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## **Examining the Effectiveness of Risk Management Processes in Project Management Supply Chains: A Case Study of the Nakonde-Chinsali Road Project**

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### **Abstract**

The successful delivery of road infrastructure projects is critical to economic development, regional integration, and social advancement. However, many road projects are often plagued by delays, cost overruns, poor quality, and inefficient resource utilization. Inefficient management practices at any point in the supply chain can cause disruptions that negatively impact project outcomes. A significant factor contributing to these challenges is the effectiveness or lack thereof of risk management processes within the project management supply chain. Management processes, encompassing planning, coordination, communication, procurement, risk management, and quality assurance, play a crucial role in ensuring that road projects are delivered on time, within budget, and to the desired specifications. This study aimed at examining the effectiveness of management processes within the project management supply chain of a road project. This study was conducted with four objectives: to establish the risk management processes utilized in the Nakonde-Chinsali Road Project, to examine the effectiveness of these processes in mitigating risks and improving project outcomes, to assess policy interventions that can be applied in risk management, and to examine the challenges faced in implementing these strategies. The study adopted an Exploratory Case study, using a quantitative methodology to collect primary data. Chi-square was used to determine associations between variables. Thematic analysis was used for qualitative data. The Nakonde-Chinsali Road Project used structured approaches to manage risks, with checklists (30%), brainstorming (25%), and SWOT analysis (20%) being the main identification tools, led by project managers (40%) and risk management teams (35%). Financial (40%) and technical risks (35%) were most documented, while environmental (10%), social (10%), and safety (5%) risks were less tracked. The probability and impact matrix (50%) was the main prioritization tool, and risk

monitoring relied on site inspections (30%), reports (25%), and software (25%). Mitigation (50%) was the most used response strategy, and communication occurred mainly through meetings (30%) and reports (25%). Chi-square results ( $\chi^2=81.250$ ,  $p=.000$ ) showed a strong link between risk management integration and reduced delays, as well as improved cost control. The most effective processes were risk assessment (30%) and response planning (25%), leading to better schedule adherence (35%) and cost performance (25%). Main challenges included lack of skilled personnel (30%), inadequate funding (25%), and poor communication (25%), while policy guidance came from company policies (40%) and ISO 31000 (25%). Internal factors like leadership commitment (25%) and team competence (25%) influenced outcomes, and external issues such as weather (25%) and regulatory changes (20%) further constrained implementation. Despite these successes, challenges such as training gaps, poor communication, resource limitations, and political or economic uncertainties hindered optimal implementation, indicating areas for improvement. The study recommends enhancing the effectiveness of risk management in the Nakonde-Chinsali Road Project by addressing key gaps in training, communication, and resource allocation. Continuous capacity-building programs should be implemented to strengthen staff competence, while structured communication frameworks and digital tools can improve risk information sharing and documentation. Adequate financial and technical resources should be provided to support comprehensive risk management activities. Strengthening policy and regulatory support, including stakeholder engagement, will guide consistent application of risk strategies. Regular monitoring and review of risk management outcomes. These measures collectively aim to optimize risk mitigation, reduce delays and cost overruns, and maintain project quality.

**Keywords:** Risk Management Processes, Project Management, Supply Chain, Project Effectiveness, Road Infrastructure Project

### **1. Introduction**

#### **1.1 Background**

Effective risk management processes are crucial for the successful execution of large-scale infrastructure projects, particularly

in the road construction sector, where the complexity of activities and the involvement of multiple stakeholders demand a structured and well-coordinated approach (Lamaj, 2025) <sup>[23]</sup>. In the context of the Nakonde-Chinsali Road Project, the effectiveness of risk management within project management supply chains becomes a central concern. Project management supply chains encompass not only the flow of materials and logistics but also the coordination of financial, human, and technological resources (Mwape, 2021). These processes are deeply interlinked with risk identification, mitigation planning, procurement, stakeholder engagement, contract administration, and quality assurance, all of which determine a project's ability to meet its time, cost, and quality benchmarks (Musyoka, 2024).

Risk management, as part of the broader supply chain framework in project management, plays a pivotal role in anticipating and minimizing disruptions that could derail project goals (Munthali, 2022). In road construction projects like Nakonde-Chinsali, risks can stem from procurement delays, adverse weather conditions, political interference, poor contractor performance, or financial mismanagement (Kumar, 2025). Effective risk management processes within the supply chain can help identify such challenges early and allow for mitigation strategies that protect the project's integrity. However, the effectiveness of these processes often depends on the institutional capacity, regulatory environment, and availability of technical tools such as project management information systems and risk modeling software (Rauniyar, 2023).

Internationally, the importance of structured risk management in project supply chains is well documented. Institutions like the Project Management Institute (PMI) and international standards such as ISO 21500 advocate for formalized risk planning and monitoring protocols (Takagi, 2022). Countries with advanced infrastructure sectors have adopted these practices to improve project outcomes. In contrast, road projects in developing nations, including Zambia, often suffer from fragmented management processes, inadequate risk identification, weak enforcement of regulations, and insufficient coordination among stakeholders, which collectively undermine the effectiveness of supply chain operations (Mejia, 2020).

The Nakonde-Chinsali Road Project, situated within this context, offers a practical case to examine how supply chain risks are managed and how management processes impact overall project performance. Past experiences in Zambia have shown that weak risk controls and supply chain inefficiencies lead to cost overruns, missed deadlines, and substandard infrastructure delivery (Mutale, 2021). This study, therefore, explores how effectively risk management strategies have been integrated into the project's supply chain management and whether these processes have enhanced or hindered the project's success.

## 1.2 Statement of the Problem

Despite the recognized importance of effective management processes in project management supply chains, road infrastructure projects in Zambia continue to suffer from significant inefficiencies, leading to frequent delays, cost overruns, and poor-quality outputs (Mukalula, 2020). Current data from the National Road Fund Agency indicates that over 60% of road projects in Zambia are completed behind schedule, with cost escalations averaging 25% above initial contract values (Mutale, 2021). At the national level,

these inefficiencies have a broader economic impact, slowing down trade, increasing transportation costs, and undermining public confidence in government-led infrastructure projects (Silwam). Zambia's Vision 2030 and the Seventh National Development Plan (7NDP) emphasize infrastructure development as critical for economic growth and diversification (Muhyila, 2023). However, the persistent management challenges within road project supply chains threaten the realization of these policy objectives. Although there is a growing body of international literature emphasizing the need for effective project management and supply chain practices, there remains a limited amount of localized empirical research focusing on how management process inefficiencies specifically affect road project outcomes in Zambia (Mbewe, 2025). The existence of these challenges highlights an urgent need for action. A systematic examination of the management processes within the supply chain of road projects is necessary to identify key inefficiencies, develop targeted interventions, and improve project outcomes. Understanding and addressing these management failures is vital for enhancing the performance of future road infrastructure projects, ensuring value for money, and achieving national development goals (Kakw'u, 2024) <sup>[20]</sup>. Thus, this study is not only timely but also essential in providing empirical insights that can inform better practices, policy reforms, and capacity-building initiatives in Zambia's road construction sector.

## 1.3 Objectives of the Study

To examine the effectiveness of management processes in project management supply chains, with a focus on the Nakonde-Chinsali Road Project.

## 1.4 Specific Objectives of the Study

1. To establish risk management processes utilized in the Nakonde-Chinsali Road project.
2. To examine the effectiveness of these risk management processes in mitigating risks improving project outcomes.
3. To assertion policy interventions that can be used in risk management processes.
4. To examine challenges in implementing risk management strategies in the Nakonde-Chinsali Road Project.

