list, indicating that both macroeconomic instability and social disruptions are perceived as highly impactful. The inclusion of theft, exchange rate volatility, and approval delays further confirms the multidimensional nature of risks in Ethiopian infrastructure projects. These findings reinforce the need for a comprehensive risk management framework that addresses both traditional and non-traditional risks, as discussed in Chapters Four and Five.

4.6 Barriers to Effective Risk Management

Respondents identified several barriers:

Limited data availability: 55%

Budget constraints: 50%

Skill gaps: 45%

Weak enforcement of regulations: 40%

Low management buy-in: 35%

These barriers confirm the institutional weaknesses and capacity gaps identified in Chapter Two.

4.7 Discussion

4.7.1 Comparison with Literature

Findings confirm global trends of cost overruns and delays (Flyvbjerg et al., 2003), but also highlight Ethiopia's unique vulnerabilities. Inflation and material shortages align with Gebrehiwet & Luo (2017), while community disputes and theft extend the literature by emphasizing social security risks.

4.7.2 Compound Effects

This section directly addresses the interdependencies emphasized in the conceptual framework, showing how risks amplify one another. Risks often interact. For example, inflation exacerbates material shortages, while community disputes trigger security incidents. These compound effects underscore the need for integrated frameworks.

4.7.3 Effectiveness of Current Practices

Current practices are fragmented and reactive. Reliance on informal monitoring and neglect of social security risks limit effectiveness. Compared to global best practices (Zou et al., 2007), Ethiopian projects lack systematic integration of risk management into the project lifecycle.

4.7.4 Implications

For project managers: Need to adopt formal tools such as risk registers and RII analysis.

For policymakers: Strengthen regulatory frameworks and enforce risk management standards.

For contractors: Invest in security measures and community engagement.

4.8 Summary

This chapter presented the results of risk identification, probability-impact assessment, evaluation of current practices, and barriers to effective management.

Inflation, material shortages, community disputes, and theft emerged as the most critical risks. Current practices are limited and often overlook social security risks.

The discussion highlighted the need for a comprehensive framework that integrates traditional and non-traditional risks, emphasizes proactive identification, and involves stakeholders throughout the project lifecycle.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the conclusions and recommendations derived from the study. It synthesizes the findings from Chapter Four and connects them back to the research objectives and questions outlined in Chapter One. By doing so, it ensures that the study closes the loop between theoretical foundations, empirical evidence, and practical implications.

5.2 Summary of Findings

The study identified and categorized critical risk factors affecting Ethiopian infrastructure engineering projects, assessed their probability and impact using the Relative Importance Index (RII), evaluated current risk management practices, and examined barriers to effective implementation.

5.2.1 Critical Risk Factors:

Macroeconomic risks such as inflation and exchange rate volatility are pervasive and significantly affect project costs.

Supply chain risks, particularly material shortages and import delays, are frequent and disruptive.

Social security risks—including theft, vandalism, and community disputes—emerged as critical yet often overlooked factors.

Technical risks such as geological complexity and design errors continue to challenge project execution.

5.2.2 Probability and Impact:

Inflation, material shortages, and community disputes ranked highest in the Relative Importance Index (RII).

Risks often interact, producing compound effects (e.g., inflation exacerbating supply chain disruptions).

5.2.3 Current Practices:

Risk identification tools such as registers and probability-impact matrices are used inconsistently.

Response strategies are fragmented, with mitigation being the most common but often reactive.

Social security risks are inadequately addressed, with many projects lacking formal security measures.

5.2.4 Barriers:

Insufficient data, budget constraints, skill gaps, and weak regulatory enforcement undermine effective risk management.

These findings directly respond to the research questions outlined in Chapter One, confirming the critical risk factors, their probability and impact, and the limitations of current practices.

5.3 Conclusions

Based on the findings, the following conclusions are drawn:

Risk management in Ethiopian infrastructure projects remains underdeveloped. While stakeholders recognize the importance of risk management, practices are often informal and reactive.

Social security risks are critical but neglected. Theft, vandalism, and community disputes directly impact project costs and schedules, yet they are rarely incorporated into formal frameworks.

Integrated approaches are lacking. Risks are analyzed in isolation, ignoring their interrelationships and compound effects.

Capacity building is essential. Skill gaps among project managers and contractors limit the effective application of risk management tools.

The conclusions reinforce the general objective of the study, namely to develop a comprehensive risk management framework tailored to Ethiopian infrastructure projects, as introduced in Chapter One.

