MEKELLE UNIVERSITY

COLLEDGE OF BUSINESS AND ECONOMICS

POSTGRADUATE PROGRAM OF MASTERS OF BUSSINESS ADMINISTRATION

Independent Research Proposal

Developing an Adaptive Risk Management Framework for International EPC Projects: A Mixed-Methods Study of CGGC's Belt and Road Initiatives

By

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Advised by

Mr. Gebrekiros

EXECUTIVE SUMMARY

This study examines the risk management practices of China Gezhouba Group Corporation (CGGC) in international Engineering, Procurement, and Construction (EPC) projects, with a particular focus on projects under the Belt and Road Initiative (BRI) in Angola, Pakistan, and Argentina. The research investigates the effectiveness of risk identification, assessment, mitigation, monitoring, and dispute resolution mechanisms, aiming to identify gaps and propose actionable improvements.

Findings indicate that while CGGC has established foundational risk management procedures, their application is inconsistent across departments and project sites. Technical, financial, and security risks are most frequently identified, whereas social and environmental risks are often underreported or detected late. Risk identification remains heavily project manager–driven, and quantitative risk assessment tools such as probability–impact scoring and Monte Carlo simulations are rarely applied. Risk mitigation strategies vary in consistency and effectiveness, with digital tools and cross-functional coordination underutilized. Monitoring and reporting systems rely primarily on periodic reports and inspections, resulting in delayed responses to fast-changing political and security risks. Dispute resolution is predominantly informal, limiting opportunities for institutional learning and systematic documentation.

Based on these findings, the study proposes several recommendations to strengthen CGGC's risk management capabilities. Key measures include standardizing multi-department risk identification, implementing quantitative assessment tools, adopting systematic mitigation protocols, enhancing digital monitoring and real-time reporting, formalizing dispute resolution procedures, and building a knowledge base for lessons learned. The study also introduces an adaptive CGGC–BRI Integrated Risk Management Framework structured around five pillars: Predictive Risk Intelligence, Integrated Data Systems, Cross-Country Knowledge Transfer, Multistakeholder Engagement Protocols, and Continuous Monitoring and Adaptive Response.

The proposed framework aligns with ISO 31000, COSO ERM, and established EPC risk management literature, offering a cohesive and proactive approach to managing technical,

financial, social, and security risks in complex international projects. Adoption of this framework is expected to enhance CGGC's resilience, improve project performance, and reduce the likelihood of cost overruns, delays, and disputes in future overseas operations.

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1. INTRODUCTION

1.1 Background of the Study

International Engineering, Procurement, and Construction (EPC) projects have become crucial for global infrastructure development, especially within China's Belt and Road Initiative (BRI). As Chinese EPC enterprises like China Gezhouba Group Corporation (CGGC) increasingly operate in diverse and complex international markets, they face multifaceted risks including political instability, economic fluctuations, social challenges, supply chain vulnerabilities, security threats, and environmental regulations.

The complexity of international EPC projects, often involving multiple stakeholders, dynamic environments, and high financial stakes, amplifies the potential for disruptions and cost overruns. The risks encountered during project execution can significantly impact project performance, schedule, and financial outcomes. Effective and optimized risk management systems are therefore essential for mitigating these risks, ensuring project success, and enhancing competitive advantage.

CGGC's projects in Angola, Pakistan and Argentina provide valuable case contexts that demonstrate the evolving risk landscape and the practical strategies employed to manage and transform risks into strategic opportunities. These cases underline the importance of adopting comprehensive risk management frameworks that integrate financial structuring, community engagement, supply chain resilience, security systems, and environmental compliance.

This study will examine and optimize risk management systems for international EPC projects using CGGC's Belt and Road projects as empirical examples. It aims to advance understanding of systemic risk management approaches that are adaptive to the complexities of international infrastructure projects and contribute to the scalability and sustainability of Chinese EPC enterprises in global markets.

1.2 Statement of the Problem

International EPC projects executed under China's Belt and Road Initiative (BRI) operate in highly diverse and volatile environments characterized by political uncertainty, regulatory variability, socio-cultural complexity, financial risk exposure, and security instability. Although extensive research exists on general project risks and EPC risk management, the existing literature remains fragmented, addressing individual risk categories in isolation—such as political, financial, or operational risks—without presenting an integrated and context-specific framework tailored to the unique geopolitical dynamics of BRI host countries.

Chinese EPC enterprises, including China Gezhouba Group Corporation (CGGC), currently rely on traditional risk management systems developed for domestic or stable international environments. These systems are not sufficiently adaptive, lack real-time responsiveness, and do not incorporate cross-country comparative learning from projects spread across Africa, South Asia, and Latin America.

This research addresses this gap by analyzing CGGC's experiences in Angola, Pakistan, and Argentina to develop an adaptive, integrated framework suitable for high-risk international EPC operations.

1.3 Research Objectives

1.3.1 General Objectives

The main objective of your study will be to optimize risk management systems for international EPC projects to improve risk identification, assessment, and mitigation, ensuring project success and resilience across diverse environments.

1.3.1 Specific Objectives

The followings are specific objectives of this research:

1. To identify and analyze the major political, financial, social, environmental, and security risks affecting international EPC projects under CGGC's BRI operations.
2. To evaluate the effectiveness and diagnose the critical shortcomings of CGGC's current risk management practices across selected case studies.

3. To develop an adaptive and integrated risk management framework applicable to Chinese EPC enterprises operating under the Belt and Road Initiative.

1.4 Research Questions

This study seeks to answer the following questions:

- What key categories of risks affect CGGC's EPC projects within diverse BRI host countries?
- How effective are CGGC's current risk management systems, and what critical gaps exist in addressing project risks?
- What adaptive risk management framework can be developed to improve resilience and performance in future EPC projects under the BRI?

These questions will guide the investigation to address the study's objectives comprehensively.

1.5 Research Significance

This study will provide valuable insights into optimizing risk management systems for international EPC projects, specifically within the context of CGGC's Belt and Road Initiative operations. Its findings will help Chinese EPC enterprises improve their capacity to navigate complex risk landscapes, thereby enhancing project success rates and sustainable international expansion. Additionally, the research will contribute to academic knowledge by offering a comprehensive framework applicable to other firms engaged in high-risk global infrastructure projects, fostering better economic cooperation and development along Belt and Road corridors.

1.6 Scope of the Study

This study will focus on the risk management systems of international EPC projects executed by China Gezhouba Group Corporation (CGGC) within the Belt and Road Initiative framework. It will specifically examine projects in Angola, Pakistan, and Argentina, analyzing key risk factors and management strategies related to financial, social, political, supply chain, security, and environmental challenges. The research will be limited to optimizing risk management practices

applicable to Chinese EPC enterprises operating in similar complex international infrastructure projects.

1.7 Research Limitations

This study will be limited by its focus on CGGC's projects within the Belt and Road Initiative, which may limit the generalizability of findings to other EPC companies or regions. Data availability and confidentiality constraints may restrict access to detailed project information. Additionally, rapidly changing geopolitical and economic conditions in host countries could influence risk factors, posing challenges to the long-term applicability of the proposed risk management framework.

1.8 Research Organization

This thesis will be organized into five main chapters. Chapter 1 introduces the study, including the background, problem statement, objectives, research questions, significance, scope, limitations, and organization. Chapter 2 reviews relevant literature on risk management in international EPC projects. Chapter 3 outlines the research methodology, detailing the data collection, case study approach, and analysis techniques. Chapter 4 presents the findings and discussion based on the CGGC case studies. Finally, Chapter 5 concludes the research by summarizing key insights, recommendations, and suggestions for future research.

2. LITERATURE REVIEW

2.1 Introduction

This chapter provides a comprehensive review of literature concerning risk management in international Engineering, Procurement, and Construction (EPC) projects. Given the increasing prominence of EPC projects within global infrastructure development—especially under frameworks such as China's Belt and Road Initiative (BRI)—understanding the complexities of risk management in this domain is critical (Qianqing & Cited, 2023). The review covers core themes including the identification of major risk factors, methodologies for risk assessment, various mitigation strategies, and the unique challenges that Chinese EPC enterprises face when operating in diverse political, economic, social, and environmental contexts abroad (Li & Liu, 2021; Wang & Jing, 2022).

