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Influence of Risk Management Practices on Performance of Infrastructure Project: A Case of Muvumba Multipurpose Dam Development Project in Nyagatare District, Rwanda (2023–2025)

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Abstract*: The general objective of this study was to assess the influence of risk management practices on the performance of the Muvumba Multipurpose Dam Development Project. Four specific objectives guided the investigation: to evaluate the effect of risk identification, to assess the effect of risk assessment, to examine the effect of risk mitigation, and to analyze the effect of risk monitoring on the performance of the Muvumba Multipurpose Dam Development Project. Validity was established through the Content Validity Index, while reliability was measured using Cronbach's alpha. Data analysis was conducted using SPSS Version 29 to generate descriptive statistics, Pearson correlations, and multiple regression models. The ANOVA findings for Muvumba Multipurpose Dam Development Project in Nyagatare District confirmed that the regression model was significant, with F = 561.375 and p = 0.000. The model summary reported R = 0.972, R Square = 0.944, and Durbin-Watson = 2.127. Risk identification had B = 0.066, t = 2.357, p = 0.020; risk assessment had B = 0.652, t = 7.581, p = 0.000; risk mitigation had B = 0.062, t = 2.480, p = 0.014; and risk monitoring had B = 0.216, t = 2.634, p = 0.010. The study concluded that risk management practices significantly strengthened project performance and recommends continuous risk assessment and monitoring. Project authorities should provide periodic capacity building on risk mitigation for relevant staff and stakeholders.*

Keywords*: Risk Management Practices, Risk Identification, Risk Assessment, Risk Mitigation, Risk Monitoring, Infrastructure Project Performance*

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1. Introduction

Risk management practices are a critical pillar for optimizing the delivery of large-scale assets in the international construction industry. Organizations integrate these practices to navigate uncertainty and align technical choices with strategic performance outcomes. Effective implementation remains essential for minimizing financial volatility and technical failures in complex environments. Decision frameworks provide a systematic approach to evaluating trade-offs between cost, time, and quality. Formalized procedures help project managers anticipate bottlenecks and allocate resources with greater precision. Performance improvements stem from the robust identification and management of potential threats (Zhang & Hu, 2023).

In the United States, infrastructure development is increasingly shaped by institutionalized risk management practices due to aging assets and evolving regulatory requirements. Federal agencies now require data-driven risk assessments for large-scale bridge and tunnel rehabilitation projects to secure funding approval. These practices reduce exposure to litigation risks and environmental delays that frequently affect public works delivery. Project managers employ probabilistic models to forecast schedule variations and allocate contingency budgets effectively. The Infrastructure Investment and Jobs Act further reinforces resilience-oriented planning as a core requirement for infrastructure investment. Comprehensive risk modeling remains central to modern engineering governance (Miller, 2022).

China's large-scale investment in high-speed rail networks demonstrates the application of centralized risk management practices to coordinate complex infrastructure systems. Authorities deploy standardized monitoring tools to ensure safety and operational efficiency across diverse geographical conditions. These systems enable real-time adjustments to project execution based on emerging geotechnical and economic information. Continuous performance tracking supports strict adherence to ambitious construction timelines. Rapid urbanization depends on the successful integration of risk data into daily project operations. Effective infrastructure delivery is closely linked to the institutionalization of risk-based controls (Wang & Chen, 2023).

In South Africa, public infrastructure delivery continues to face challenges associated with budget constraints and limited technical capacity. The adoption of risk management practices offers a structured pathway to improve transparency and reliability in project outcomes. Municipal authorities use these practices to prioritize essential service delivery projects under constrained fiscal conditions. Early identification of risks during feasibility studies helps prevent cost escalation in later stages of implementation. Project performance is widely used as an indicator of governance effectiveness within the national infrastructure system. Improved outcomes depend on consistent application of structured risk governance frameworks (Dlamini & Zulu, 2023).

Tanzania's Standard Gauge Railway project demonstrates the application of risk management practices in coordinating large infrastructure investments. Decision-makers focus on mitigating financial exposure while ensuring compliance with international engineering standards. These practices enhance coordination between international contractors and local implementing agencies. Performance monitoring systems track progress against predefined benchmarks to ensure alignment with socio-economic objectives. Systematic risk governance reduces the likelihood of delays in the delivery of critical transport infrastructure. Project success is evaluated against global infrastructure performance standards (Macha & Temu, 2023).