## 1.5 Research Questions

1. What risk management processes were utilized in the Nakonde-Chinsali Road project?
2. How effective were the risk management processes in mitigating risks and improving project outcomes in the Nakonde-Chinsali Road project?
3. What policy interventions can be used to enhance risk management processes in road construction projects like the Nakonde-Chinsali Road project?
4. What challenges were faced in implementing risk management strategies in the Nakonde-Chinsali Road project?

## 1.6 Theoretical Framework.

The Theory of Constraints (TOC), developed by Eliyahu M. Goldratt in the 1980s, is a management philosophy centered on identifying and addressing the most critical limiting factor (the "constraint") that prevents a system from achieving its goals (Dutta, 2023) <sup>[9]</sup>. TOC assumes that in

any system whether manufacturing, services, or construction there is always at least one bottleneck that restricts overall performance. By systematically improving this constraint, significant enhancements in overall system effectiveness can be achieved (Mabi, 2020) <sup>[26]</sup>. The TOC process involves five main steps: identifying the constraint, exploiting the constraint, subordinating other processes to support the constraint, elevating the constraint through resource investment, and repeating the process to address new constraints as they emerge (Rahadi, 2021). Fundamentally, TOC emphasizes that a system's performance is dictated by its weakest link, and therefore managing this link is key to systemic improvement.

In the context of examining the effectiveness of management processes in project management supply chains within a road project, the Theory of Constraints is highly applicable. Road construction projects typically involve complex networks of supply chains, procurement activities, and contractor coordination efforts. These components often experience delays, mismanagement, or bottlenecks that hamper project success. TOC provides a structured and strategic method to identify specific management process failures such as late procurement, insufficient coordination between contractors, or delayed delivery of materials that act as bottlenecks within the supply chain. Through TOC principles, the study can focus precisely on these critical points that limit project performance rather than diluting efforts across all project aspects.

Moreover, TOC emphasizes focusing improvement efforts specifically on the area that will produce the greatest positive impact. Instead of undertaking widespread changes, TOC encourages management to prioritize addressing the identified constraint first. In a road project, for example, if delays in sourcing construction materials are found to be the major constraint, management interventions would initially concentrate on streamlining procurement procedures, enhancing supplier partnerships, or improving inventory management. This focused approach ensures cost-effective and efficient use of resources, which is particularly valuable in resource-constrained environments common to road infrastructure projects.

Additionally, applying TOC helps enhance project flow by systematically removing bottlenecks that cause downtime, delays, and cost overruns. By eliminating constraints, road construction activities can proceed more smoothly, leading to timely completion, reduced expenses, and better quality outcomes. Through this application, the study will offer a deeper understanding of how resolving key supply chain bottlenecks can contribute to improved project performance metrics, such as cost efficiency, quality assurance, and adherence to project timelines.

The Theory of Constraints also significantly supports better decision-making within project management. It encourages evidence-based decisions by guiding project managers to allocate their attention and resources to the most pressing constraint rather than spreading efforts thinly across multiple areas. In this study, applying TOC will assist in determining where project management practices are faltering most significantly, and in proposing practical solutions to improve these areas, thereby enhancing overall project delivery effectiveness.

Finally, TOC promotes sustainability and continuous improvement. Once a constraint is resolved, the approach involves identifying new constraints and addressing them,

ensuring that system improvement becomes a continuous cycle rather than a one-time effort. For the selected road project, this approach aligns well with the long-term goals of improving project management supply chains sustainably, ensuring that lessons learned from addressing one bottleneck feed into future project management strategies.

## 2. Literature Review

### 2.1 Risk management processes utilized in Road project.

Risk identification is a foundational step in the risk management process and is crucial for the successful implementation of road construction projects (Shayan, 2022). This stage involves systematically recognizing all potential risks that might adversely affect project objectives such as time, cost, quality, safety, and environmental performance. Road projects are particularly susceptible to numerous uncertainties due to their complex and multi-phase nature, often involving extensive coordination among various stakeholders, including contractors, government agencies, consultants, and local communities (Chege, 2024) <sup>[8]</sup>.

Following the identification of potential risks, the next crucial step in the risk management process is risk assessment or analysis. This stage involves a detailed evaluation of each identified risk based on two primary criteria: the likelihood or probability of the risk occurring, and the magnitude or severity of its impact on the project if it does occur. This dual analysis allows project managers to determine which risks require immediate attention, which can be monitored, and which may be acceptable without further action. In the context of road construction projects, risk assessment plays a pivotal role in planning and resource allocation, helping teams to prioritize responses effectively and efficiently (Landoll, 2021) <sup>[25]</sup>.

Risk evaluation and prioritization represent a critical phase in the overall risk management process, especially in road construction projects where the scale, complexity, and resource constraints demand a focused approach to risk response. After risks have been identified and analyzed for their likelihood and potential impact, they must be evaluated in terms of their overall threat to the project's success. This step involves comparing and ranking risks to determine which ones require the most immediate attention and intervention. The main objective is to ensure that limited resources time, personnel, funding are directed toward managing the most critical risks, thus minimizing potential project disruptions.

Risk mitigation and response planning form a fundamental phase in the risk management process, where the focus shifts from identifying and evaluating risks to actively addressing them (Mizrak, 2024) <sup>[30]</sup>. In the context of road construction projects, where delays, cost overruns, safety issues, and stakeholder disputes are common, having a robust mitigation and response plan is essential to safeguarding project objectives (Hubbard, 2020) <sup>[17]</sup>. This stage involves developing and implementing strategies that either prevent risks from occurring or minimize their impact should they materialize. Effective response planning ensures that the project team is not caught off guard by predictable risks, and that contingency measures are ready for deployment (Saleh, 2022).

The final and equally critical phase of the risk management process in road construction projects involves documentation and capturing lessons learned. Once a project

reaches completion, it is imperative to review and document all risk-related activities undertaken during its lifecycle (Adafin, 2021). This includes identified risks, their assessed impact and likelihood, the mitigation strategies implemented, the outcomes of those strategies, and any unanticipated events that occurred. Thorough documentation not only serves as a project archive but also plays a vital role in institutional learning, allowing organizations to continuously improve their project management practices and enhance future risk management frameworks (Chege, 2024) [8].

## 2.2 The effectiveness of these risk management processes in mitigating risks improving project outcomes

Examine the impact of project risk management on the performance of road construction projects in Kenya, as well as to assess the moderating role of organizational culture in this relationship. A cross-sectional research design was employed, guided by a positivist research paradigm. The study focused on road construction projects overseen by Kenya's National Government road agencies KURA, KeRRA, and KeNHA with management staff involved in project execution serving as the units of observation. The target population consisted of 695 individuals, including director generals, directors, project engineers, resident engineers, site engineers, and surveyors. Using Krejcie and Morgan's formula, a sample size of 248 respondents was determined, and stratified random sampling was used to select participants. Primary data was gathered through a semi-structured questionnaire, which was pilot tested on 24 respondents to assess its reliability and validity. Data analysis was conducted using SPSS version 25. Thematic analysis was applied to qualitative responses, presented in narrative form, while quantitative data was analyzed using descriptive statistics, and results were displayed in tables and figures. Correlation and regression analyses were also performed to test relationships among variables and validate the study's hypotheses. The findings revealed a strong, positive, and significant relationship between project risk management and the performance of road construction projects. Additionally, organizational culture significantly moderated this relationship. Based on these insights, the study recommends that organizations involved in road construction in Kenya should place greater emphasis on both project risk management and cultivating a supportive organizational culture (Gichohi, 2024).