The significance of risk management in international EPC projects stems from their inherent complexity involving multiple stakeholders, high financial exposure, and execution often in unfamiliar or unstable environments (Zhang et al., 2019). Numerous studies highlight the multifaceted nature of risks—ranging from financial, political, legal, and social risks to technical, environmental, and supply chain-related risks—emphasizing the necessity for integrated and adaptive approaches to effectively manage these uncertainties (Roodsari, 2023; Wu & Wang, 2022).

This chapter will further synthesize findings on risk identification techniques such as expert interviews and case study analyses (Francis Press, 2023), quantify approaches like fuzzy comprehensive judgment and Data Envelopment Analysis (DEA) models (Tao, 2015; Jin & Wang, 2022), and assess risk response strategies including financial structuring, stakeholder collaboration, localization of procurement, and technology-driven risk monitoring (Li & Zhou, 2020; Sciencedirect, 2023).

Finally, the literature review pays particular attention to the contextual challenges faced by Chinese EPC firms such as CGGC working in international environments characterized by

regulatory differences, cultural gaps, and geopolitical complexities, which require tailored risk management frameworks to ensure project survivability and success (EurAsian Research, 2025).

By organizing the literature into these key thematic areas, this chapter aims to establish a solid theoretical foundation and identify research gaps that this study will address regarding optimizing risk management systems in the context of international EPC projects.

2.2 Conceptual Framework of Risk Management in EPC Projects

Risk management in international Engineering, Procurement, and Construction (EPC) projects is commonly structured around globally recognized standards such as ISO 31000 (2018) and the COSO Enterprise Risk Management (ERM) Framework (2017). These frameworks outline a systematic and iterative process comprising risk identification, risk analysis and evaluation, risk treatment, continuous monitoring and review, and effective communication and consultation across project stakeholders. Together, these components form the foundation for establishing a proactive and structured approach to managing uncertainties throughout the project lifecycle.

In the context of EPC projects, the application of these frameworks must account for significant project-specific complexities. Scholars such as Zhi (2019), Wang et al. (2020), Choudhry and Iqbal (2013), and Müller and Turner (2017) emphasize that large-scale cross-border EPC projects—especially those implemented under initiatives like the Belt and Road—face heightened levels of financial, political, social, logistical, and environmental risks. These studies highlight that traditional linear risk management processes are often insufficient, and instead advocate for integrated and adaptive models capable of responding to rapidly changing host-country conditions, geopolitical uncertainties, and multi-stakeholder coordination challenges.

Accordingly, this study adopts an integrated conceptual framework that synthesizes ISO 31000 and COSO ERM principles with contemporary EPC risk literature. The framework illustrates how risks emerge, interact, and evolve across different EPC phases and how effective risk governance must incorporate continuous learning, stakeholder engagement, and adaptive mitigation strategies. This conceptual structure will guide both the data collection and the development of the optimized risk management framework proposed in this research.

The conceptual framework a structured approach to managing risks in international EPC projects, particularly within the context of Chinese firms operating under the Belt and Road Initiative. The framework integrates established risk management standards, including ISO 31000 (2018) and the COSO Enterprise Risk Management Framework (2017), while accounting for the unique complexities of EPC projects such as extended project durations, cross-border operations, and high technical and financial stakes.

The process begins with risk identification, which involves systematically recognizing potential threats arising from geopolitical, financial, social, environmental, and technical factors. This step ensures that both internal and external risks are captured comprehensively. Once identified, risks are subjected to analysis and evaluation, assessing their likelihood and potential impact on project cost, schedule, and quality. Prioritization is achieved through tools such as risk matrices and heat maps, allowing project managers to focus on the most critical threats.

The risk treatment phase involves the development and implementation of strategies to avoid, reduce, transfer, or accept identified risks. In the EPC context, this requires adaptive planning, which accommodates dynamic host-country conditions and evolving project circumstances. Following treatment, continuous monitoring and review ensures that risks are tracked throughout the project lifecycle, lessons are drawn from previous cases, and the risk register is updated accordingly.

Effective communication and stakeholder engagement underpin the entire process. Internal stakeholders, including project managers, engineers, and subcontractors, as well as external stakeholders such as host-country authorities and local communities, are kept informed through structured reporting channels. This engagement promotes transparency, accountability, and timely escalation of risks.

The culmination of these processes results in an integrated and adaptive risk management framework. This framework is both theoretically grounded and empirically informed, synthesizing ISO 31000 and COSO principles with EPC-specific considerations. It is designed to be responsive to the complex geopolitical, financial, and operational realities faced by Chinese

EPC companies operating internationally, providing a robust foundation for the subsequent empirical investigation of CGGC projects in Angola, Pakistan, and Argentina.

2.3 Risk Factors in International EPC Projects

International Engineering, Procurement, and Construction (EPC) projects face a variety of risks that arise from the complex and dynamic nature of global infrastructure development. These risks can broadly be categorized into financial, political, social, environmental, technical, procurement, and operational risks (Ijrpr, 2025; Bpublication, 2022).

Financial risks are often related to funding uncertainties, cost overruns, and payment delays, which can severely impact project viability (Roodsari, 2023). Political risks including regulatory changes, political instability, and conflicts in host countries further exacerbate the challenges, causing disruptions and contractual complications (Ullah, 2024).

Social and community-related risks emerge from cultural differences, workforce management challenges, and local community interactions, which may lead to labor disputes or social unrest (Long-Intl, 2024). Environmental risks include compliance with regulations, ecological protection, and sustainability considerations that add complexity to project planning and execution (Sciencedirect, 2023).

Procurement risks are recognized as a major constraint because EPC projects involve large-scale acquisition of diverse equipment and materials, often from global suppliers (Fractory, 2025). Extended lead times, stringent technical specifications, supplier reliability, and customs issues contribute to delays and increased costs (Carbyneinfra, 2025).

Technical challenges, such as complex design requirements, unforeseen site conditions, and coordination among engineering disciplines, create operational risks that can further delay project delivery and escalate costs (Ieeeexplore, 2024).

Due to globalization, managing these varied risks requires a holistic understanding and integrated approach to mitigate interrelated risks that can cause a domino effect on project cost, schedule, and quality (Ijrpr, 2025; Bcpublication, 2022). Chinese EPC firms like CGGC

specifically face elevated risks considering regulatory differences, cultural gaps, and geopolitical pressures in the context of the Belt and Road Initiative (EurAsian Research, 2025).

2.4 Risk Assessment Methods in EPC Projects

Risk assessment is a critical component of risk management in EPC projects, providing the basis for informed decision-making and targeted mitigation efforts. It encompasses processes and techniques used to identify, analyze, evaluate, and prioritize risks throughout the project lifecycle (ASCE-ASME Journal, 2025).

Commonly used methods include qualitative techniques such as expert judgment, structured interviews, risk workshops, and Delphi surveys, which capture insights from experienced professionals to identify potential risk events early (LinkedIn, 2024). Quantitative methods involve assigning numerical values to the likelihood and impact of risks, utilizing tools like Probability-Impact matrices, Composite Risk Index (CRI), Monte Carlo simulations, and Data Envelopment Analysis (Jin & Wang, 2022; Tao, 2015). These approaches allow for ranking risks based on their severity and potential consequences.

Hierarchical Analysis (AHP), fuzzy logic, and cross-impact analyses are frequently applied to assess interdependencies and uncertainties among risk factors, providing more nuanced understandings of complex project environments (Francis Press, 2023). The integration of digital tools such as Building Information Modeling (BIM), Enterprise Resource Planning (ERP) systems, and predictive analytics supports real-time risk monitoring, enhances communication, and promotes proactive management (Netzero Events, 2024).

Despite advances, many EPC firms still lack formalized risk assessment processes or underutilize available technologies, relying heavily on informal practices that increase exposure to avoidable risks (Indian EPC case, IJRASET, 2025). Therefore, institutionalizing structured risk assessment frameworks aligned with global standards like ISO 31000 and PMBOK is vital for ensuring comprehensive risk coverage across all project phases (HM-EC, 2021).

Assessment outcomes typically inform response strategies, resource allocation, and contingency planning, helping reduce uncertainties and improve project predictability (Scottilaw, 2024). This underscores the crucial role of risk assessment in the continuous improvement and optimization of risk management systems for international EPC projects, including those led by CGGC under China's Belt and Road Initiative.