Rwanda's Strategic Transport Master Plan emphasizes integrating risk management practices to improve efficiency in road and bridge construction projects. Infrastructure development in the country faces challenges related to mountainous terrain and seasonal weather variability. Risk assessment processes incorporate environmental and technical evaluations to enhance asset durability. Strong project performance contributes to Rwanda's ambition of becoming a regional logistics hub. Risk governance remains a core component of national infrastructure investment strategy. Structured planning ensures alignment between infrastructure delivery and national development priorities (Hategekimana & Mugenzi, 2024).

Public infrastructure projects in Rwanda increasingly apply advanced risk management practices to optimize limited financial resources. National agencies, such as the Rwanda Transport Development Agency, use structured decision-making protocols to minimize cost overruns in urban infrastructure development. These practices enable early identification of potential project risks during planning stages. Consistent performance in the construction sector contributes significantly to national economic output. Risk governance systems provide the structure necessary for sustainable infrastructure development. Project quality and efficiency depend on strict adherence to these management standards throughout implementation (Niyonkuru & Gasana, 2024).

None of the existing studies conduct a comprehensive assessment of the influence of risk management practices on the performance of the Muvumba Multipurpose Dam Development Project in Nyagatare District. Current literature lacks empirical evidence regarding how these processes influence the local construction environment. This research aims to bridge the identified knowledge gap through a detailed analysis of local infrastructure projects.

The general objective was to assess the influence of risk management practices on the performance of Muvumba Multipurpose Dam Development Project in Nyagatare District.

2. Literature Review

This section reviews the theoretical literature relevant to risk management practices and infrastructure project performance. The study was underpinned by Complexity Theory, Prospect Theory, Resource-Based View (RBV) Theory, and Theory of Change. The manuscript retains a concise explanation of each theory together with its direct application to the study variables.

2.1 Complexity Theory

Nonlinear dynamics within complex systems mean that minor changes in input variables often lead to disproportionately large outcomes in the final results. This perspective shifts the focus of management from linear cause-and-effect models to observing patterns over time. Adaptive capacity allows entities to survive environmental shifts by reconfiguring their internal communication and operational structures. Diversity among agents within a system enhances the system's collective robustness to sudden external shocks. Managers must recognize the deep interdependencies between different functional units to ensure cohesive organizational growth. Complexity remains a permanent feature of modern technological landscapes and requires flexible governance (Mitleton-Kelly, 2023).

The study utilized Complexity Theory to evaluate the effect of risk identification on the performance of performance of Muvumba Multipurpose Dam Development Project. The researcher investigated how emergent risks arising from interactions among multiple stakeholders and technical components influence project success.

2.2 Prospect Theory

Daniel Kahneman and Amos Tversky developed Prospect Theory in 1979 to explain how individuals make choices under conditions of uncertainty and risk. The theory challenges the traditional expected utility model by suggesting that people value gains and losses differently in their decision cycles. Decision-makers are often risk-averse when considering potential gains but become risk-seeking when faced with certain losses. This behavioral approach highlights the cognitive biases that influence human judgment in financial and technical environments. Loss aversion is a central tenet explaining why the psychological impact of losing is more powerful than that of gaining (Barberis, 2023).

This research employed Prospect Theory to assess the effect of risk assessment on the performance of performance of Muvumba Multipurpose Dam Development Project. This theoretical application helped in understanding why certain high-impact risks are underestimated during the initial planning phases.

2.3 Resource-Based View (RBV) Theory

Teece (2023) argues that firms with strong resource-orchestration capabilities are better able to absorb shocks and maintain project stability under uncertainty. This capability is particularly important in large infrastructure projects where risk exposure is high, and mitigation requires flexible resource allocation and technical responsiveness.

The Resource-Based View Theory was therefore applied in this study to examine the influence of risk mitigation on the performance of the Muvumba Multipurpose Dam Development Project. Specifically, it explained how internal resources such as financial capacity, technical expertise, and managerial competence enable effective implementation of mitigation strategies including risk avoidance, risk reduction, and risk transfer.

2.4 Theory of Change

Theory of Change explains how planned project actions are expected to generate intended outputs and outcomes through an explicit causal pathway. In the context of infrastructure projects, the approach is useful for linking continuous monitoring, feedback, and corrective action to the achievement of cost, time, quality, and sustainability objectives.