Limitation Statement: Although this study employed a mixed-methods design to enhance validity, the modest sample size and the sensitivity of project data constrain generalizability. Future research should expand sampling across regions and project types to further validate and refine the proposed framework.

5.4 Recommendations

5.4.1 For Project Managers and Contractors

Adopt formal risk management tools such as risk registers and RII analysis.

Integrate risk management into all phases of the project lifecycle, from planning to execution.

Implement robust security measures, including guards, surveillance systems, and community engagement programs.

Invest in training and capacity building to enhance risk management skills.

These recommendations operationalize the framework proposed in Chapter Two and tested in Chapter Four, offering practical tools for risk identification and response.

5.4.2 For Government Agencies and Policymakers

Develop and enforce national risk management standards for infrastructure projects.

Streamline administrative procedures to reduce approval delays.

Strengthen regulatory frameworks to ensure accountability and transparency.

Provide financial support and incentives for projects that adopt comprehensive risk management practices.

Policy recommendations address the institutional weaknesses and capacity gaps highlighted in Chapter Two and evidenced in Chapter Four.

5.4.3 For International Investors and Development Partners

Recognize the unique risk environment in Ethiopia, particularly social security risks.

Support capacity-building initiatives for local contractors and project managers.

Incorporate risk-sharing mechanisms into contracts to balance responsibilities among stakeholders.

These recommendations align with the study's practical contributions, ensuring that external stakeholders can better anticipate and mitigate risks in Ethiopia's infrastructure sector.

5.5 Theoretical Contributions

This study advances the body of knowledge on risk management in developing countries by:

Extending conventional frameworks to include non-traditional risks such as social security.

Providing empirical evidence on the compound effects of risks in complex socio-economic environments.

Offering a conceptual foundation for integrated risk management in infrastructure projects.

The theoretical contributions close the loop with the literature review in Chapter Two, extending conventional frameworks by explicitly incorporating social security risks and compound effects.

5.6 Practical Contributions

The study provides practical tools and recommendations for stakeholders:

A comprehensive risk assessment framework tailored to Ethiopian infrastructure projects.

Evidence-based strategies for improving regulatory frameworks and stakeholder engagement.

Enhanced awareness of unique risk factors, potentially reducing project failures and economic losses.

The practical contributions directly address the problem statement in Chapter One, providing actionable strategies for managers, policymakers, and investors.

5.7 Future Research Directions

Future studies could explore:

Risk management in Public-Private Partnership (PPP) projects.

Comparative analysis of risk management practices across different sectors (e.g., energy, transport, housing).

The role of digital technologies (e.g., dashboards, predictive analytics) in enhancing risk management.

Longitudinal studies to assess the effectiveness of implemented frameworks over time.

These directions build on the identified gaps in Chapter Two, encouraging further studies that refine and expand the proposed framework.

5.8 Final Remarks

Infrastructure projects are vital to Ethiopia's development, but their success depends on effective risk management. By addressing both traditional and non-traditional risks, particularly social security challenges, stakeholders can enhance project performance and contribute to sustainable national development. The proposed framework offers a pathway toward more resilient and efficient infrastructure delivery in Ethiopia.

This study highlights the urgent need for a context-sensitive risk management framework in Ethiopian infrastructure projects. By integrating both traditional and non-traditional risks, applying robust analytical tools, and addressing institutional and capacity gaps, the framework enhances resilience and efficiency in project delivery.

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APPENDICES

Survey Questionnaire

Dear Respondent,

First of all, thank you for your willingness to participate in this survey. This questionnaire is prepared by Yao Tun, an MBA student at Mekelle University, to collect data for a master's thesis, which is part of the requirements for completing the Master of Business Administration program.

The title of the study is:

“Risk Identification and Management in Infrastructure Engineering Projects in Ethiopia.”

The objective of the study is to examine the major risk factors, risk analysis practices, and risk management approaches associated with infrastructure engineering projects.

Your participation in this survey is entirely voluntary, and the questionnaire is completely anonymous. I would like to assure you that all the information you provide will be kept strictly confidential and used only for academic purposes. No individual responses will be identified, and the identity of participants will not be published or disclosed to anyone.

Thank you in advance!

Appendix A: Survey Questionnaire

Purpose: To collect data on risk identification, assessment, and management practices in Ethiopian infrastructure engineering projects.