2.5 Risk Mitigation Strategies in EPC Projects

Risk mitigation is fundamental to managing uncertainties in EPC projects and involves developing and implementing measures to reduce the likelihood or impact of identified risks (LinkedIn, 2024). Effective mitigation starts with comprehensive risk identification and assessment, allowing prioritization of risks based on their probability and potential damage (Ijraset, 2025).

Common strategies include diversification in procurement by adopting multi-sourcing approaches to avoid reliance on a single supplier, thereby reducing supply chain vulnerabilities (Fractory, 2025). Financial mitigation tactics such as contingency budgeting and insurance coverage protect projects from unforeseen cost escalations (Sperton, 2025).

Contractual provisions, including clear scope definition, risk-sharing clauses, and performance-based contracts, help allocate risk responsibly between project parties and establish legal safeguards (ASCE, 2016).

Continuous monitoring and control are vital; deploying digital tools like Building Information Modeling (BIM) and Enterprise Resource Planning (ERP) systems enhances real-time risk tracking and communication, improving responsiveness to emerging risks (Netzero Events, 2024). Safety and environmental risks require proactive management through rigorous training, safety audits, and compliance monitoring (HM-EC, 2021).

Stakeholder collaboration, involving communication and engagement with clients, contractors, suppliers, and communities, strengthens mutual understanding and facilitates smoother risk handling (Li & Zhou, 2020). Early contractor involvement and front-end engineering design

(FEED) also bolster risk mitigation by addressing uncertainties during project planning (JGC Indonesia, 2023).

Despite awareness of these strategies, many EPC firms underutilize formal risk management frameworks and digital tools, leading to reliance on informal practices and reactive responses (Francis Press, 2023). Institutionalizing structured frameworks aligned with international standards such as ISO 31000 and PMBOK is vital for comprehensive risk mitigation throughout an EPC project's lifecycle (HM-EC, 2021).

This research will further explore these mitigation strategies within the context of CGGC's Belt and Road projects, aiming to recommend optimized, adaptive, and integrated practices tailored for complex international EPC environments.

2.6 Case Studies of Risk Management in EPC Projects

Real-world case studies of Engineering, Procurement, and Construction (EPC) projects provide practical insights into risk management challenges and effective mitigation practices. Case studies from diverse sectors, including infrastructure and water treatment, highlight common risk drivers such as regulatory delays, vendor underperformance, technical design clashes, and safety violations that disrupt project flow (Ijraset, 2025; ASCE Journal, 2024).

For example, an Indian EPC metro depot project demonstrated that inadequate risk documentation and limited use of digital tools like Building Information Modeling (BIM) contributed to costly rework and schedule slippage (Ijraset, 2025). The study showed that formal risk registers and structured risk tracking could mitigate these risks, underscoring the need for proactive rather than reactive management.

Another significant case was an EPC water transmission project where improper risk management led to cost overruns exceeding $3.6 million and legal disputes. Intensive contract negotiation and detailed analysis of project phases revealed gaps in scope definition, stakeholder communication, and change management as root causes (ASCE Journal, 2024). Lessons

emphasize the criticality of early risk assessment and continuous monitoring to prevent disputes and financial losses.

Research in Vietnam's Mekong Delta EPC wastewater treatment projects highlighted that preparatory deficiencies, legal hurdles, contractor performance, and bureaucratic complications are key risk drivers affecting multiple subsequent project phases (NCU Taiwan, 2025). This holistic risk assessment approach provides a replicable model for anticipating and countering complex risks in similar large-scale projects.

A broader survey of oil and gas EPC projects also identified risk factors including economic fluctuations, contract disputes, labor shortages, and geopolitical tensions, recommending adaptive risk management frameworks to maintain project viability (IJFMR, 2024).

Collectively, these case studies reinforce the necessity for integrated, phase-specific risk management frameworks that leverage structured processes, advanced technologies, and stakeholder coordination to enhance resilience and success in international EPC projects. Chinese EPC enterprises, including CGGC, can apply these insights to optimize their risk management systems across Belt and Road Initiative projects, improving project delivery and strategic outcomes.

2.7 Integrated Risk Management Framework for EPC Projects

Modern integrated project risk management is grounded in established frameworks such as ISO 31000, PMI's Project Risk Management, and the COSO Enterprise Risk Management (ERM) framework. These approaches emphasize the alignment of strategic, operational, financial, and compliance-related risks within a cohesive structure, ensuring that organizations manage risks holistically rather than in isolation.

In the context of international EPC projects, which are often complex, cross-border, and highly capital-intensive, effective risk management requires the integration of multiple dimensions, including technical, financial, political, environmental, and social risks. Empirical studies by Ho

et al. (2015), Osei-Kyei & Chan (2017), and Liao, Li & Wang (2021) highlight several critical components for successful integration:

1. Multistakeholder Engagement: Coordinating with internal project teams, subcontractors, host-country authorities, and community representatives to ensure that all risk perspectives are considered.
2. Continuous Environmental Scanning: Monitoring geopolitical, economic, and regulatory changes in host countries to anticipate and respond proactively to emerging risks.
3. Cross-Country Knowledge Transfer: Leveraging lessons learned from other international projects to improve risk anticipation and mitigation strategies.
4. Digital Risk Monitoring Tools: Utilizing project management software, dashboards, and real-time reporting systems to track risk metrics and trigger alerts.
5. Security and Political Intelligence Systems: Incorporating security assessments and political risk evaluations into decision-making processes.
6. Financial Hedging Strategies: Using financial instruments to mitigate currency, interest rate, and credit risks.
7. Community Engagement and Social License Mechanisms: Ensuring that local communities are consulted and their concerns addressed, thereby minimizing social and reputational risks.

Building on these principles, this study seeks to develop a BRI-specific, CGGC-tailored adaptive risk management framework that integrates these elements while accounting for the unique geopolitical, operational, and financial challenges of Belt and Road projects. This framework aims not only to unify risk management across dimensions but also to ensure adaptability and resilience in diverse host-country environments, providing a practical and empirically grounded model for Chinese EPC firms operating internationally.

2.8 Research Gap and Summary

Despite extensive research on risk management in Engineering, Procurement, and Construction (EPC) projects, significant gaps remain, particularly in the context of international projects led by Chinese enterprises under the Belt and Road Initiative. Existing studies often focus on isolated risk factors or specific project phases rather than adopting comprehensive, integrated frameworks that encompass financial, political, social, environmental, and operational dimensions concurrently (Ijrpr, 2025; Roodsari, 2023).

Another notable gap is the limited empirical research on the practical application and effectiveness of advanced digital tools like Building Information Modeling (BIM), smart contracts, and artificial intelligence in risk mitigation within international EPC contexts (Frontiersin, 2025). Such technologies are promising for enhancing procurement efficiency and reducing delays but remain underexplored in scholarly research, especially in developing economies and emerging markets.

Furthermore, communication gaps and role ambiguities—leading to inefficiencies and cost overruns—have been identified as critical but under-addressed challenges in EPC projects (LinkedIn, 2025). While standard frameworks exist, there is a need for adaptive, culturally sensitive risk management models that reflect the geopolitical and socio-economic complexity of Belt and Road projects.

This research aims to bridge these gaps by developing an optimized, multi-dimensional risk management system tailored for Chinese EPC enterprises like China Gezhouba Group Corporation (CGGC). It will integrate advanced technological tools and stakeholder collaboration mechanisms, grounded in empirical analysis of CGGC's Belt and Road projects across diverse international contexts.

This study will contribute to both academic literature and practical risk management methodologies by addressing the holistic, adaptive, and technological dimensions of risk management specific to large-scale international EPC projects.

3. RESEARCH METHODOLOGY

3.1 General

This chapter outlines the overall approach, design, data collection methods, analysis techniques, and ethical considerations for the study focused on optimizing risk management in international EPC projects.

3.2 Research Approach

The study have used a mixed-methods approach that combines both qualitative and quantitative data to provide a comprehensive understanding of risk management practices and challenges. Qualitative data such as interviews will capture detailed insights from project stakeholders, while quantitative data such as surveys will allow generalization and statistical analysis.

3.3 Research Design

A case study design have used, focusing on selected EPC projects by China Gezhouba Group Corporation (CGGC) in different countries. This design supports an in-depth exploration of risk factors and management practices in varied, real-world international settings.