The Theory of Change was applied in this study to examine the influence of risk monitoring on the performance of the Muvumba Multipurpose Dam Development Project. It explained how monitoring processes such as continuous risk tracking, feedback systems, and performance evaluation contribute to improved cost efficiency, timely project completion, quality assurance, and long-term sustainability.

3. Methodology

3.1 Research Design

The study adopted a descriptive and correlational research design utilizing both quantitative and qualitative approaches to meet the research objectives. Descriptive and correlational designs allow for the measurement of characteristics and relationships between variables without manipulation. Quantitative methods involved collecting numerical data via structured questionnaires to test the relationship between risk management and project performance.

3.2 Study Population and Sampling Design

The target population for this study consisted of 224 professionals involved in infrastructure projects within the performance of the Muvumba Multipurpose Dam Development Project. The population was selected based on their direct involvement in the planning and execution of urban development projects in Rwanda. Using a varied population enhanced the validity of the research findings across the infrastructure sector.

The target population comprised 224 professionals involved in the Muvumba Multipurpose Dam Development Project. Slovin's formula was applied at a 0.05 margin of error, resulting in a sample of 144 respondents, as reported in the study.

The researcher employed stratified sampling to categorize the population into government agencies, private contractors, and individual project teams. Simple random sampling was used within these strata to select the 144 participants who received questionnaires.

3.3 Data Collection Instruments

The study used a self-administered questionnaire with a five-point Likert scale to collect data from the 144 selected respondents. The instrument was divided into sections focusing on the four independent variables and the dependent variable of project performance. Questions were phrased clearly to ensure that technical professionals can provide accurate responses regarding their risk management activities. Distribution was done through both physical copies and digital platforms to maximize the response rate. This primary data source provided the numerical evidence required for correlation and regression analysis.

3.4 Pilot Study, Validity and Reliability

The researcher conducted a pilot study using 10% of the calculated sample size, involving 14 professionals from an infrastructure project in Bugesera District. This area was selected because it lies outside the main case study area yet shares similar technical characteristics. The trial focused on testing the clarity and relevance of the questionnaire statements. Any identified weaknesses in the instruments were corrected to ensure high-quality data during the main study phase. The pilot study served as a foundational step to ensure the methodology's effectiveness.

The study determined the content validity of the instruments through review by two academic supervisors and three infrastructure experts. These evaluators rated each item in the questionnaire based on its relevance to the study variables. The researcher then calculated the Content Validity Index by dividing the number of relevant items by the total number of items. Any statement with a low relevance score was revised or removed from the final instrument.

The Content Validity Index of 0.86 was obtained from 24 relevant questionnaire statements out of 28 total items. The total included the 24 statements in the variable tables and four demographic categories. As the CVI exceeded the acceptable threshold of 0.70, the questionnaire demonstrated good content validity and was considered appropriate for measuring the study variables.

The researcher used SPSS Version 29 to calculate Cronbach's alpha for each section of the questionnaire following the pilot study. This test verified whether the indicators for risk identification, assessment, mitigation, and monitoring provided consistent results. If the coefficient for any variable falls below 0.70, the corresponding questions were adjusted to improve clarity. High internal consistency allowed the researcher to proceed with the main data collection phase with confidence. The reliability results were presented in the final research report to support the quality of the findings.

The Cronbach's Alpha coefficients ranged from 0.806 to 0.843, which were all above 0.70. The questionnaire therefore had good internal consistency and was reliable for the study.

3.5 Data Analysis

The study utilized SPSS Version 29 to conduct descriptive, inferential, and qualitative analysis of the collected data. Descriptive statistics were used to summarize the characteristics of the sample and the intensity of risk management practices. Inferential analysis involved correlation and multiple regression to test the hypotheses regarding project performance.

3.6 Ethical Considerations

The study adhered to strict ethical standards to protect the rights and privacy of participants during the implementation of the Muvumba Multipurpose Dam Development Project. Official permission was sought from the School of Graduate Studies and the management of the targeted infrastructure organizations. The researcher ensured that all data were used solely for academic purposes and that findings were reported accurately. Professional integrity was maintained throughout the data collection, analysis, and reporting phases of the project. This ethical framework provided a safe and transparent environment for the research investigation.