Kirira (2020) investigated the impact of risk management strategies on the performance of road construction projects, specifically focusing on the KeNHA Coast Region. The study aimed to validate how risk identification, implementers' perceptions of risk appraisal, mitigation approaches, and control and monitoring practices affect project outcomes. It was anchored on risk management and agency theories and adopted an introspective survey design. The study targeted key personnel involved in nine selected road construction projects implemented in the Coast Region by KeNHA over a ten-year period starting in 2007. A stratified random sampling technique was used to select participants, and a sample size of 159 was determined using the Morgan and Krejcie (1970) formula. Data collection was conducted through questionnaires, which were pilot-tested on 16 participants (10% of the sample) to ensure validity, with the pilot group selected randomly. Data analysis was carried out using SPSS Version 25, and multiple regression

analysis was applied to determine the relationships between the independent variables (risk management components) and the dependent variable (project performance). The findings revealed that all four risk management elements risk identification, perception of risk appraisal, mitigation strategies, and control and monitoring had a strong, positive, and significant influence on project performance. Among these, risk identification had the most substantial effect, followed by risk appraisal perception, mitigation strategies, and lastly, control and monitoring. The study concluded that risk management is a critical determinant of project success in the KeNHA Coast Region and the broader construction industry. It recommended that project managers enhance their involvement in risk management training and that professionals in the sector be more actively engaged in offering expert guidance on implementing risk management practices (Kirira, 2020).

## 2.3 Policy interventions that can be used in risk management processes

In road infrastructure development, the implementation of mandatory risk management frameworks represents a crucial policy intervention aimed at institutionalizing systematic risk control measures across all stages of project execution (Mazher, 2022). Governments and regulatory authorities play a central role in enforcing the adoption of these standardized frameworks, ensuring that each public infrastructure initiative is planned and executed with a clear risk management agenda (Alex, 2024). By making it mandatory for every road project to incorporate a comprehensive risk management plan, policymakers can promote a culture of proactive planning rather than reactive problem-solving. These plans must include detailed procedures for risk identification, evaluation, and prioritization, along with a suite of assessment tools such as risk matrices or scenario analyses (Tariq, 2024).

Alongside risk management frameworks, regulatory compliance and environmental policies form another cornerstone of effective risk governance in road construction. Non-compliance with environmental and safety regulations is a common and often costly source of risk in infrastructure projects (Ruiz, 2020). These risks manifest in various forms, including project delays due to litigation, penalties from regulatory bodies, reputational damage, and community resistance. To address these challenges, governments must enforce stringent Environmental Impact Assessments (EIAs) before project approval. EIAs ensure that environmental risks such as habitat disruption, air and water pollution, and ecological degradation are identified early and managed effectively (Latilo, 2024). Mwape (2021) carried out a study aimed at identifying potential areas for collaboration between regulatory authorities and logistics-supply chain companies in Zambia, as well as examining the challenges and barriers to effective information sharing. Employing a mixed-methods approach, data was gathered through self-administered questionnaire interviews from a convenience sample of 88 participants 55 from logistics and supply chain firms and 33 from regulatory agencies. The data was analyzed using a correlational research design with the aid of the Statistical Package for Social Sciences (SPSS). The study revealed a substantial opportunity for collaborative information sharing between these stakeholders. However, legal and policy-related frameworks were identified as the

primary obstacles to such collaboration. Additional barriers included political interference and the absence of established best practice models. The study recommended initiating policy-level dialogues between logistics-supply chain entities and regulatory bodies to develop a comprehensive framework backed by enabling laws and policies that facilitate effective information exchange (Mwape, 2021).

#### 2.4 Challenges in implementing risk management strategies in road project

One of the most pervasive and impactful challenges in implementing risk management strategies in road construction projects is the inadequate identification and analysis of risks (Fikiru, 2023) <sup>[12]</sup>. Effective risk management begins with a thorough understanding of what could go wrong, yet many road projects either underestimate or completely overlook potential threats during the early planning and design stages. This oversight stems from a combination of factors, including limited access to accurate and up-to-date data, absence of historical project information, insufficient stakeholder involvement, and a general lack of risk management culture or expertise within project teams (Pomaza, 2023).

Another contributing factor is the limited engagement of key stakeholders during the risk identification phase. Road projects typically involve a wide array of actors, including government officials, engineers, contractors, local communities, and environmental agencies (Dutta, 2023) <sup>[9]</sup>. When these stakeholders are not consulted adequately, critical risks such as land acquisition disputes, community resistance, or legal compliance issues may be missed entirely. This lack of engagement not only leads to an incomplete risk profile but also weakens the legitimacy and social license of the project, potentially sparking delays and opposition later on (Mbewe, 2025).

Limited institutional capacity and expertise pose a significant barrier to the effective implementation of risk management strategies in road construction projects. In many developing countries, including Zambia, there is a marked deficiency in the availability of trained professionals with adequate knowledge of formal risk management frameworks and tools (Tamosaitiene, 2020). Project managers, engineers, and implementing agencies often approach risk informally, relying on past experiences and ad hoc responses rather than systematic, structured methodologies. This reliance on intuition instead of analytical risk management processes increases the likelihood of oversight, miscalculation, and poor preparedness for unexpected events. Consequently, risks that could have been anticipated and planned for early in the project lifecycle are only addressed reactively, often when their impact has already become costly or disruptive (Dutta, 2023) <sup>[9]</sup>.

One of the significant but often overlooked challenges in implementing effective risk management in road construction projects is the resistance to change and lack of organizational buy-in (Adfina, 2021). Many project teams and institutions, especially in environments where traditional practices dominate, tend to view risk management as a bureaucratic or administrative formality rather than an essential process for achieving long-term success (Chege, 2024) <sup>[8]</sup>. This mindset is rooted in organizational cultures that prioritize immediate outputs, cost-cutting, and short-term performance metrics over

strategic planning and risk resilience. As a result, initiatives aimed at integrating structured risk management practices are often met with skepticism or outright opposition (Hillson, 2020).

In many developing nations, governments often lack the financial capacity to independently execute urban infrastructure construction projects (UICPs), primarily due to limited budgets and financial resources. To address this challenge, public-private partnerships (PPPs) have emerged as a viable strategy to enhance the efficiency and effectiveness of urban infrastructure development. However, in regions such as the Middle East, attracting private investment for UICPs presents significant challenges that have not been thoroughly identified or prioritized.

#### 2.5 Establishment of research gaps

**Lack of Systems Thinking in Risk Management:** While many studies identify individual risk factors (e.g., design changes, material price fluctuations, poor planning), there is a significant gap in exploring how these factors interact within a system. Understanding how risks compound or trigger secondary risks is crucial for more effective risk management. Future research could focus on adopting a systems-thinking approach to uncover the interconnected nature of project risks, which would lead to more holistic risk mitigation strategies.

**Limited Empirical Validation of Digital Tools:** Studies such as Shayan (2022) and Rao (2022) highlight the potential of digital tools in managing project risks and capturing lessons learned. However, these studies remain largely conceptual, with little empirical evidence supporting the effectiveness of these tools. There is a gap in research that tests these digital solutions in real-world projects to validate their practical utility. Future studies could include case-based research to provide empirical insights into the success of these digital tools in enhancing risk management practices.

**Comparative Analysis of Risk Management Strategies across Contexts:** Despite the recognition of various risk management strategies, there is a lack of comparative analysis across different geographic, economic, and cultural contexts. Research could explore how project risk management strategies differ between developing and developed countries, as well as within different industries. Comparative studies could also identify region-specific challenges and recommend tailored approaches for effective risk management.

**Integration of Stakeholder Perspectives in Risk Management:** While several studies discuss the role of stakeholder engagement in risk management (e.g., Kakw'u, 2024) <sup>[20]</sup>, there is a lack of detailed investigation into how different stakeholders perceive and respond to risks. Future research could examine how the perspectives of various stakeholders (e.g., contractors, consultants, local communities) influence the identification, assessment, and response to risks in road construction projects. This would help develop a more comprehensive approach to stakeholder management in risk mitigation.