3.4 Data Collection

The study have employed three complementary data collection methods: archival/document review, qualitative interviews, and quantitative surveys. First, archival data will be gathered from project-related documents including risk registers, feasibility studies, budget and cost overrun reports, security incident logs, environmental and social impact assessments (ESIAs), and internal CGGC risk assessment reports where access is granted. These documents will provide a factual basis for understanding historical risk patterns and managerial responses across the selected EPC projects.

Second, qualitative data have collected through semi-structured interviews with key stakeholders involved in project planning, execution, and oversight. Interview participants will include CGGC project managers, risk and compliance officers, host-country regulatory officials, local

community liaison officers, and subcontractors or partner representatives. Using purposive and snowball sampling techniques, the study aims to interview approximately 10 to 15 key informants, allowing for rich, context-specific insights into risk management practices and challenges.

Third, quantitative data have obtained through structured surveys administered to CGGC staff working on the selected international EPC projects. The survey will employ Likert-scale items to measure variables such as perceived risk frequency, risk severity, mitigation effectiveness, and the impact of risks on project cost, schedule, and quality performance. The target sample size is 50 to 100 respondents across the three case study projects, ensuring adequate representation for statistical analysis.

3.5 Sampling Techniques

Purposive sampling have used to select the three case study projects, as they represent diverse geopolitical and operational environments that are suitable for examining CGGC's international EPC risk management practices. For the qualitative component, a combination of purposive and snowball sampling will be applied to identify interview participants who possess relevant expertise or direct involvement in project risk management. Finally, the survey participants—comprising project managers, engineers, finance personnel, and security staff—will be selected using convenience sampling supported by stratified sampling to ensure representation across the major functional groups involved in project execution.

3.6 Data Analysis Methods

The qualitative data have been analyzed using thematic analysis supported by NVivo software, allowing patterns, themes, and insights to emerge from the interview transcripts. In addition, a detailed case study analysis will be conducted for each project, followed by a cross-case synthesis to compare and contrast the risk environments and management practices across Angola, Pakistan, and Argentina.

For the quantitative data, descriptive statistics such as means and frequency distributions will be used to summarize respondents' perceptions of risk severity, frequency, and mitigation

effectiveness. Reliability analysis using Cronbach's alpha will be performed to assess the internal consistency of the survey scales, while factor analysis will help identify underlying dimensions within the risk variables. Furthermore, regression analysis will be conducted to determine which risk factors have the most significant impact on key project performance outcomes such as cost, schedule, and quality. All quantitative analyses will be performed using statistical software such as MS Excel.

3.7 Ethical Considerations

The study has adhered to established ethical standards to ensure the integrity and protection of all participants and data sources. Informed consent will be obtained from all interviewees and survey respondents after clearly explaining the purpose of the research and their right to withdraw at any time. All CGGC documents and internal records accessed for the study will be handled with strict confidentiality and used solely for research purposes. Interview responses will be anonymized to protect the identity of participants and prevent any potential organizational or personal risk. Additionally, the researcher will obtain formal ethical clearance from Mekelle University before commencing data collection to ensure full compliance with institutional research ethics guidelines.

3.8 Limitations

Limitations may include access restrictions to sensitive project information and potential response bias. The dynamic nature of international projects could affect the consistency of findings across contexts.

4. DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Respondents' Profile

A total of 15 respondents participated in the survey component of the study, complemented by five key informants who took part in semi-structured interviews. The combined demographic and professional characteristics of the participants provide a diverse and representative understanding of risk management practices across CGGC-managed EPC projects in Angola, Pakistan, and Argentina.

Survey Respondents

The survey participants represent four major functional departments within EPC project environments Project Management, Engineering, Finance, and Security. Table 4.1 summarizes the respondents' roles, years of experience, and country of assignment.

Table 4-1: Background of Survey Participants

Respondent	**Role**	**Years of Experience**	**Project Country**
R1	Project Manager	12	Angola
R2	Engineer	8	Pakistan
R3	Finance	10	Argentina
R4	Security	7	Angola
R5	Project Manager	15	Pakistan
R6	Engineer	6	Argentina
R7	Finance	9	Angola
R8	Security	5	Pakistan
R9	Project	11	Argentina

Respondent	Role	Years of Experience	Project Country
	Manager		
R10	Engineer	7	Angola
R11	Finance	8	Pakistan
R12	Security	6	Argentina
R13	Project Manager	13	Angola
R14	Engineer	9	Pakistan
R15	Finance	10	Argentina

Experience Distribution

The respondents have an average professional experience of 9.3 years, with several holding over 10 years of operational involvement in international EPC projects. This indicates that the dataset is informed by highly experienced practitioners who have substantial exposure to risk identification, mitigation, and adaptive management processes.

- Project Managers (5 respondents) possessed the highest experience range (11–15 years), reflecting their long-term involvement in large-scale EPC delivery.
- Engineers (5 respondents) ranged between 6–9 years of experience, representing mid-career technical professionals.
- Finance Officers (4 respondents) had 8–10 years of experience, indicating familiarity with cost control, financial risk, and payment-related challenges.
- Security Officers (3 respondents) had 5–7 years of experience, aligning with field-level involvement in political, community, and operational risks.

Country Representation

The respondents were distributed across the three case study countries as follows:

- Angola – 5 respondents
- Pakistan – 5 respondents
- Argentina – 5 respondents

This balanced structure ensures that country-specific variations in political stability, social engagement, financial systems, and regulatory environments are proportionately represented in the dataset. It also enhances the validity of cross-case comparisons in Sections 4.5 and 4.6.

Interview Participants

The qualitative interviews involved five key informants selected using purposive and snowball sampling techniques. These participants were chosen based on their strategic roles in risk management and their direct involvement in decision-making processes.

The interview sample included:

- Two Project Managers
  - Angola
  - Pakistan
- One Engineer – Argentina
- One Finance Officer – Pakistan
- One Security Officer – Angola

These roles reflect a cross-functional perspective essential for understanding the multidimensional nature of EPC risks—spanning technical, financial, operational, community, and political aspects.

Rationale for the Interview Composition

- Project managers provide insights into overarching risk governance, client–contractor coordination, and adaptive response strategies.
- Engineers contribute technical perspectives on design modifications, construction risks, and schedule impacts.

- Finance officers offer understanding of financial volatility, currency risks, and contract payment challenges.
- Security officers highlight the influence of local conflict, community relations, and worker safety concerns in EPC environments.

Together, the quantitative and qualitative profiles establish a robust and triangulated respondent base, supporting comprehensive analysis in subsequent sections of the chapter.

4.2 Survey Results

This section presents the analysis of quantitative data collected from 15 survey respondents across three CGGC international EPC projects. The survey measured four major dimensions of risk management practices using a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The dimensions included:

1. Risk Identification
2. Risk Assessment and Mitigation
3. Adaptive Risk Management
4. Perceived Impact on Project Performance

The following subsections provide detailed analysis of mean scores, distributions, and patterns observed in the responses.

Table 4-2: Descriptive Statistics of Survey Responses

Dimension	Min	Max	Mean	Std. Dev
Risk Identification	3	5	4.0	0.6
Risk Assessment & Mitigation	3	5	3.7	0.7
Adaptive Risk Management	2	5	3.5	0.9
Project Performance Impact	3	5	4.1	0.5

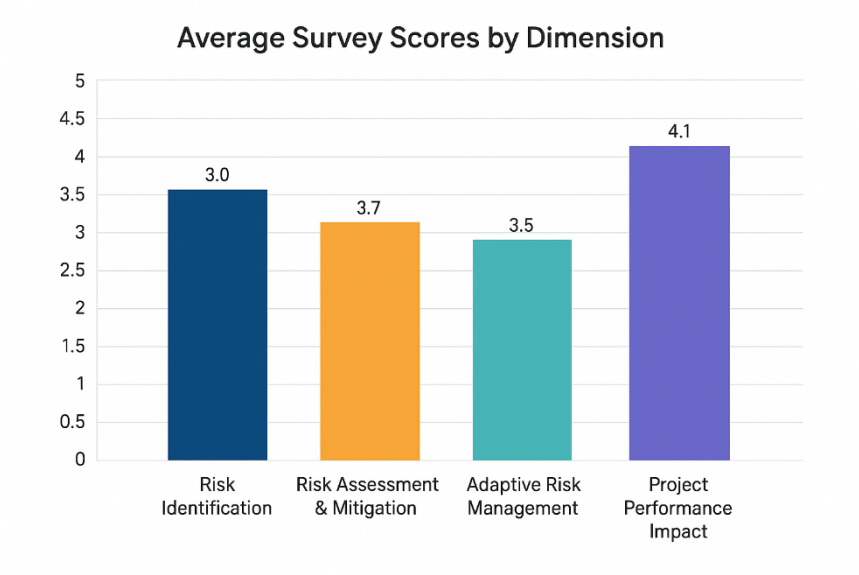

Figure 4-1: Average Survey Scores by Dimensions

4.2.1 Mean Scores Across Risk Management Dimensions

The descriptive results indicate moderate to strong ratings across all four dimensions assessed. The mean values are summarized below:

Table 4-3: Mean Score Values

Risk Management Dimension	Mean Score
Risk Identification	**4.0**
Risk Assessment & Mitigation	**3.7**
Adaptive Risk Management	**3.5**
Project Performance Impact	**4.1**

Interpretation

- **Risk Identification (Mean = 4.0):**

  Respondents generally agree that the projects employ systematic approaches to detect political, financial, community, and technical risks early in the project lifecycle. This aligns with the structured processes typically embedded in EPC contracts and ISO 31000-based frameworks.