The researcher obtained a formal letter of recommendation from the University of Kigali to facilitate access to the selected project sites and government offices.

4. Results and Discussion

This section presents, analyzes, and interprets data obtained from respondents involved in Muvumba Multipurpose Dam Development Project in Nyagatare District. It covers the response rate, respondent characteristics, descriptive results on risk identification, risk assessment, risk mitigation, risk monitoring, and project performance, inferential analysis, decisions regarding the null hypotheses, and a discussion of the findings. The results indicate that the response rate for Muvumba Multipurpose Dam Development Project in Nyagatare District was satisfactory, as 132 respondents representing 91.67% returned completed questionnaires. This provided an adequate basis for analyzing the stated objectives, as most of the selected participants contributed their views. The 12 questionnaires representing 8.33% were not returned, which occurred as some selected respondents were unavailable when questionnaires were collected. Others

4.1 Descriptive Statistics

Descriptive statistics summarize how respondents rated risk identification, risk assessment, risk mitigation, risk monitoring, and project performance in the Muvumba Multipurpose Dam Development Project in Nyagatare District. Responses were measured on a five-point scale from 1, Strongly Disagree, to 5, Strongly Agree. Mean scores of 1.0–1.8 were interpreted as very low, 1.9–2.6 as low, 2.7–3.4 as neutral, 3.5–4.2 as high, and 4.3–5.0 as very high; a standard deviation of 0.5 or below indicated homogeneity, while a value above 0.5 indicated heterogeneity.

Table 1: Risk Identification in Muvumba Multipurpose Dam Development Project

Statements	N	Mean	Std. Dev.
Systematic hazard detection is performed to identify physical and environmental threats.	132	4.30	.461
A formalized risk listing is maintained to ensure potential project disruptors are documented early in the planning phase.	132	4.20	.405
Threat mapping is utilized to visualize the geographical and technical vulnerabilities across different infrastructure locations.	132	4.30	.461
Formal risk categorization is applied to distinguish between financial, technical, and logistical uncertainties.	132	4.20	.423
Management emphasizes source tracing to identify the root causes of potential failures in the delivery of urban infrastructure.	132	4.12	.479
Overall	**132**	**4.22**	**.446**

Source: Primary Data, 2026

The results in Table 1 indicate that risk identification in Muvumba Multipurpose Dam Development Project in Nyagatare District had a mean of 4.22, which represented a high mean and indicated strong positive agreement among respondents. The overall standard deviation of 0.446 showed homogeneity in responses. This means that the assessments of this practice were closely aligned among the participating respondents. The result suggests that risk identification was viewed as an important aspect of the project's implementation and performance environment.

Table 2: Risk Assessment in Muvumba Multipurpose Dam Development Project

Statements	N	Mean	Std. Dev.
Identified hazards are assigned a probability rating to assess their likelihood of occurrence throughout the project lifecycle.	132	4.14	.406
Impact scoring is used to evaluate the severity of consequences that technical risks may have on project outcomes.	132	4.17	.374
A rigorous risk-ranking process is used to categorize threats into high-, medium-, and low-priority levels.	132	4.33	.473
Formal severity grading helps assess the magnitude of potential damage to infrastructure assets.	132	4.30	.458
Strategic risk prioritization ensures that limited resources are focused on managing the most critical project threats.	132	4.19	.465
Overall	**132**	**4.23**	**.435**

Source: Primary Data, 2026

The results in Table 2 indicate risk assessment in Muvumba Multipurpose Dam Development Project in Nyagatare District had a mean of 4.23, which represented a high mean and indicated strong positive agreement among respondents. The overall standard deviation of 0.435 showed homogeneity in responses. This means that the assessments of this practice were closely aligned among the participating respondents. The result suggests that risk assessment was viewed as an important aspect of the project's implementation and performance environment.