**Longitudinal Analysis of Risk Management Practices:** Many studies provide a snapshot of risk management practices but fail to track the long-term effectiveness of these practices over time. There is a gap in longitudinal studies that assess how risk management strategies evolve across different phases of a project and their long-term impact on project success. Future research could explore how lessons learned

from past projects are integrated into future projects and how risk management practices adapt to emerging challenges.

**Incorporation of Government Policy Influence:** Some studies (e.g., Kakw'u, 2024) [20] briefly mention the potential influence of government policies on project risk management, but there is insufficient research into how government regulations and policies shape risk management strategies in road construction projects. Further studies could investigate how the alignment of risk management with government policy frameworks influences project outcomes, particularly in developing countries where policy gaps may exacerbate project risks.

**Risk Management in the Context of Emerging Technologies:** With the rapid adoption of emerging technologies in construction (e.g., AI, IoT), there is a gap in research that explores how these technologies are influencing risk management practices. Studies could investigate how digital tools and advanced technologies are used to predict, monitor, and mitigate risks in road projects, providing a modern perspective on risk management.

**3. Methods and Procedures**

**3.1 Research Design**

The investigation embraced a cross-sectional exploratory study design, employing a quantitative methodology for gathering primary data. This approach allowed for the collection of data at a single point in time, offering a snapshot of the variables under investigation (Alsadaan, 2025).

**3.2 Target population**

By definition, a population is defined as a collection of objects, events, or individuals sharing common characteristics that the researcher is interested in studying. The target population for this study will consist of project managers, architects, engineers at responsible for the constructin of the Nakonde-Chinsali road (Tisdell, 2025).

**3.3 Sample size**

The study consisted of 100 construction company workers.

**3.4 Sampling**

The study utilized a convenience sampling approach, which involved selecting participants who were readily accessible and willing to take part in the research. This method was chosen due to its practicality and feasibility, especially considering the constraints of time and resources faced during data collection (Gillet, 2025). By targeting individuals who were easily available, the study was able to gather relevant data efficiently and within the required timeframe. While convenience sampling may limit the generalizability of the findings to the wider population, it is particularly suitable for exploratory studies such as this one, where the primary goal is to gain insights and identify patterns related to risk management processes in the Nakonde-Chinsali Road Project (Tisdell, 2025).

**3.5 Data Collection Methods**

The primary research tool for this study was a structured questionnaire comprising closed-ended questions. Data was collected through structured surveys and interviews, utilizing standardized questionnaires (Lim, 2025).

**3.6 Data Analysis**

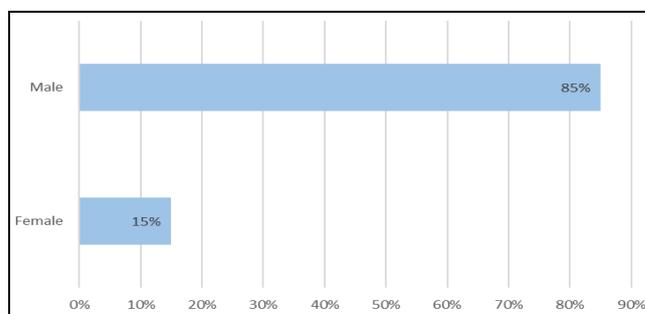
Data entry and statistical analysis was done using the Statistical Package for the Social Sciences (SPSS) version 26 and STATA. For inferential statistics, Chi-square was employed to establish associations between variables (Nyarko, 2025).

**3.7 Triangulation**

The study employed triangulation as a research strategy to enhance the validity and reliability of the findings. Triangulation involved the use of multiple data sources, data collection methods, and/or researchers' perspectives to corroborate and cross-verify research results. In this study, triangulation was achieved by obtaining quantitative data collected through surveys. This approach helped mitigate potential biases and provided a more comprehensive and accurate understanding of the research phenomenon, increasing the overall robustness of the study's conclusions.

**4. Presentation of Findings**

**4.1 Presentation of results on background characteristics of the respondents**



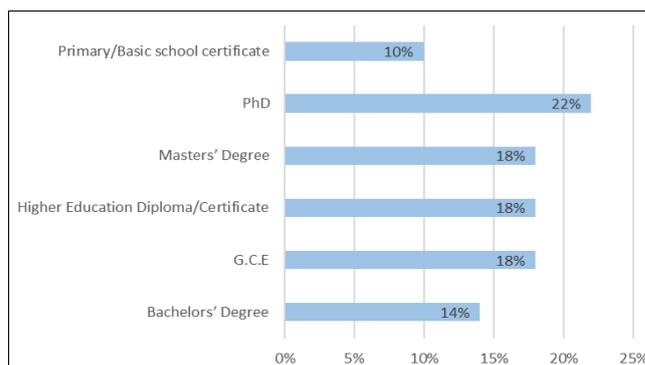
**Fig 4.1.1:** Participant’s gender

The sample had a gender distribution of 85% male and 15% female respondents.

**Table 4.1.1** Participant’ Age

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	50	22	60	40.94	12.523
Valid N (listwise)	50				

The respondents’ ages ranged from 22 to 60 years, with an average age of 40.94 years. The standard deviation of 12.523 indicated a moderate variation in the ages of participants.



**Fig 4.1.2:** Education Background

The respondents were fairly well-educated, with the largest groups holding PhDs (22%), Masters' Degrees (18%), or Higher Education Diplomas/Certificates (18%). Lower educational levels such as G.C.E (18%), Bachelors' Degree (14%), and Primary/Basic School (10%) were less represented, indicating a predominantly highly educated sample.

### 4.2 Risk Management Processes Utilized in the Nakonde-Chinsali Road Project

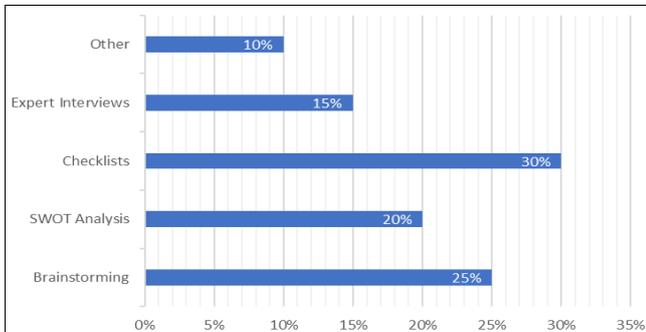


Fig 4.2.1: Techniques Used for Risk Identification

The study revealed that checklists were the most commonly used technique for risk identification, selected by 30% of respondents. Brainstorming (25%) and SWOT analysis (20%) were also applied frequently, indicating that structured and collaborative approaches are preferred. Less frequently, expert interviews (15%) and other methods (10%) were used.

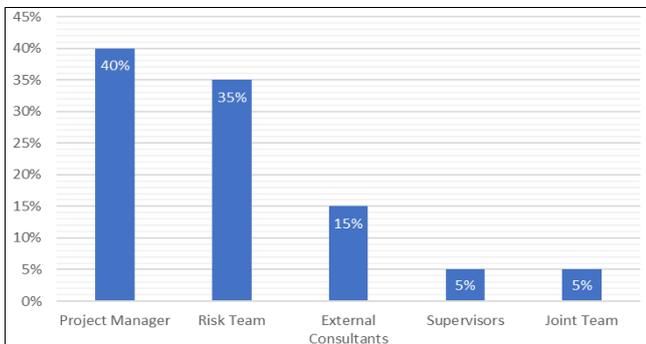


Fig 4.2.2: Responsibility for Conducting Risk Assessments

Regarding responsibility for conducting risk assessments, project managers (40%) and designated risk management teams (35%) played the central roles. External consultants were involved in 15% of cases, while site supervisors (5%) and joint teams (5%) had minimal involvement.