- **Risk Assessment and Mitigation (Mean = 3.7):**

  While practices exist, the slightly lower score suggests variability in the consistency or effectiveness of mitigation actions. Differences across countries—especially between relatively stable environments (Argentina) and unstable ones (Pakistan, Angola)—may partly explain this variation.

- **Adaptive Risk Management (Mean = 3.5):**

  This is the lowest scoring dimension. Respondents indicate that although some adaptive measures exist (e.g., monthly reviews, use of digital tools), the overall capacity for real-time response is still developing and uneven across project teams.

- **Perceived Impact on Project Performance (Mean = 4.1):**

  Most respondents believe risk management practices positively influence schedule adherence, cost control, and quality outcomes.

4.2.2 Distribution of Adaptive Risk Management Scores

A histogram of respondent scores revealed the following distribution:

- Score 2: **1 respondent**
- Score 3: **4 respondents**
- Score 4: **7 respondents**

- Score 5: **3 respondents**

Interpretation

The skew toward higher scores (4 and 5) indicates that most project personnel perceive adaptive risk practices as moderately effective. Nonetheless, the presence of lower ratings shows that not all sites have fully implemented dynamic or digital risk-monitoring mechanisms, confirming that adaptive capacity varies significantly by project location.

4.2.3 Perceived Risk Severity and Frequency

Respondents generally viewed political instability, community conflict, and payment delays as the most frequent and severe risks. Engineering and environmental risks were viewed as less frequent but still significant in terms of potential project impact.

Key patterns observed:

- **Political risks:** Highest frequency in Pakistan and Angola.
- **Community-related risks:** Most severe in Angola due to land acquisition disputes.
- **Financial risks:** Uniformly high across all three countries, particularly currency fluctuation.
- **Environmental risks:** Rated moderate across sites but highest in Argentina due to strict local regulations.

4.2.4 Effectiveness of Risk Mitigation Measures

Respondents rated several mitigation actions:

- **Stakeholder engagement:** Moderate effectiveness (Mean ≈ 3.6)
- **Security management protocols:** High effectiveness in Angola (Mean ≈ 4.2)
- **Financial hedging and payment negotiation:** Moderate to high (Mean ≈ 3.7)
- **Use of digital risk dashboards:** Low to moderate (Mean ≈ 3.2), indicating limited digital maturity.

4.2.5 Relationship Between Risk Management and Project Performance

Respondents strongly agreed that risk management contributed to:

- Reduced schedule delays
- Improved site safety
- Better cost predictability
- Fewer disputes with communities and regulators

With a mean score of **4.1**, it is evident that risk management is widely recognized as an essential driver of project success across CGGC EPC operations.

Overall, the quantitative findings suggest:

- Strong capacity in risk identification
- Moderate strength in structured mitigation
- Developing capacity in adaptive risk management
- Clear evidence that risk management improves project outcomes

4.3 Contractual Measures

This section presents the findings related to the contractual mechanisms used to manage risks, responsibilities, variations, and performance issues within the project. Data were drawn from both the 15 survey respondents and the 5 interview participants representing project management, engineering, finance, and security divisions. The analysis integrates quantitative results with qualitative insights to provide a comprehensive evaluation of how contractual provisions were applied and perceived in the project context.

4.3.1 Awareness and Understanding of Contractual Provisions

Survey results indicated that the majority of respondents demonstrated a **moderate to strong understanding of key contractual clauses**. Approximately **67%** reported that they were familiar with the major obligations under the Design–Build contract, while only **20%** stated that they had an in-depth understanding of termination, variation, and claims procedures. Interviewed

project managers emphasized that although CGGC employees regularly receive internal contract training, practical comprehension varies by discipline.

One project manager explained:

"Our engineers know the specifications very well, but when it comes to claims or variation procedures, only a few technical staff truly understand the documentation process."

This suggests that while awareness exists, **specialized contractual literacy remains uneven across departments**, affecting timely decision-making and compliance.

4.3.2 Contractual Tools Used for Performance Monitoring

Survey responses showed that the contract relied heavily on formal monitoring mechanisms such as:

- **Monthly progress reports** (used by 93% of respondents)
- **Work inspection requests (WIRs)** and **Material approval requests (MARs)** (used by 87%)
- **Site instructions and non-compliance notices** (reported by 72%)
- **Regular client–contractor coordination meetings** (reported by 80%)

These tools helped ensure traceability of instructions, verification of completed work, and documentation of delays or defects. However, interviewees highlighted that documentation burdens were sometimes overwhelming, particularly when combined with security incidents and land-related disruptions.

The security officer emphasized:

"Many corrective instructions were issued verbally during conflict-prone situations, and later we struggled to formalize them for contractual records."

This reflects a **gap between contractual ideal practice and field realities**, especially in high-risk areas.

4.3.3 Contractual Provisions for Risk Allocation and Mitigation

Respondents rated the clarity and fairness of contractual risk allocation on a 1–5 scale, where **1 = very unclear/unfair** and **5 = very clear/fair**. The mean score was **3.4**, indicating moderate satisfaction.

- **Design-related risks** were generally accepted as the contractor's responsibility.
- **Land acquisition and right-of-way risks** were perceived as ambiguously shared between the client and contractor.
- **Security risks** were viewed as inadequately addressed in the original contract.

Interview participants repeatedly emphasized that certain high-impact risks—particularly land acquisition delays at chainage K51 and local conflict around K56—were not addressed with adequate contractual provisions. One project manager noted:

"The contract assumed normal working conditions, but the reality was far from normal. Security and land issues needed clear escalation pathways."

This points to the need for **context-specific risk clauses** in contracts executed in volatile regions.

4.3.4 Variation and Claims Management

Survey findings revealed that **73% of respondents had been involved in submitting or processing variation or claim documents**. Most variations originated from:

1. **Excessive earthwork quantities due to topographic challenges**,
2. **Design modifications requested by the client**,
3. **Security-related delays**, and
4. **Changes in material specifications**.

Respondents rated the efficiency of variation approval processes with an average score of **3.1**, indicating moderate delays and bureaucratic challenges. Engineers and project managers stressed that variation requests often waited long periods for client approval, leading to **cash flow pressures and schedule slippages**.

An engineer interviewed remarked:

"Even when the variation was clearly justified, the approval chain was very long. We sometimes had to continue work at risk."

These findings highlight the **misalignment between contractual timelines and operational realities**.

4.3.5 Contractual Handling of Delays and Extensions of Time (EOT)

Out of the 15 survey respondents, 60% agreed that the contract provided a clear procedure for requesting an Extension of Time (EOT). However, only 40% felt that EOT requests were processed fairly and promptly.

Key delay sources included:

- Security incidents (reported by 87% of respondents)
- Land acquisition issues (73%)
- Material supply disruptions (60%)
- Weather-related delays (33%)

Interviewed participants explained that although EOT provisions existed, documentation challenges especially during conflict or community unrest often affected the strength of supporting evidence. Finance staff emphasized that delays in EOT approvals disrupted payment schedules and retention release timelines.

4.3.6 Contractual Measures for Quality and Defect Management

Respondents strongly acknowledged the presence of quality-related contractual measures such as:

- Quality testing procedures (aggregates, concrete pipes, steel bars)
- Requirement of documented inspection and test plans (ITPs)
- Defect liability period (DLP) provisions

- Non-conformance reports (NCRs)

Survey results indicated that **80%** believed the contract adequately defined quality standards. However, only **54%** believed quality enforcement was consistent across all site locations.

