EdinBurg Peer-Reviewed Journals and Books Publishers
Journal of Entrepreneurship & Project Management
Vol. 6||Issue 2||pp 29-42||September||2026
Email: info@edinburgjournals.org||ISSN: 2789-2115

Influence of Client-Related Variations on Implementation of Kenya National Highways Authority Projects

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Accepted: 19 August 2026 || Published: 18 September 2026

Abstract

Client-related variations such as scope changes, specification modifications, delayed instructions, and financial constraints are a major source of delays and cost overruns in infrastructure projects. Globally, they account for 6-15% of cost escalations in Europe and up to 45% of schedule slippages in Asia. In Africa, systemic challenges including weak planning and financial constraints exacerbate these impacts. In Kenya, despite recent improvements - including 4.5% sector growth reported by KNBS in 2025 and clearance of a KShs.177 billion backlog in 2026 - client-related variations remain a key disruptor of KeNHA road projects. A descriptive research design was employed, targeting 600 respondents across 50 ongoing KeNHA projects. A total of 443 valid responses were obtained (73.8% response rate). Data was collected using structured questionnaires and analyzed through descriptive statistics, regression models, and moderation analysis. Regression analysis revealed that client-related varwereiations explained 60.3% of the variance in project implementation outcomes, with unclear scopes, delayed instructions, and financial constraints as key drivers. Moderation analysis confirmed that project risk management significantly reduced adverse effects, raising explanatory power from 57.3% to 88.9%. Client-related variations significantly influence project implementation outcomes in KeNHA projects, but effective risk management frameworks can mitigate their disruptive effects. Embedding proactive risk identification, clear communication, and accountability mechanisms is essential for timely, cost-effective, and quality delivery of road infrastructure, supporting Kenya's broader economic growth and poverty reduction objectives.

Keywords: *Client Variations, Contingency Theory, Risk Management, Infrastructure Projects, Implementation*

How to Cite: Ondiek, F. B., Sije, A., & Muchelule, Y. (2026). Influence of Client-Related Variations on Implementation of Kenya National Highways Authority Projects. *Journal of Entrepreneurship and Project Management, 6*(2), 29-42.

1. Introduction

Globally, client-related variations remain a dominant factor influencing project implementation outcomes. Recent studies highlight that variation orders initiated by clients account for 6 - 15% of cost overruns in Europe and contribute to schedule slippages of up to 45% in Asia, largely due to scope changes, evolving specifications, and technological adjustments (Gavamukulya, 2024; O'Rourke, Coughlan, Spillane, & Bradley, 2025). While such changes may enhance project relevance, they frequently disrupt schedules and escalate costs, leading to disputes between contractors and owners. These findings underscore that client-related variations are

inevitable but must be managed through robust contractual frameworks to minimize inefficiencies and ensure successful project delivery (HKA, 2020).

In Africa, client-related variations are particularly pronounced due to systemic challenges such as weak planning, fragmented coordination, and financial constraints. Evidence shows that delayed instructions, unclear scopes, and client-side financing difficulties remain critical sources of project delays and failures (AfDB, 2020; Lakmeeharan, Manji, Nyairo & Poeltner, 2020). For instance, in Nigeria, client-driven design changes and poor project management practices have led to cost overruns and even project abandonment, while in Egypt, delayed decision-making has disrupted schedules and inflated costs (Edward-Alikor & Adiele, 2025). These findings illustrate that client-related variations compound existing infrastructural challenges, undermining timely and cost-effective project delivery across the continent. Strengthening accountability and planning mechanisms is therefore essential to mitigate their impact.

In Kenya, client-related variations significantly affect road construction projects, which are vital for economic growth and poverty reduction. Recent evidence indicates that unclear scopes, delayed instructions, and client-initiated disputes over contract terms often result in prolonged timelines and inflated costs (Gatitu, Kabubo & Ajwang, 2020; Karanja & Ruguru, 2023). The Kenya National Bureau of Statistics (KNBS, 2025) reported that road infrastructure expanded by 4.5% in 2025, exceeding targets by 269%, with backlog clearance unlocking 6,000 km of roads in 2026. However, client-related variations remain a key source of delays, as illustrated by projects such as the Sagana–Marua dual carriageway, where scope adjustments disrupted schedules and weakened accountability (KeNHA, 2023).

KeNHA road projects are particularly vulnerable to client-related variations because of evolving national priorities, budget reallocations, and specification changes. Such variations often necessitate redesigns, material substitutions, or schedule adjustments, directly affecting project implementation. While variation orders are legally recognized, their excessive frequency undermines efficiency and increases costs. For example, client-driven financial diversions or scope changes frequently delay procurement processes and disrupt contractor workflows, weakening the sector's role in supporting trade and development (Kenya Roads Board, 2025). This highlights the need for stronger project management frameworks and improved client accountability.

The link between client-related variations and project implementation in Kenya demonstrates that while changes are sometimes necessary, their mismanagement can lead to inefficiencies. Effective implementation requires clear project scopes, timely instructions, and transparent communication between clients and contractors. The KeNHA Strategic Plan (2023–2027) emphasizes adaptive strategies, including improved planning, data-driven monitoring, and enhanced institutional capacity to address contract delays and variation-related risks (KeNHA, 2024). By embedding these strategies, KeNHA can minimize delays, reduce cost overruns, and enhance the quality of road infrastructure delivery. Ultimately, managing client-related variations effectively ensures that road projects meet their intended objectives of supporting economic growth, improving mobility, and reducing poverty.