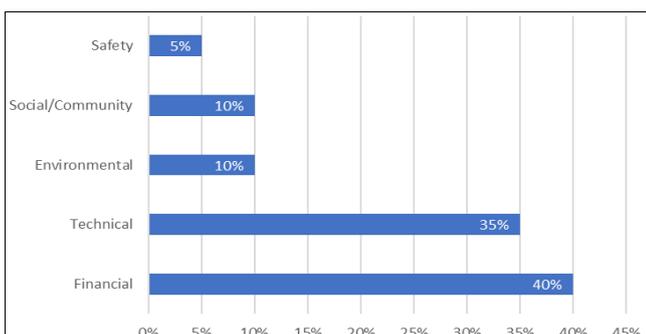


Fig 4.2.3: Types of Risks Documented in the Project

In terms of risk documentation, financial risks (40%) and technical risks (35%) were the most consistently recorded, reflecting the project's focus on budget and engineering challenges. Environmental (10%), social/community (10%), and safety risks (5%) were less systematically documented, highlighting a potential gap in comprehensive risk tracking.

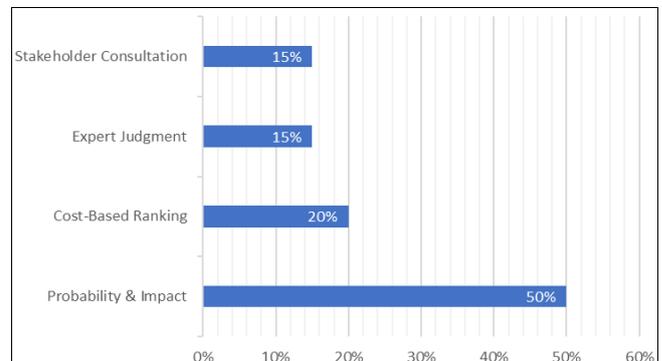


Fig 4.2.4: Methods Used for Risk Prioritization

The probability and impact matrix was the dominant method used for prioritizing risks, with 50% of respondents indicating its use. Other methods, including cost-based ranking (20%), expert judgment (15%), and stakeholder consultation (15%), were less frequent.

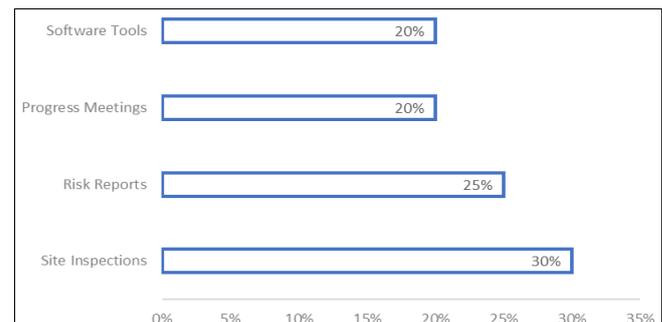


Fig 4.2.5: Approaches to Risk Monitoring

Risk monitoring was conducted through multiple channels, with site inspections (30%) and formal risk reports (25%) being the most common. Progress meetings (20%), and software tools (25%).

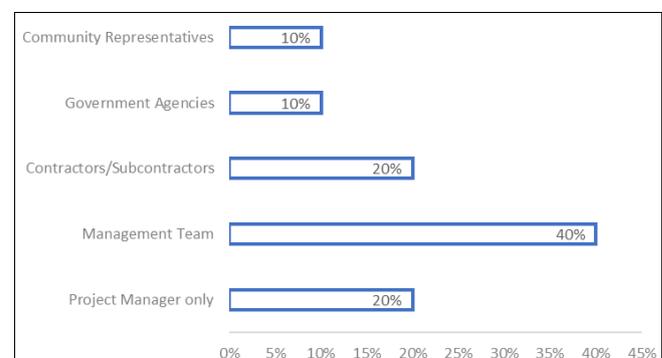


Fig 4.2.6: Decision-Making Structure in Risk Management

### 4.3 Effectiveness of Risk Management Processes in Mitigating Risks and Improving Project Outcomes

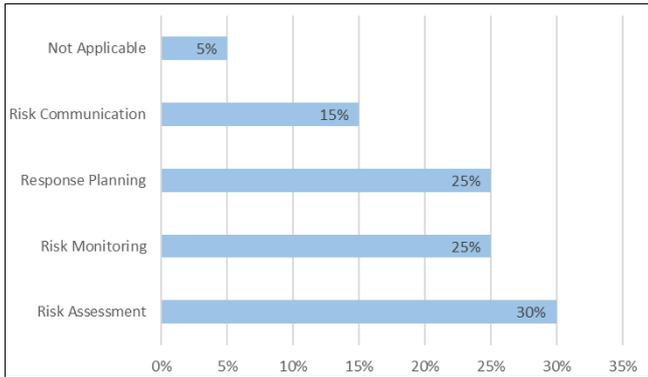


Fig 4.3.1: Processes Contributing to Risk Reduction

Risk assessment (30%) and risk response planning (25%) were identified as the processes with the greatest effect on reducing project risks. Risk monitoring (25%) and communication (15%) also contributed, while 5% reported that no process significantly impacted risk reduction.

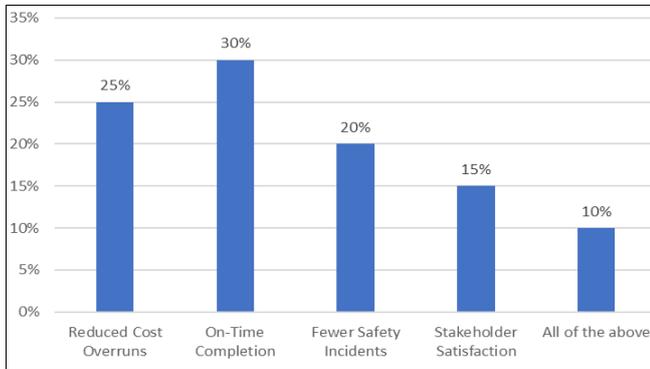


Fig 4.3.2: Measures of Risk Mitigation Effectiveness

On measuring the effectiveness of risk mitigation, on-time project completion (30%) and reduced cost overruns (25%) were most frequently cited, with fewer respondents indicating fewer safety incidents (20%) and stakeholder satisfaction (15%). Only 10% considered all measures together.

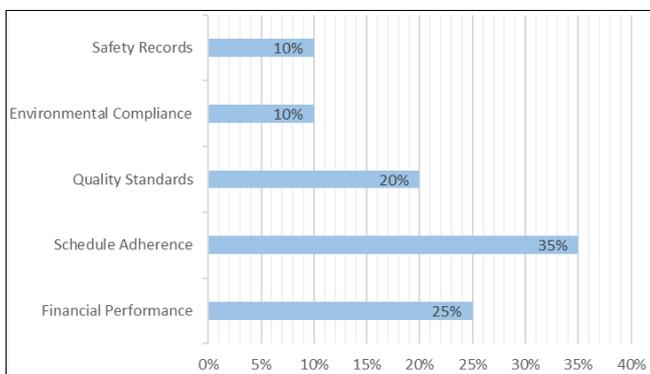


Fig 4.3.3: Project Outcomes Most Improved by Risk Management

Regarding which project outcomes improved most, schedule adherence (35%) and financial performance (25%) were reported as the most affected by risk management. Quality

standards (20%), environmental compliance (10%), and safety records (10%) were less affected.