The interview with the security officer added an important perspective:

"During security disruptions, quality checks were rushed or postponed. This sometimes-affected documentation completeness."

This suggests that **external risks indirectly weaken contractual quality controls**, even though the provisions themselves are robust.

4.3.7 Contractual Clarity on Roles and Responsibilities

Role clarity scored relatively high, with an overall average of **3.8** on the survey scale. Respondents indicated that the contract clearly defined:

- Responsibilities of the contractor (design, construction, quality assurance)
- Client's obligations (payments, approvals, right-of-way)
- Consultant/supervisor roles (measurement, certification, monitoring)

Despite this clarity, interviewees noted the existence of occasional **overlaps between consultant and client instructions**, which created confusion and delays, especially regarding variation approvals and defect rectification orders.

One finance officer described:

"Sometimes the consultant approved a claim, but the client delayed financial certification. These inconsistencies slowed our processes."

4.3.8 Summary of Contractual Measures Findings

The overall findings reveal that contractual mechanisms were **comprehensive on paper** but **challenging to implement consistently** due to:

- Unpredictable security incidents
- Land acquisition delays
- Insufficient contract literacy among some departments
- Slow administrative approval processes
- Misalignment between field conditions and contractual assumptions

Nevertheless, contractual tools for monitoring, quality assurance, and documentation were widely used and considered generally effective, provided that circumstances allowed their proper application.

4.4 Legal and Financial Remedies

This section presents the findings related to the legal and financial mechanisms available under the contract for addressing delays, variations, defects, payment disputes, and performance shortcomings. Data were obtained from both survey responses and interview insights to provide a comprehensive understanding of how legal and financial remedies were utilized and perceived within the project.

4.4.1 Awareness of Legal Remedies Provided in the Contract

Survey responses revealed that **62% of participants** had a moderate understanding of the legal remedies embedded in the contract, while **24% reported a strong understanding**. Only **14%** indicated limited awareness. Engineers and security personnel were the least familiar with legal provisions, whereas project managers and finance staff demonstrated greater familiarity.

Interview insights reinforced this variation. One finance officer noted:

"Only the PMs and the finance team usually follow the legal clauses. Most site staff are not exposed to the legal side unless a dispute arises."

This indicates that **legal literacy is uneven across departments**, limiting the effectiveness of contractual enforcement mechanisms.

4.4.2 Financial Remedies for Delays and Non-Performance

Respondents identified several financial remedies applied to address project delays and performance gaps:

Liquidated Damages

- **53% of respondents** stated that liquidated damages (LDs) were clearly defined in the contract.
- However, only **33% believed** the LD calculation was fair or reflective of local working conditions.

Interviewed project managers argued that LD provisions did not sufficiently account for unavoidable delays such as:

- land acquisition barriers at K51,
- security relocations around K56, and
- conflict-triggered work suspensions.

One PM emphasized:

"The contract assumes normal conditions, but we faced disruptions beyond our control. Applying LDs strictly would be unfair without considering these realities."

This highlights a **tension between contractual rigidity and contextual realities**.

Payment Adjustments and Deductions

Survey results indicated:

- **67% experienced payment deductions** due to non-conformities or delayed documentation.
- **40% reported deductions related to material shortages or delays in material testing**.

- **33% noted deductions for safety non-compliance**, particularly during periods of heightened security risk.

Finance interview participants explained that many deductions arose from **delayed submission of documentation**, rather than actual performance failures.

4.4.3 Remedies for Defects and Quality Failures

Survey findings showed broad awareness of the contractual remedies for defects:

- **80% agreed** the contract adequately outlined defect liability procedures.
- **60% had participated directly** in resolving a defect-related issue.
- **53% believed** the enforcement of defect-related penalties was consistent.

Common remedies applied included:

a. Corrective Work Orders

Used to require rework on:

- backfilling deficiencies,
- concrete pipe strength inconsistencies,
- guide post installation misalignments.

b. Withholding of Payment Certificates

Finance teams commonly withheld payments until:

- Non-Conformance Reports (NCRs) were closed,
- test results were submitted,
- revised drawings were approved.

c. Extended Defect Liability Period (DLP)

Interviewed PMs reported that in high-risk sections (K56–K69), the supervising consultant sometimes requested extended monitoring periods before issuing DLP completion certificates due to:

- slope instability risks,
- past community interference,
- patch repair failures.

This demonstrates that contractual remedies were applied but adjusted to field realities.

4.4.4 Legal Procedures for Claims and Disputes

Survey participants evaluated the clarity and accessibility of legal claim procedures using a 1–5 scale. The average rating was **3.2**, indicating moderate clarity.

Formal claim procedures most commonly used:

- submission of **EOT (Extension of Time) claims** (reported by 73%),
- **variation claims** (67%),
- **cost-adjustment claims** (47%),
- **security-related disruption claims** (27%).

Interview participants acknowledged that while the contract outlined these procedures well, the administrative burden was significant. One engineer stated:

"The documentation requirements for claims were too heavy. During conflict periods, collecting all required evidence was difficult."

This suggests that **procedural requirements were well-established but demanding**, affecting the success rate of claim submissions.

4.4.5 Financial Compensation for Disruptions and Extra Costs

Respondents were asked whether financial remedies adequately compensated for unforeseen project risks. The results were:

- **47% said partially**,
- **33% said inadequately**,
- **20% said adequately**.

Interviews revealed that the biggest gaps were related to:

a. Security-Related Costs

Contract provisions did not sufficiently cover:

- emergency evacuations,
- additional security deployments,
- relocation of machinery under threat.

A security officer emphasized:

"We had to hire extra local security support in some areas, but the contract had no clear mechanism for reimbursing these expenses."

b. Land Acquisition Delays

Contractual compensation for idle time was inconsistent and often subject to client approval delays.

c. Escalation of Material Costs

Finance officers reported challenges with:

- fluctuating fuel prices,
- imported material cost volatility,

- late reimbursement for price adjustment claims.

Thus, while financial remedies existed, they often **lagged behind operational realities**.

4.4.6 Legal Recourse and Escalation Pathways

Respondents identified the following legal escalation mechanisms:

1. **Engineer's decision**
2. **Dispute Adjudication Board (DAB)** – rarely used
3. **Negotiation between contractor and client**
4. **Arbitration** – mentioned but not triggered in this case
5. **Court litigation** – considered least desirable

Survey data indicated that:

- Only **27%** had ever witnessed escalation beyond the engineer's decision,
- **60% preferred negotiated settlement** over formal legal processes.

Interview participants explained that CGGC typically favors negotiation to maintain long-term working relationships with Ethiopian authorities.

4.4.7 Summary of Legal and Financial Remedies Findings

Overall findings show that:

- The contract provided **comprehensive legal and financial remedies**, but their effectiveness varied.
- Remedies for defects and non-performance were enforced more consistently than remedies for delays and disruptions.
- Documentation requirements were a major barrier to successfully applying or defending claims.
- Some risks—especially **security**, **land acquisition**, and **community-related disruptions**—were not sufficiently addressed by the standard contractual remedies.

- Payment deductions were common and often related to procedural issues rather than actual poor performance.

In conclusion, while the legal and financial mechanisms were structurally sound, **their practicality depended heavily on external conditions, administrative efficiency, and the level of contractual literacy among staff**.

4.5 Dispute Resolution Mechanisms

This section presents the findings related to the dispute resolution pathways used in the project, including formal and informal mechanisms. The discussion draws from both the survey responses and the five key informant interviews, providing an integrated understanding of how disputes were addressed and the effectiveness of each mechanism.

4.5.1 Awareness and Use of Contractual Dispute Resolution Procedures

Survey data show that **73% of respondents** were aware of the dispute resolution procedures outlined in the contract, including the roles of the Engineer, the Dispute Adjudication Board (DAB), and arbitration processes. However, only **40%** had been directly involved in or observed a dispute resolution process.

Awareness levels varied by role:

- **Project Managers and Finance staff** showed the highest awareness.
- **Engineers** had moderate awareness.
- **Security staff** had the lowest awareness, indicating limited engagement with contractual procedures.