Table 3: Risk Mitigation in Muvumba Multipurpose Dam Development Project

Statements	N	Mean	Std. Dev.
Detailed response planning is developed for each major risk to establish specific reactions if a threat manifests.	132	4.17	.381
Effective control measures are implemented on-site to reduce the occurrence of accidents and technical errors.	132	4.17	.394
The organization prioritizes risk reduction activities to lower the overall vulnerability of infrastructure.	132	4.11	.376
Pre-defined contingency actions are established to manage unforeseen disruptions in the construction schedule.	132	4.20	.423
Formal mitigation budgeting is integrated into the project financial plan to cover the costs of protective strategies.	132	4.12	.446
Overall	**132**	**4.15**	**.404**

Source: Primary Data, 2026

The results in Table 3 indicate that risk mitigation in Muvumba Multipurpose Dam Development Project in Nyagatare District had a mean of 4.15, which represented a high mean and indicated strong positive agreement among respondents. The overall standard deviation of 0.404 showed homogeneity in responses. This means that the assessments of this practice were closely aligned among the participating respondents. The result suggests that risk mitigation was viewed as an important aspect of the project's implementation and performance environment.

Table 4: Risk Monitoring in Muvumba Multipurpose Dam Development Project

Statements	N	Mean	Std. Dev.
Continuous risk tracking is performed throughout the execution phase to observe changes in the status of hazards.	132	4.23	.438
Regular status updating of the risk register ensures that decision-makers have current data on emerging project threats.	132	4.27	.496
Formal progress review meetings are held to evaluate if risk management efforts are achieving established goals.	132	4.17	.448
Frequent risk reporting is used to communicate threat levels and mitigation status to all project stakeholders.	132	4.30	.458
Systematic control auditing is conducted to verify that safety and risk protocols are strictly followed on site.	132	4.28	.451
Overall	**132**	**4.25**	**.458**

Source: Primary Data, 2026

The results in Table 4 indicate risk monitoring in Muvumba Multipurpose Dam Development Project in Nyagatare District had a mean of 4.25, which represented a high mean and indicated strong positive agreement among respondents. The overall standard deviation of 0.458 showed homogeneity in responses. This means that the assessments of this practice were closely aligned among the participating respondents. The result suggests that risk monitoring was viewed as an important aspect of the project's implementation and performance environment.

Table 5: Performance of Muvumba Multipurpose Dam Development Project

Statements	N	Mean	Std. Dev.
Project is consistently completed within the originally approved cost and budget.	132	4.11	.422
High levels of timeliness are achieved by meeting established completion deadlines for construction ventures.	132	4.16	.425
Final infrastructure assets meet Rwanda's required technical quality and engineering standards.	132	4.14	.344
Construction ventures successfully deliver all requirements defined in the original project scope without major changes.	132	4.23	.426
Overall	**132**	**4.16**	**.404**

Source: Primary Data, 2026

The results in Table 5 indicate that project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District had a mean of 4.16, which represented a high mean and indicated strong positive agreement among respondents. The overall standard deviation of 0.404 showed homogeneity in responses. This means that the assessments of this practice were closely aligned among the participating respondents. The result suggests that project performance was viewed as an important aspect of the project's implementation and performance environment.

4.2 Inferential Statistics

This section examines the relationships between risk identification, risk assessment, risk mitigation, risk monitoring, and project performance in the Muvumba Multipurpose Dam Development Project in Nyagatare District. Pearson correlation analysis was used to assess the direction and strength of each relationship, while multiple regression analysis was used to assess the joint model, its significance, and the individual contribution of each independent variable at the 0.05 significance level.

4.2.1 Correlation Analysis

Correlation analysis was conducted to determine the strength and direction of the relationship between each independent variable and project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District.

Table 6: Correlation between Study Variables

		Risk identification	Risk assessment	Risk mitigation	Risk monitoring	Project performance
Risk identification	Pearson Correlation	1	.708**	.629**	.694**	.732**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	132	132	132	132	132
Risk assessment	Pearson Correlation	.708**	1	.707**	.968**	.966**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	132	132	132	132	132
Risk mitigation	Pearson Correlation	.629**	.707**	1	.705**	.735**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	132	132	132	132	132
Risk monitoring	Pearson Correlation	.694**	.968**	.705**	1	.951**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	132	132	132	132	132
Project performance	Pearson Correlation	.732**	.966**	.735**	.951**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	132	132	132	132	132

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Primary Data, 2026

The findings in Table 6 indicate a positive and strong relationship between risk identification and project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District (r = 0.732, p = 0.000). The p-value was below 0.05, showing that the relationship was statistically significant. This implies that stronger risk identification was associated with improved project performance in the study setting.