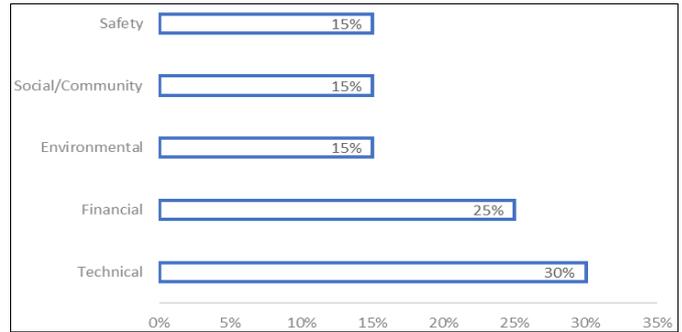


Fig 4.3.4: Types of Risks Most Effectively Reduced

Technical risks (30%) were most successfully reduced by risk management strategies, followed by financial (25%), safety, environmental, and social risks (15% each). This reflects the project’s focus on engineering and financial risks, potentially at the expense of other risk categories.

Table 4.3.2: Association between Risk Management Effectiveness and Avoidance of Cost Overruns

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	81.250 <sup>a</sup>	6	0.000
Likelihood Ratio	88.489	6	0.000
Linear-by-Linear Association	1.796	1	0.180
N of Valid Cases	50		

The Chi-square test results indicate a statistically significant association between the effectiveness of risk management strategies in improving project cost control and the extent to which risk management processes help to avoid cost overruns. The Pearson Chi-Square value of 81.250 with 6 degrees of freedom and a p-value of 0.000 confirms a strong relationship between these variables, showing that better cost control is closely linked to reduced cost overruns. The Likelihood Ratio (88.489, p = 0.000) reinforces this association. These results indicate that effective implementation of risk management strategies plays a crucial role in maintaining financial efficiency in the project.

### 4.4 Policy Interventions Applicable to Risk Management Processes

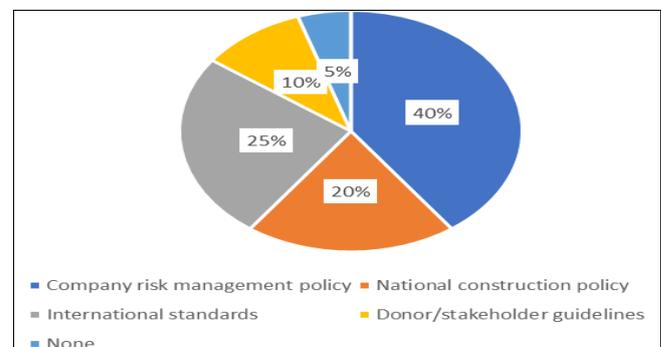


Fig 4.4.1: Policies Guiding Risk Management Practice

Most respondents indicated that risk management is guided by company risk management policies (40%) and

international standards such as ISO 31000 (25%), with national construction policies (20%) and donor/stakeholder guidelines (10%) playing lesser roles. A small proportion (5%) reported no guiding policy.

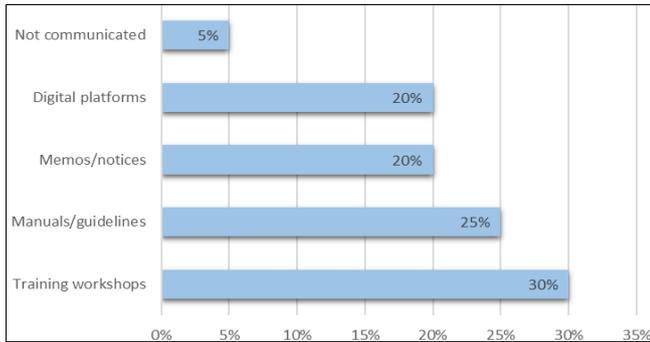


Fig 4.4.2: Modes of Policy Communication

Policy communication within the project primarily occurs through training workshops (30%) and manuals/guidelines (25%), followed by memos/notices (20%) and digital platforms (20%). About 5% of respondents indicated that policies are not communicated. This highlights that formal training and written documentation are the main methods to ensure staff awareness, though some gaps remain in reaching all project participants.



Fig 4.4.3: Policy Interventions Needed to Improve Risk Management

Respondents identified financial oversight policies (25%) and safety/environmental regulations (25%) as the most needed interventions to improve risk management. Project reporting standards (20%), contractor compliance policies (15%), and a combination of all policies (15%) were also suggested. This indicates that both regulatory compliance and internal accountability mechanisms are critical areas for policy improvement

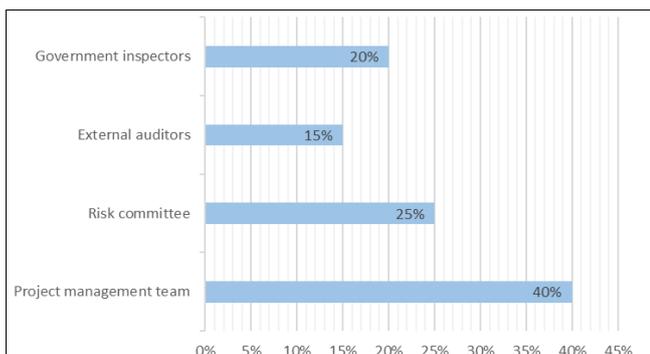


Fig 4.4.4: Enforcement of Risk Management Policies

Enforcement of risk management policies was primarily carried out by the project management team (40%) and risk management committees (25%), with external auditors (15%), and government inspectors (20%) This shows that policy compliance relies mainly on internal oversight rather than external enforcement.

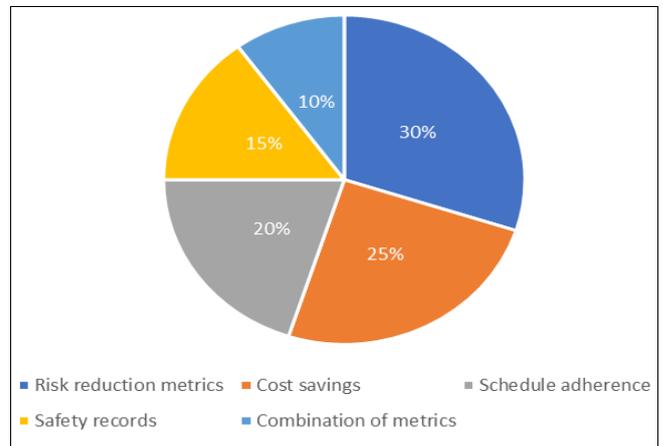


Fig 4.4.7: Measurement of Policy Impact

Measurement of the impact of policy interventions was primarily based on risk reduction metrics (30%) and project cost savings (25%), with schedule adherence (20%), safety records (15%), and multiple combined measures (10%) also used. This suggests that quantitative performance indicators are emphasized in evaluating policy effectiveness.

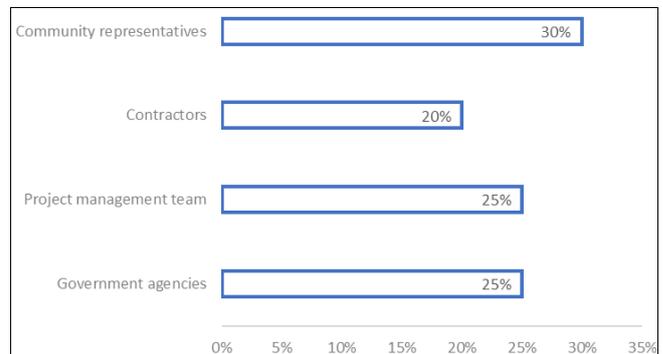


Fig 4.4.8: Stakeholder Involvement in Policy Formulation

Stakeholders involved in policy formulation included government agencies (25%), project management teams (25%), contractors (20%), and community representatives (30%). This shows that while internal and government stakeholders are engaged, broader community involvement is limited.