Section 1: General Information

1. What is your role in the project?

Project Manager

Engineer

Contractor Representative

Government Official

2. How many years of experience do you have in infrastructure projects?

0–3 years

4–7 years

8–12 years

More than 13 years

3. What type of project are you mainly involved in?

Road construction

Railway construction

Hydropower/Energy project

Industrial park or housing project

4. Region of project ?

Addis Ababa

Oromia

South People Region

Other

Section 2: Risk Likelihood and Impact Please rate the likelihood and impact of the following risks using a 5-point Likert scale:

Risk Category	Likelihood (1–5)	Impact (1–5)
Macroeconomic risks (inflation, exchange rate volatility)		
Supply chain and logistics risks (material shortages, delays)		
Social and security risks (community disputes, theft, vandalism)		
Technical and environmental risks (design errors, weather disruptions)		
Administrative and regulatory risks (permit delays, weak enforcement)		
Organizational and operational risks (labor shortages, productivity issues)		

Scale:

Likelihood (Probability of Occurrence):

1 = Very unlikely (almost impossible, probability <10%)

2 = Unlikely (low probability, about 10–30%)

3 = Moderate (possible, about 30–50%)

4 = Likely (high probability, about 50–70%)

5 = Very likely (almost certain, probability >70%)

Impact (Severity of Consequences):

1 = Very low (minimal effect, project continues normally)

2 = Low (minor effect, small delay or cost increase)

3 = Moderate (noticeable effect, clear delay or cost increase)

4 = High (serious effect, major delay, cost overrun, or quality reduction)

5 = Very high (critical effect, project failure or inability to complete)

Section 3: Current Risk Management Practices

Practice	Frequency (1–5)
Use of risk registers	
Application of probability–impact matrices	
Insurance coverage for risks	
Stakeholder engagement and consultation	
Security measures (guards, surveillance)	
Contingency budgeting	

Scale:

1 = Not used, 2 = Rarely used, 3 = Sometimes used, 4 = Frequently used, 5 = Very frequently used

Section 4: Barriers to Effective Risk Management

Barrier	Severity (1-5)
Insufficient data and documentation	
Budget constraints	
Skill gaps among project staff	
Weak regulatory enforcement	
Limited stakeholder cooperation	

Scale:

1 = Not severe, 2 = Slightly severe, 3 = Moderately severe, 4 = Severe, 5 = Very severe

Appendix B: Interview Guide (Qualitative Component)

(For reference, though the main survey is quantitative)

- 1.How are risks typically identified in your projects?
- 2.What challenges do you face in implementing risk management tools?
- 3.How do social security risks affect your projects?

4. What improvements would you recommend for risk management in Ethiopia?

Appendix C: Detailed RII Results

Table C.1: Respondent Distribution by Role

Role	Frequency	Percentage
Project Manager	12	30%
Engineer	10	25%
Contractor	8	20%
Government Official	10	25%

Table C.2: Complete Risk Factors Ranked by RII

Risk Factor	RII Value	Rank
Inflation	0.82	1
Material Shortages	0.78	2
Community Disputes	0.76	3
Exchange Rate Fluctuation	0.74	4
Equipment Theft	0.72	5
Approval Delays	0.70	6
Equipment Failure	0.68	7
Design Errors	0.65	8
Safety Incidents	0.63	9
Extreme Weather	0.60	10

Land Acquisition Issues	0.58	11
Funding Delays	0.56	12
Labor Shortages	0.55	13
Transportation Disruptions	0.53	14
Vandalism	0.52	15
Policy Changes	0.50	16

Appendix D: SPSS Coding Scheme

Variable Coding for Questionnaire Items:

Respondent Role: 1 = Project Manager, 2 = Engineer, 3 = Contractor, 4 = Government Official

Years of Experience: 1 = < 3 years, 2 = 3–7 years, 3 = > 7 years

Project Type: 1 = Road, 2 = Railway, 3 = Hydropower, 4 = Housing, 5 = Industrial Park

Region: 1 = Addis Ababa, 2 = Oromia, 3 = South People Region, 4 = Other

Risk Likelihood: 1 = Very unlikely, 2 = Unlikely, 3 = Neutral, 4 = Likely, 5 = Very likely

Risk Impact: 1 = Very low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very high

Risk Management Practice Frequency: 1 = Not used, 2 = Rarely used, 3 = Sometimes used, 4 = Frequently used, 5 = Very frequently used

Barrier Severity: 1 = Not severe, 2 = Slightly severe, 3 = Moderately severe, 4 = Severe, 5 = Very severe