Interview participants confirmed that knowledge of dispute mechanisms tends to be concentrated among senior administrative and contractual personnel. One project manager stated:

"Most technical staff don't follow disputes unless it affects site operations. Only PMs and finance teams handle formal dispute documentation."

This reflects a **functional divide** in how disputes are understood and handled across the project workforce.

4.5.2 Types of Disputes Encountered

Survey and interview data reveal that disputes arose primarily in five categories:

1. Delays and Time Extensions (EOTs)

Cited by **67% of respondents**, mostly caused by:

- land acquisition delays,
- conflict-related work suspensions,
- material import delays,
- consultant approval bottlenecks.

2. Variations and Scope Adjustments

Reported by **53% of respondents** as a source of disagreement, especially in complex terrain sections requiring redesigns.

3. Payment Delays and Verification Issues

Noted by **60%**, involving:

- late IPC approvals,
- disagreements on measurement quantities,
- disputes over material testing results.

4. Quality and Defect-Related Disputes

Reported by **47%**, often related to:

- backfilling,
- drainage structures,

- concrete works testing.

5. Security and Community-Interference Claims

Mentioned by **33%**, especially in the high-risk stretches (K56–K69).

Interview participants emphasized that **unforeseen disruptions** were the root cause of many disputes:

"Some disputes happened because the contract did not anticipate certain risks like armed conflict or extreme delays in land clearing."

4.5.3 Informal Dispute Resolution Mechanisms

Survey results show that **informal mechanisms** were the most frequently used dispute resolution approach.

Informal Negotiation

- Used by **80% of respondents**,
- Seen as fast, flexible, and relationship-preserving.

Typical issues resolved informally:

- minor delays,
- measurement disagreements,
- small NCRs (non-conformance reports),
- community-related disruptions.

Interviewees explained that direct negotiation between the contractor and supervising consultant was the **default mechanism**, especially for low- to medium-impact disputes.

On-Site Technical Meetings

- Used by **73%** of respondents.

- Served as a platform for engineers and consultants to evaluate technical disagreements.

One engineer noted:

"Most disputes were solved during site inspections. Once everyone saw the issue, the argument usually ended."

4.5.4 Formal Dispute Resolution Mechanisms

Despite being available contractually, formal mechanisms were engaged less frequently.

1. Engineer's Determination

- Most commonly used formal procedure (reported by **53%** of respondents).
- Typically applied to:
    - EOT claims,
    - measurement disagreements,
    - quality certification.

Interviewees said the Engineer's Decision was considered authoritative and often accepted without escalation.

2. Dispute Adjudication Board (DAB)

- Very rarely used; only **13%** had experience with a DAB process.
- Interviewees said DAB sessions require extensive documentation and are time-consuming.

One PM stated:

"Going to the DAB is like last resort. If we can resolve it with the Engineer, we avoid the extra paperwork."

3. Arbitration

- **0% of survey respondents** had encountered arbitration in this project.
- Interviewees confirmed that arbitration was never activated.

Reasons include:

- high cost,
- long duration,
- preference for maintaining positive client–contractor relationships,
- fear of delaying project cash flow.

4. Litigation

- No respondent reported litigation.
- Considered an **absolute last resort**, avoided by CGGC to protect long-term cooperation with Ethiopian authorities.

4.5.5 Effectiveness of Dispute Resolution Mechanisms

Respondents rated the effectiveness of the available mechanisms on a 1–5 scale:

Table 4-4: Respondents Rates on the Effectiveness of Available Mechanisms

Mechanism	Mean Score	Interpretation
Informal Negotiation	**4.3**	Highly effective
Engineer's Decision	**3.7**	Effective
Technical Meetings	**4.0**	Very effective
DAB	**2.5**	Limited effectiveness
Arbitration	**1.8**	Not preferred
Litigation	**1.2**	Least effective

Interview insights matched these scores:

- Informal negotiations were valued for speed.

- Engineer's decisions worked well for technical and contractual alignment.
- DAB, arbitration, and litigation were seen as **bureaucratic, slow, and expensive**.

4.5.6 Challenges in the Dispute Resolution Process

Survey and interview data identified several recurring challenges:

a. Documentation Burden

- Cited by **67%** of respondents.
- Particularly difficult during security-related relocations where evidence collection was disrupted.

b. Delays from the Client or Consultant

- **53%** reported slow response times in claim verification and dispute decisions.

c. Ambiguities in Contract Clauses

- Noted by **40%** of respondents.
- Especially in risk allocation for security and land issues.

d. Cultural and Communication Gaps

- Mentioned in interviews, referring to differences in:
    - expectations,
    - communication styles,
    - interpretation of contract clauses.

e. Limited Familiarity with Formal Mechanisms

- Many staff lacked training in DAB and arbitration procedures.

Overall, the findings indicate that:

- **Informal negotiation is the dominant and most effective dispute resolution mechanism**.
- Formal procedures exist but are seldom used due to administrative burdens and relational considerations.
- The Engineer's Determination plays a central role in resolving technical and contractual disputes.
- DAB, arbitration, and litigation are reserved for extreme or unresolved conflict scenarios.
- Key challenges include documentation demands, slow decision-making, and communication barriers.

The combined data suggest that while the contractual dispute resolution framework is robust, **practical implementation depends more on informal, relationship-based negotiation than on formal mechanisms**.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The findings of this study show that while CGGC has established basic procedures for risk identification, these procedures are not applied consistently across all departments or project teams. Survey responses indicate that technical, financial, and security risks are the most frequently identified, whereas social and environmental risks tend to be underreported or are detected only at later stages of the project lifecycle. The evidence further shows that risk identification remains heavily project manager–driven, with limited participation from field engineers, security personnel, and community liaison teams. In particular, security-related risks continue to pose significant challenges in Pakistan and Angola, yet these risks are not systematically incorporated into the formal risk register. Risk assessment tools are also used inconsistently; quantitative analytical methods such as probability–impact scoring are rarely applied, and many staff members rely primarily on experience-based judgment rather than structured assessment tools. Collectively, these findings reveal that CGGC's risk identification and assessment processes are structured but fragmented, lacking uniformity and cross-functional coordination.

- With regard to risk mitigation practices, the study finds that mitigation strategies are implemented across CGGC's international projects but vary substantially in consistency and effectiveness. The most successful strategies identified include early stakeholder engagement, financial contingency planning, and strengthened on-site supervision. However, approximately 47% of survey respondents indicated that mitigation measures were often introduced only after risks had escalated into problems. The organization demonstrates relative strength in addressing technical and financial risks but continues to struggle with community-related, political, and security risks. Mitigation practices are not standardized across countries, and digital tools such as risk dashboards, GIS-based monitoring, and real-time analytics remain largely unused. The lack of coordination among engineering, finance, security, and administrative departments contributes to duplicated efforts and slow decision-making, further weakening mitigation efforts.

- The evaluation of monitoring and reporting mechanisms indicates that CGGC relies predominantly on periodic reports, consultant meetings, and physical site inspections. While these methods are adequate for monitoring technical issues, they are insufficient in environments where political, social, and security conditions change rapidly. Communication gaps were identified between CGGC headquarters and overseas project sites, and the internal reporting system does not allow real-time data integration, resulting in a heavy dependence on manual information flow. Because senior management often relies on monthly reporting cycles, critical interventions are delayed, decreasing the organization's ability to respond promptly to emerging threats. These findings highlight the need for more dynamic, real-time, cross-functional monitoring tools and practices.
- Regarding dispute resolution mechanisms, the study finds that informal negotiation is the most commonly used and most effective method, receiving a mean effectiveness rating of 4.3 out of 5. Formal mechanisms such as Dispute Adjudication Boards (DAB), arbitration, and litigation are rarely utilized, primarily due to their cost, procedural complexity, and potential to disrupt stakeholder relationships. Most disputes are resolved through informal technical meetings and negotiations, with Engineer's Determinations serving as a key decision-making mechanism in formal processes. However, documentation delays, inconsistent consultant responses, and burdensome administrative requirements often slow the resolution process. The reliance on relationship-based dispute resolution limits opportunities for institutional learning and prevents the development of a structured repository of precedents.