### 4.5 Challenges in Implementing Risk Management Strategies in the Nakonde-Chinsali Road Project

critical role of timely and accurate communication in effective risk management.

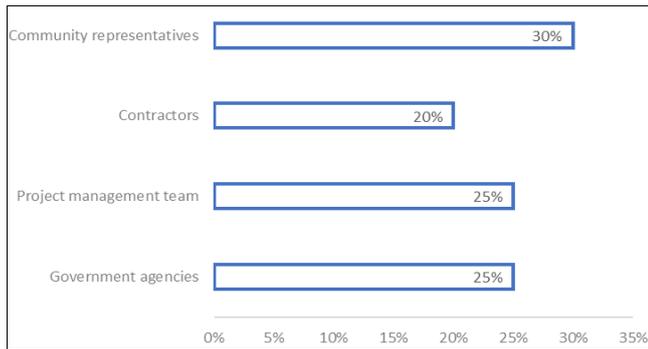


Fig 4.5.1: Challenges in Risk Identification

Limited expertise (30%) and incomplete data (25%) were reported as the main challenges in identifying risks, with time constraints (20%), poor stakeholder input (15%), and other factors (10%) also cited. This suggests that both human and informational resources constrain comprehensive risk identification.

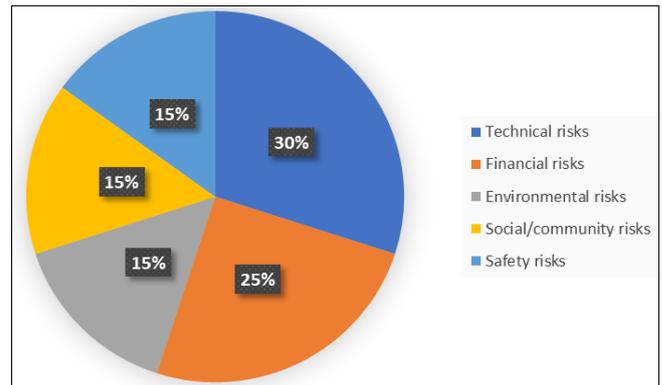


Fig 4.5.4: Risks Most Difficult to Mitigate

Technical risks (30%) were considered the most difficult to mitigate, followed by financial (25%), environmental (15%), social/community (15%), and safety risks (15%). This demonstrates that complex engineering and budget-related risks pose the greatest challenge to project teams.

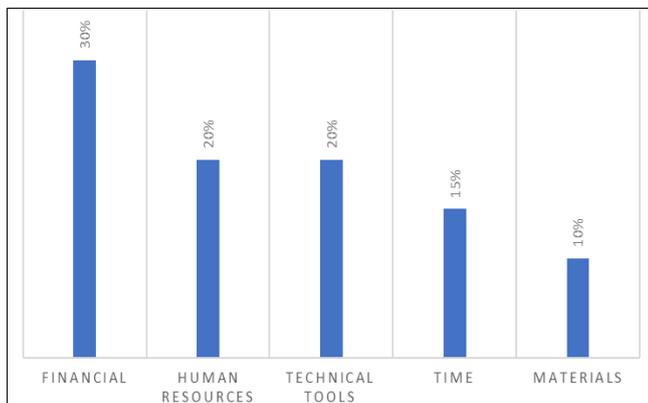


Fig 4.5.2: Resource Constraints Affecting Risk Management

Among resource constraints, financial limitations (30%) and human resource shortages (25%) were the most significant, followed by technical tools (20%), time (15%), and material resources (10%). This indicates that effective risk management is highly dependent on sufficient funding and skilled personnel.

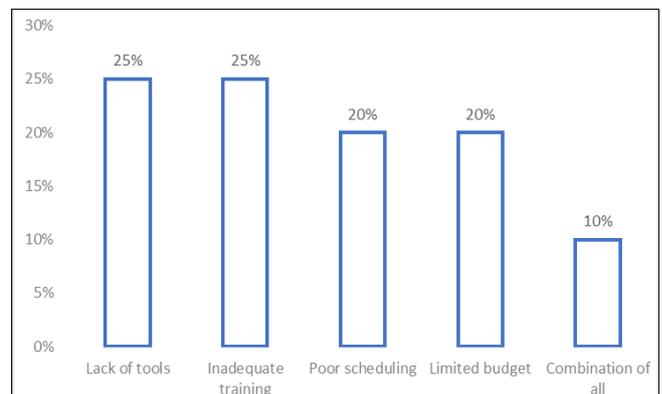


Fig 4.5.5: Limitations in Risk Monitoring

Limitations in risk monitoring were attributed to lack of tools (25%), inadequate training (25%), poor scheduling (20%), limited budgets (20%), and combined factors (10%). This indicates that both human and technological resources affect the ability to track risks effectively.



Fig 4.5.3 Communication Barriers in Risk Implementation

Communication challenges that hindered implementation included delayed reporting (25%), misinterpretation of risk data (25%), lack of meetings (20%), poor documentation (20%), and other issues (10%). These findings highlight the

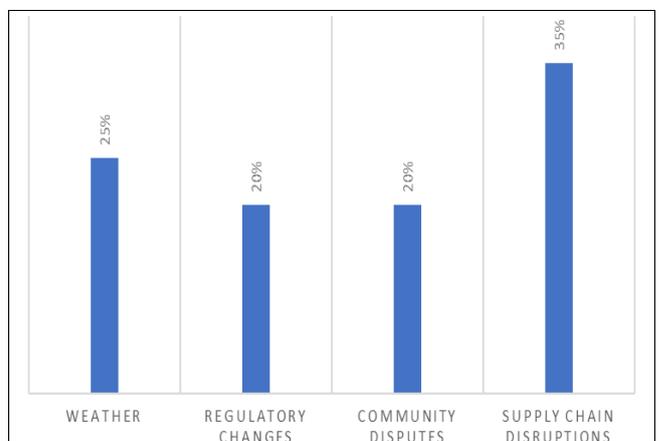
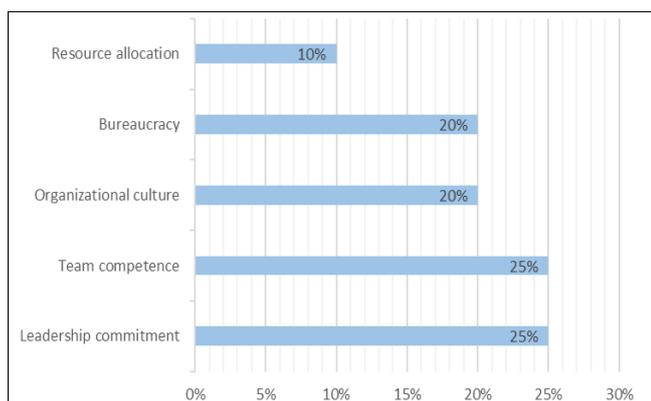


Fig 4.5.6: External Factors Affecting Risk Management

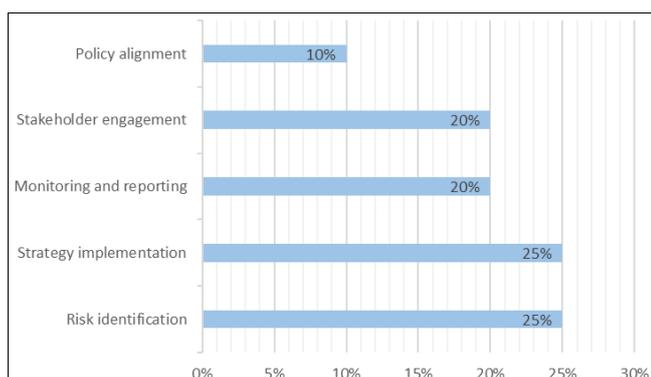
External factors challenging implementation included weather conditions (25%), regulatory changes (20%),

community disputes (20%), supply chain disruptions (20%), and a combination of all (15%). This suggests that external unpredictability is a significant constraint.