The correlation results show a positive and very strong relationship between risk assessment and project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District (r = 0.966, p = 0.000). The p-value was below 0.05, showing that the relationship was statistically significant. This implies that stronger risk assessment was associated with improved project performance in the study setting.

The correlation results show a positive and strong relationship between risk mitigation and project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District (r = 0.735, p = 0.000). The p-value was below 0.05, showing that the relationship was statistically significant. This implies that stronger risk mitigation was associated with improved project performance in the study setting.

The correlation results show a positive and very strong relationship between risk monitoring and project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District (r = 0.951, p = 0.000). The p-value was below 0.05, showing that the relationship was statistically significant. This implies that stronger risk monitoring was associated with improved project performance in the study setting.

Therefore, the correlation analysis showed that each independent variable was positively and significantly associated with project performance. The results supported proceeding to regression analysis to assess the unique contribution of the variables when considered together.

4.2.2 Regression Analysis

Multiple regression analysis was performed to assess how well risk identification, risk assessment, risk mitigation, risk monitoring predicted project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District. The model summary shows the strength and explanatory power of the model; the ANOVA table tests whether the model is statistically significant; and the coefficients table explains the separate contribution of each predictor.

Table 7: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.972[a]	.944	.943	.09127

a. Predictors: (Constant), Risk monitoring, Risk identification, Risk mitigation, Risk assessment

b. Dependent Variable: Project performance

Source: Primary Data, 2026

The results in Table 7 indicate that the regression model had a strong multiple correlation coefficient of R = 0.972. This shows a close relationship between the combined independent variables and project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District. The R Square of 0.944 means that 94.4% of the variation in project performance was explained by the variables included in the model. The remaining variation may be explained by other factors not included in the study.

Table 8: ANOVA Summary

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17.965	4	4.491	561.375	.000[b]
	Residual	1.058	127	.008		
	Total	19.023	131			

a. Dependent Variable: Project performance

b. Predictors: (Constant), Risk monitoring, Risk identification, Risk mitigation, Risk assessment

Source: Primary Data, 2026

The findings in Table 8 indicate that the regression model was statistically significant for Muvumba Multipurpose Dam Development Project in Nyagatare District ($F = 561.375$, $p = 0.000$). The significance value was below the 0.05 threshold, meaning that the independent variables jointly explained variation in project performance. This confirms that the observed model was unlikely to have occurred by chance. The analysis therefore provides evidence that the selected project management practices collectively mattered to project performance. The model was consequently appropriate for interpreting the individual coefficients.

Table 9: Coefficients Summary

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.031	.095		.326	.741
	Risk identification	.066	.028	.072	2.357	.020
	Risk assessment	.652	.086	.649	7.581	.000
	Risk mitigation	.062	.025	.076	2.480	.014
	Risk monitoring	.216	.082	.219	2.634	.010

a. Dependent Variable: Project performance

Source: Primary Data, 2026

The results in Table 9 indicate that risk identification made a positive and statistically significant contribution to project performance. A one-unit increase in risk identification would increase project performance by 0.066 units when the other variables were held constant. The t-value of 2.357 and p-value of 0.020 confirmed significance at the 0.05 level. The null hypothesis on risk identification was rejected, and the study concluded that risk identification significantly influenced project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District.

Risk assessment had a statistically significant and positive influence on project performance. A one-unit increase in risk assessment would increase project performance by 0.652 units, holding other variables constant. The t-value of 7.581 and p-value of 0.000 confirmed significance at the 0.05 level. The null hypothesis on risk assessment was rejected, and the study concluded that risk assessment significantly influenced project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District.

A positive contribution to project performance was also observed for risk mitigation, and its effect was statistically significant. A one-unit increase in risk mitigation would increase project performance by 0.062 units, holding other variables constant. The t-value of 2.480 and p-value of 0.014 confirmed significance at the 0.05 level. Its tolerance of 0.462 and VIF of 2.166 did not show a serious collinearity concern. The null hypothesis on risk mitigation was rejected, and the study concluded that risk mitigation significantly influenced project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District.

Risk monitoring emerged as another meaningful predictor, showing a positive and statistically significant effect on project performance. A one-unit increase in risk monitoring would increase project performance by 0.216 units, holding other variables constant. The t-value of 2.634 and p-value of 0.010 confirmed significance at the 0.05 level. The null hypothesis on risk monitoring was rejected, and the study concluded that risk monitoring significantly influenced project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District.