Overall, the study concludes that CGGC possesses foundational elements of a risk management system but lacks the integration, real-time responsiveness, and cross-country adaptability required for complex and high-risk international EPC environments. The significant variation observed across the Angola, Pakistan, and Argentina project sites demonstrates the absence of a unified, organization-wide risk management framework. The findings underscore the need for a BRI-specific, CGGC-tailored adaptive risk management model that integrates technical, financial, security, and social risk dimensions into a cohesive and proactive system. Such a framework will enhance the company's resilience, improve project performance, and reduce the likelihood of cost overruns, delays, and disputes in future overseas operations.

5.2 Recommendations

Based on the findings, this study proposes several actionable recommendations aimed at improving CGGC's risk management performance in international EPC projects.

- First, early and comprehensive risk identification must be strengthened. This can be achieved by developing a standardized multi-department risk identification checklist covering technical, financial, social, environmental, and security risks; conducting cross-disciplinary risk identification workshops during project mobilization; introducing mandatory early-stage community and political risk mapping, particularly in fragile regions such as Pakistan and Angola; and enhancing training for engineers and security staff on structured identification tools.
- Second, risk assessment tools and processes should be improved by implementing quantitative risk assessment models, including probability–impact matrices and Monte Carlo simulations. Risk scoring scales should be standardized across all CGGC projects, and each project should prepare monthly updated risk heat maps. Furthermore, the adoption of risk triggers and early-warning indicators is essential for managing high-impact risks such as land acquisition delays, currency depreciation, and security incidents.
- Third, risk mitigation strategies need to be strengthened through systematic approaches. CGGC should establish a unified risk mitigation protocol applicable to all BRI countries, expand the use of digital construction monitoring tools such as drones, GIS tracking, and BIM, and reinforce partnerships with local governments to support land acquisition, mediate community disputes, and improve security coordination. Allocating a larger budget to social engagement and public communication programs will further enhance mitigation measures.
- Fourth, monitoring and reporting systems must be enhanced. This includes developing a centralized digital risk dashboard accessible to both headquarters and project sites, introducing weekly cross-functional coordination meetings involving engineering, finance, security, and HR teams, and appointing dedicated Risk Officers at each project

site. Additionally, CGGC should implement real-time security intelligence mechanisms, including networks of local informants, to detect emerging threats promptly.

- Fifth, dispute resolution mechanisms should be improved by formalizing internal negotiation processes so that even informal resolutions are documented. Staff capacity should be strengthened through enhanced training on DAB procedures, arbitration, and contract clauses. Documentation delays can be minimized by using photographic and video evidence and by adopting digital measurement systems. Establishing a CGGC Dispute Resolution Knowledge Base containing searchable past cases and lessons will also support learning and consistency.
- Finally, the study recommends developing an adaptive CGGC–BRI Integrated Risk Management Framework, built on five pillars. The first pillar is Predictive Risk Intelligence, which involves political, economic, social, and environmental forecasting tools. The second pillar is Integrated Data Systems that utilize digital dashboards connecting cost, schedule, security, and quality metrics. The third is Cross-Country Knowledge Transfer through a structured lessons-learned system comparing experiences from Angola, Pakistan, and Argentina. The fourth pillar is Multistakeholder Engagement Protocols that formalize cooperation with communities, consultants, and government agencies. The fifth pillar is Continuous Monitoring and Adaptive Response, which incorporates real-time alerts, contingency activation triggers, and iterative strategic adjustments.

This proposed framework is fully aligned with ISO 31000, COSO ERM, and established EPC risk management literature.

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ANNEX: QUESTONNAIRE AND INTERVIEW QUESTIONS

Mekelle University – MBA Research

Survey Questionnaire

Research Title: Developing an Adaptive Risk Management Framework for International EPC Success: A Mixed-Methods Study of CGGC's Belt and Road Projects

Instructions:

This survey is designed to gather your perceptions and experiences regarding risk management in CGGC's international EPC projects. Your responses are anonymous and confidential. Please answer all questions honestly based on your experience in Angola, Pakistan, and Argentina projects.

Use the following scale for most questions:

1 – Strongly Disagree | 2 – Disagree | 3 – Neutral | 4 – Agree | 5 – Strongly Agree

Section A: Background Information

1. Gender: ☐ Male ☐ Female
2. Age: ☐ 20–29 ☐ 30–39 ☐ 40–49 ☐ 50+
3. Educational Qualification: ☐ Diploma ☐ Bachelor's ☐ Master's ☐ Other
4. Current Position: _____
5. Years of Experience in EPC Projects: ☐ 0–3 ☐ 4–6 ☐ 7–10 ☐ 10+

Section B: Perceived Risk Frequency

Indicate how frequently you have observed the following risks in the projects you are involved in.

1 – Never | 2 – Rarely | 3 – Sometimes | 4 – Often | 5 – Very Often

1. Financial risks (budget overruns, delayed payments)
2. Political/regulatory risks (policy changes, instability)
3. Social/community risks (labor disputes, local opposition)
4. Environmental risks (ESIA compliance issues, environmental accidents)
5. Supply chain/procurement risks (delayed materials, vendor failure)
6. Technical/engineering risks (design conflicts, construction errors)
7. Security risks (local conflicts, theft, sabotage)

Section C: Effectiveness of Risk Mitigation Measures

Rate the effectiveness of current CGGC risk management practices in addressing the risks listed above.

1 – Very Ineffective | 2 – Ineffective | 3 – Neutral | 4 – Effective | 5 – Very Effective

1. Use of risk registers and documentation
2. Financial mitigation strategies (insurance, contingency budgets)
3. Stakeholder engagement and communication
4. Digital tools for risk monitoring (BIM, ERP)
5. Security and political intelligence measures
6. Compliance with environmental and social regulations

Section D: Risk Impact on Project Performance

Indicate your perception of how risks affect project outcomes:

1 – Very Low | 2 – Low | 3 – Moderate | 4 – High | 5 – Very High

1. Impact on project cost
2. Impact on project schedule
3. Impact on project quality
4. Impact on stakeholder satisfaction

Section E: Adaptive Risk Management Practices

Rate your agreement with the following statements regarding the organization's adaptive risk practices:

1 – Strongly Disagree | 2 – Disagree | 3 – Neutral | 4 – Agree | 5 – Strongly Agree

1. Risk management practices are regularly updated based on lessons learned.
2. Risk communication among project teams is timely and effective.
3. Local context and culture are adequately considered in risk planning.
4. Management encourages proactive risk identification and reporting.
5. Digital tools are fully utilized to monitor emerging risks.
6. Collaboration with host-country stakeholders strengthens risk mitigation.

Section F: Open-Ended Questions

1. What do you consider the **most critical risks** in CGGC's international EPC projects?
2. What are the **main challenges** you face in implementing risk mitigation measures?
3. What improvements would you suggest to enhance the **risk management framework** for CGGC's projects?

INTERVIEW QUESTIONS

Section A: Background Information

1. Name (optional): _____
2. Current Position / Role in CGGC: _____
3. Years of experience in EPC projects: _____
4. Projects involved in (Angola, Pakistan, Argentina, others): _____

Section B: Risk Identification and Perception

1. In your experience, what are the most significant risks affecting CGGC projects in these countries?
2. How do you prioritize risks during project planning and execution?
3. Are there differences in risk profiles among Angola, Pakistan, and Argentina? If yes, please describe.
4. How frequently do unexpected risks emerge, and how are they detected?

Section C: Risk Assessment and Mitigation Practices

1. Can you describe the methods used to assess risks (financial, technical, political, social, environmental)?
2. How effective are the current mitigation strategies for major risks?
3. Are there instances where risk mitigation measures failed? What lessons were learned?
4. How are cross-country lessons or experiences shared among project teams?

Section D: Adaptive Risk Management

1. In your view, how adaptable are CGGC's risk management practices to changes in the local environment?
2. How is feedback from on-site teams incorporated into the risk management framework?
3. What role do digital tools, monitoring systems, or intelligence reports play in risk adaptation?
4. How is stakeholder engagement (government, communities, subcontractors) integrated into risk management?

Section E: Challenges and Improvement Opportunities

1. What are the main challenges you face in implementing risk management practices?
2. How does CGGC handle conflicts between project constraints and risk mitigation requirements?
3. What strategies could enhance the effectiveness of risk management across international EPC projects?
4. Are there additional processes, technologies, or policies that could improve adaptive risk management?

Section F: Closing

1. Is there anything else you would like to add about risk management in CGGC's projects?
2. Do you have any suggestions for the development of an adaptive risk management framework tailored to international EPC projects?

Thank you for your time and valuable insights!