**Fig 4.5.7: Internal Factors Influencing Strategy Adoption**

Internal factors affecting strategy adoption included leadership commitment (25%), team competence (25%), organizational culture (20%), bureaucracy (20%), and resource allocation (10%). This highlights that both managerial support and organizational structure influence effective risk management



**Fig 4.5.8: Mitigation Challenges Requiring Urgent Attention**

Mitigation challenges requiring urgent attention included risk identification (25%), strategy implementation (25%), monitoring and reporting (20%), stakeholder engagement (20%), and policy alignment (10%). This shows that multiple phases of the risk management process require improvement to enhance overall effectiveness.

## 5. Discussions

The study examined the risk management processes, their effectiveness, and relevant policy interventions applied in the Nakonde-Chinsali Road Project. The discussion integrates empirical findings with contemporary literature to interpret the extent to which risk management contributed to project performance and governance.

Findings revealed that the project adopted the main elements of standard risk management frameworks identification, assessment, prioritization, mitigation, monitoring, and communication but their application varied in depth and focus. Technical and financial risks received the greatest attention, while environmental, safety, and social dimensions were less emphasized. The most common techniques used for identifying risks included checklists, brainstorming, and SWOT analysis, confirming observations

by Hubbard (2020) [17] and Chege (2024) [8] that structured and participatory methods are practical in complex construction settings. Yet, the limited use of expert interviews indicated underutilization of specialized technical knowledge, echoing Fikiru's (2023) [12] view that external expertise strengthens accuracy in risk identification. Risk assessment was mainly handled internally by project managers, aligning with Landoll (2021) [25] but exposing potential bias due to limited external oversight.

The prioritization process relied heavily on the probability-impact matrix, consistent with ISO 31000 and Banerjee (2021), ensuring analytical consistency but lacking participatory input. Monitoring combined site inspections, formal reports, and limited digital tools an approach balancing tradition and modernization but still falling short of real-time responsiveness (Rauniyar, 2023). Mitigation dominated as the preferred risk response strategy, consistent with Mizrak (2024) [30], while transfer and contingency planning were less practiced, exposing financial vulnerability. Communication depended mainly on meetings and reports rather than digital platforms, reflecting structured but slow information flow, which, according to Rojas (2022), can delay decision-making. Overall, the project demonstrated progress toward systematic risk management but remained operationally narrow and insufficiently inclusive of social and environmental risks.

Regarding effectiveness, the findings confirmed that comprehensive application of risk management processes significantly improved project outcomes, especially cost control and timely completion. The Chi-square results ( $p = 0.000$ ) established a strong statistical relationship between integrated risk management and reduced project delays, consistent with Gichohi (2024) and Kirira (2020). Assessment and response planning emerged as the most influential stages, supporting Alkhawaja's (2023) assertion that proper risk evaluation directly minimizes inefficiencies. While financial and technical risks were effectively managed, safety and environmental risks were less so, a pattern typical of developing contexts where tangible performance metrics dominate (Senić, 2025). Communication mechanisms were established but relied largely on informal feedback, suggesting the need for digital integration to improve transparency. The use of risk registers and Primavera P6 indicated maturity in documentation but limited adoption of real-time dashboards constrained coordination efficiency. Lack of skilled personnel, financial constraints, and incomplete data were the key challenges limiting process effectiveness. As supported by Kirira (2020) and Alkhawaja (2023), these resource deficits often undermine preventive risk control and institutional learning.

From a policy perspective, company-specific policies and international standards such as ISO 31000 provided the main risk management frameworks, while national regulatory guidance remained weak. This finding aligns with Mazher (2022) and Alex (2024), who advocate mandatory national risk frameworks to ensure consistency and accountability. Communication of policies through workshops and manuals demonstrated functional internal dissemination but limited digital utilization. Financial oversight and environmental compliance policies were identified as critical interventions for strengthening risk control, consistent with Hillson (2020) and Ruiz (2020). Enforcement largely depended on internal audits rather than

external oversight, a pattern that fosters ownership but weakens accountability (Hossain, 2021). Although incentive systems such as recognition and bonuses supported compliance, weak sanctions reduced deterrence. Policy impact was mainly measured through quantitative metrics cost and time savings indicating a narrow performance evaluation approach.

## 6. Conclusions and Recommendations

### 6.1 Conclusions

Based on the study findings, the Nakonde–Chinsali Road Project applied structured and systematic risk management processes that contributed to improved project performance, particularly in schedule adherence and cost control. The use of standardized tools such as checklists, probability and impact matrices, and formal documentation enhanced consistency and accountability in managing financial and technical risks. Statistical analysis ( $\chi^2=81.250$ ,  $p=.000$ ) confirmed a strong relationship between the integration of risk management and the reduction of project delays and cost overruns, demonstrating the value of proactive risk planning and monitoring. However, the findings also reveal notable gaps, including limited attention to environmental, social, and safety risks, inadequate skilled personnel, insufficient funding, and weak communication systems. Policy reliance on internal and international standards was evident, but enforcement and community participation were minimal. Overall, while the project achieved measurable benefits through effective risk management integration, strengthening capacity, stakeholder engagement, and comprehensive policy alignment remains essential for improving the resilience and sustainability of future infrastructure projects.

### 6.2 Recommendations

**Enhance Training and Capacity Building:** Continuous professional development programs should be implemented to address the training gaps identified among project personnel. Regular workshops, seminars, and practical training sessions on risk management tools, techniques, and best practices will strengthen staff competence and ensure consistent application of risk management processes.

**Improve Communication Channels:** Project stakeholders should establish clear and structured communication frameworks to facilitate timely risk information sharing. This includes regular meetings, progress reports, and centralized digital platforms for documenting and disseminating risk updates to ensure all stakeholders are adequately informed.

**Strengthen Resource Allocation:** Adequate resources, both financial and technical, should be allocated to support comprehensive risk management activities. Ensuring sufficient staffing, funding, and access to risk management tools will reduce constraints and enhance the effectiveness of risk mitigation strategies.

**Enhance Policy and Regulatory Support:** Collaboration with government agencies and regulatory bodies should be strengthened to ensure that policies guiding risk management are clearly understood and consistently applied. Updating or reinforcing regulations where gaps exist can improve compliance and overall project performance.

**Promote Stakeholder Engagement:** Active involvement of all stakeholders in risk identification, assessment, and

mitigation should be prioritized. Engaging contractors, local authorities, and community representatives will foster shared responsibility and improve the effectiveness of risk response strategies.

**Implement Continuous Monitoring and Evaluation:** Regular reviews of risk management outcomes should be institutionalized to identify lessons learned, evaluate the effectiveness of risk strategies, and adjust processes as needed. This will ensure adaptive risk management that responds effectively to evolving project challenges.

**Address Political and Economic Uncertainties:** Risk management strategies should include proactive planning for external uncertainties, including political and economic factors. Scenario planning, sensitivity analyses, and contingency frameworks can reduce potential disruptions and enhance project resilience.

**Leverage Technology for Risk Management:** Adoption of project management software and digital risk tracking tools should be expanded to improve accuracy, efficiency, and accessibility of risk data. Integrating technology will support decision-making, documentation, and communication across the project lifecycle.

## 7. Acknowledgements

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