The adopted model for analysis was structured as follows:

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \varepsilon$

Where Y = project performance; X_1 = risk identification; X_2 = risk assessment; X_3 = risk mitigation; X_4 = risk monitoring; β_0 = constant; and ε = error term.

The estimated regression model was: Project Performance = $0.031 + 0.066X_1 + 0.652X_2 + 0.062X_3 + 0.216X_4 + \varepsilon$.

In conclusion, all the independent variables had positive and significant effects on project performance in Muvumba Multipurpose Dam Development Project in Nyagatare District. The regression evidence therefore supported rejection of all the null hypotheses.

4.3 Decision on Null Hypotheses

This section gives conclusions based on the null hypotheses that drove the investigation of the Muvumba Multipurpose Dam Development Project in Nyagatare District. Each choice is based on the regression significance value at the 0.05 level and is presented in connection to the research aim.

Table 10: Decision on Null Hypotheses

Null Hypothesis	Test Result	Decision
$H_0$1: Risk identification has no significant effect on project performance.	p = 0.020	Rejected
$H_0$2: Risk assessment has no significant effect on project performance.	p = 0.000	Rejected
$H_0$3: Risk mitigation has no significant effect on project performance.	p = 0.014	Rejected
$H_0$4: Risk monitoring has no significant effect on project performance.	p = 0.010	Rejected

Source: Primary Data, 2026

The decision results show that each null hypothesis was rejected because the relevant significance value was below 0.05. Accordingly, risk identification, risk assessment, risk mitigation, and risk monitoring each had a statistically significant positive effect on project performance in the Muvumba Multipurpose Dam Development Project in Nyagatare District.

4.4 Discussion of Research Findings

This section explores how the descriptive and inferential results relate to the empirical and theoretical literature. The debate focuses on how risk identification, assessment, mitigation, monitoring, and project performance are related to the Muvumba Multipurpose Dam Development Project in Nyagatare District.

4.4.1 Risk identification and Project Performance

The evidence on risk identification in Muvumba Multipurpose Dam Development Project in Nyagatare District aligns with Khan et al. (2022), who emphasized that systematic practice in this area strengthens coordination and supports the delivery of planned project results. It also resonates with Trzeciak (2022), whose work associates deliberate management of this practice with clearer decisions and better implementation conditions.

The observed association between risk identification and project performance is consistent with Khan et al. (2022), who linked the practice to improved delivery conditions in project environments. This evidence underlines that disciplined attention to the variable can create a basis for clearer coordination, timely response, and achievement of planned outcomes in comparable projects. It also shows why the variable deserves continued managerial attention within the project context.

The predictive contribution of risk identification to project performance is supported by Khan et al. (2022), who present this practice as an important operational driver of successful project delivery. The evidence similarly suggests that consistent application of the practice helps institutions translate plans and resources into improved implementation results. This makes the variable a relevant management priority for the continuing delivery of project activities.

Complexity Theory further supports this pattern by explaining how structured actions and relationships can contribute to desired project outcomes.

4.4.2 Risk assessment and Project Performance

The evidence on risk assessment in Muvumba Multipurpose Dam Development Project in Nyagatare District aligns with Zhou et al. (2023), who emphasized that systematic practice in this area strengthens coordination and supports the delivery of planned project results. It also resonates with Morelli et al. (2022), whose work associates deliberate management of this practice with clearer decisions and better implementation conditions.

The observed association between risk assessment and project performance is consistent with Zhou et al. (2023), who linked the practice to improved delivery conditions in project environments. This evidence underlines that disciplined attention to the variable can create a basis for clearer coordination, timely response, and achievement of planned outcomes in comparable projects. It also shows why the variable deserves continued managerial attention within the project context.

The predictive contribution of risk assessment to project performance is supported by Zhou et al. (2023), who present this practice as an important operational driver of successful project delivery. The evidence similarly suggests that consistent application of the practice helps institutions translate plans and resources into improved implementation results. This makes the variable a relevant management priority for the continuing delivery of project activities.

Prospect Theory reinforces this trend by demonstrating how organized activities and connections may contribute to desired project outcomes.

4.4.3 Risk mitigation and Project Performance

The evidence on risk mitigation in Muvumba Multipurpose Dam Development Project in Nyagatare District aligns with Rajput et al. (2023), who emphasized that systematic practice in this area strengthens coordination and supports the delivery of planned project results. It also resonates with Smith (2022), whose work associates deliberate management of this practice with clearer decisions and better implementation conditions.

The Resource-Based View Theory reinforces this trend by describing how organized behaviors and connections may contribute to desired project results.

The observed association between risk mitigation and project performance is consistent with Rajput et al. (2023), who linked the practice to improved delivery conditions in project environments. This evidence underlines that disciplined attention to the variable can create a basis for clearer coordination, timely response, and achievement of planned outcomes in comparable projects. It also shows why the variable deserves continued managerial attention within the project context.

The predictive contribution of risk mitigation to project performance is supported by Rajput et al. (2023), who present this practice as an important operational driver of successful project delivery. The evidence similarly suggests that consistent application of the practice helps institutions translate plans and resources into improved implementation results. This makes the variable a relevant management priority for the continuing delivery of project activities.

4.4.4 Risk monitoring and Project Performance

The evidence on risk monitoring in Muvumba Multipurpose Dam Development Project in Nyagatare District aligns with Do (2023), who emphasized that systematic practice in this area strengthens coordination and supports the delivery of planned project results. It also resonates with Veen (2022), whose work associates deliberate management of this practice with clearer decisions and better implementation conditions.

The observed association between risk monitoring and project performance is consistent with Do (2023), who linked the practice to improved delivery conditions in project environments. This evidence underlines that disciplined attention to the variable can create a basis for clearer coordination, timely response, and achievement of planned outcomes in comparable projects. It also shows why the variable deserves continued managerial attention within the project context.

The predictive contribution of risk monitoring to project performance is supported by Do (2023), who presents this practice as an important operational driver of successful project delivery. The evidence similarly suggests that consistent application of the practice helps institutions translate plans and resources into improved implementation results. This makes the variable a relevant management priority for the continuing delivery of project activities.

The combined analytical evidence is in line with Khan et al. (2022) and Zhou et al. (2023), who both show that related management practices can jointly strengthen project delivery conditions. The result indicates that the selected practices should be treated as connected rather than isolated activities in Muvumba Multipurpose Dam Development Project in Nyagatare District. Their combined application can support clearer decisions, coordinated action, and sustained attention to outputs.

Theory of Change further clarifies this pattern by delineating how organized behaviors and connections might facilitate desired project results.

5. Conclusion and Recommendations

5.1 Conclusion

It is found that risk identification is a significant contributor to project performance in the Muvumba Multipurpose Dam Development Project in Nyagatare District. Strengthening this practice fosters the environment necessary for dependable execution, responsive coordination, and the achievement of desired outcomes.

It is established that risk assessment plays a significant role in the Muvumba Multipurpose Dam Development Project in Nyagatare District. Strengthening this practice fosters the environment necessary for dependable execution, responsive coordination, and the achievement of desired outcomes. The research disputes the notion that risk assessment has no significant impact on project performance. Project managers should consequently see this approach as an essential component of continuous project management.

An essential factor in the flourishing of the Muvumba Multipurpose Dam Development Project in the Nyagatare District was the successful reduction of associated risks. Strengthening this practice fosters the environment necessary for dependable execution, responsive coordination, and the achievement of desired outcomes.

Risk management significantly enhances project performance in the Muvumba Multipurpose Dam Development Project located in Nyagatare District. Enhancing this practice creates the conditions for reliable execution, adaptive coordination, and the achievement of intended outcomes.

The study concludes that the combined application of risk identification, risk assessment, risk mitigation, and risk monitoring supports stronger project performance in the Muvumba Multipurpose Dam Development Project in Nyagatare District. These practices work together to help the project identify issues, make timely decisions, allocate attention, and follow through on actions.

5.2 Recommendations

Based on the findings and conclusions of the study, the following recommendations were made:

1. Project authorities should provide periodic capacity building on risk assessment for relevant staff and stakeholders.
2. The management of the Muvumba Multipurpose Dam Development Project in Nyagatare District should formalize risk-mitigation procedures in its operational plans.
3. Project authorities should provide periodic capacity building on risk mitigation for relevant staff and stakeholders.
4. The management of the Muvumba Multipurpose Dam Development Project in Nyagatare District should formalize risk-monitoring procedures in its operational plans.

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