1.1 Problem Statement

Road infrastructure projects are central to economic growth, yet client-related variations often disrupt their implementation. Globally, evidence shows that client-initiated changes such as scope adjustments, specification modifications, or retrofitting requirements frequently lead to delays and cost escalations. Recent studies indicate that variation orders account for 6–15% of

cost overruns in Europe and up to 45% of schedule slippages in Asia, underscoring the complexity of balancing evolving client needs with project timelines and budgets (Gavamukulya, 2024; O'Rourke, Coughlan, Spillane, & Bradley, 2025). While client variations may improve project relevance, mismanagement often leads to inefficiencies, disputes, and compromised quality, making them a critical factor in infrastructure delivery worldwide (HKA, 2020).

In Africa, client-related variations are particularly pronounced due to systemic challenges such as poor planning, weak coordination, and financial constraints. Evidence shows that delayed instructions, unclear scopes, and client-side financing difficulties remain critical sources of project delays and failures (AfDB, 2020). In Nigeria, client-driven design changes have led to cost overruns and project abandonment (Edward-Alikor & Adiele, 2025), while in Egypt, recent research confirms that delayed decision-making and scope changes continue to disrupt schedules and inflate costs (Elbeltagi & Dawood, 2021). Kenya faces similar challenges, though recent data show improvements. The Kenya National Bureau of Statistics (KNBS, 2025) reported that road infrastructure expanded by 4.5% in 2025, exceeding targets by 269%, and that backlog clearance unlocked 6,000 km of roads in 2026. Case studies such as the Sagana–Marua dual carriageway illustrate how client-driven delays in land compensation and utility relocation hinder project progress despite these gains (KeNHA, 2023).

Recent empirical studies provide valuable insights into the causes and impacts of client-related variations. Jibrin, Muhammad, & Labaran (2020) found that scope changes were the most significant factor driving variation orders in Nigerian civil engineering projects. Edward-Alikor & Adiele (2025) confirmed that client-related factors ranked highest among the factors causing variations in building projects in Rivers State, leading to cost and time overruns. Alenazi, Adamu, & Al-Otaibi (2022) demonstrated that client-related delays in Saudi projects produced poor schedule and cost performance, with SPI values as low as 0.71. A mixed-methods study in Nepalese road projects revealed that scope alterations and design errors were primary causes of variation orders, often triggering disputes and overruns. Gatitu, Kabubo, & Ajwang (2020) identified mitigation approaches to variation orders in KeNHA road projects, emphasizing planning and scope clarity. These studies highlight important lessons but also reveal gaps: most focus on specific sectors or regions, lack comprehensive quantification of variation magnitude, or emphasize mitigation without evaluating long-term effectiveness. This underscores the need for a Kenya-specific synthesis of client-related variations in national highway projects, particularly under KeNHA, to strengthen project management strategies and ensure timely, cost-effective delivery of road infrastructure.

1.2 Specific Objectives

i. To examine the effect of client-related variations (financial and resource constraints, project planning and scope management, contractual complexity and client expectations) on the implementation of Kenya National Highways Authority (KeNHA) projects.

ii. To assess the moderating role of project risk management (risk identification, quantification, and analysis) on the relationship between client-related variations and implementation of Kenya National Highways Authority (KeNHA) projects.

1.3 Research Hypotheses

H_{01}: Client-related variations (financial and resource constraints, project planning and scope management, contractual complexity, and client expectations) have no significant effect on project implementation outcomes (schedule, budget, quality, and specifications) in KeNHA projects.

H_{02}: Project risk management does not significantly moderate the relationship between client-related variations and project implementation outcomes.

2. Literature Review

2.1 Theoretical Review

Fred Edward Fiedler advanced contingency theory in 1964, emphasizing that managerial decisions must align with a project's prevailing circumstances. Fiedler argued that managers should focus on situational aspects rather than relying on rigid, universal approaches. In construction projects, each undertaking is unique, with distinct complexities and environments that require adaptive management strategies. The theory rejects the idea of a single best way to manage projects and instead advocates flexibility and responsiveness to changing conditions. This situational approach makes Contingency Theory highly relevant in contexts where client-related variations frequently disrupt project implementation.

Contingency theory has been widely recognized for explaining why no single management approach is universally effective. Its greatest strength lies in acknowledging that organizational and project outcomes depend on situational factors such as environment, technology, and leadership style (Fiedler, 1964; Donaldson, 2001). By rejecting rigid “one-best-way” prescriptions, the theory encourages managers to adopt flexible strategies that align with each project's unique demands (Morgan, 1997). In construction and infrastructure contexts, this adaptability has proven valuable in managing uncertainties such as scope changes, financial constraints, and evolving stakeholder demands (Hanisch & Wald, 2012). Recent studies confirm that contingency approaches remain highly relevant in dynamic environments, particularly in post-COVID infrastructure projects where supply chain disruptions and policy shifts require adaptive planning and risk buffers (Sing, Ma, & Gu, 2025; Czarnigowska & Tomczak, 2025). The theory’s emphasis on situational alignment therefore provides a practical lens for project managers to anticipate variations, embed risk management, and enhance resilience in complex construction environments.

The theory has faced criticism for its lack of prescriptive clarity (Donaldson, 2001). Some scholars contend that the theory is overly broad and offers no concrete guidelines for managers to follow in specific situations (Ginsberg & Venkatraman, 1985). Critics argue that the theory's reliance on situational variables makes it difficult to standardize practices across projects, thereby limiting its practical applicability (Hanisch & Wald, 2012). Others suggest that the theory underestimates the value of structured methodologies, which can provide consistency and predictability in project management (Burrell & Morgan, 2017). Recent critiques further highlight that in dynamic contexts such as post-COVID infrastructure projects, contingency approaches struggle to provide actionable frameworks for managing uncertainty (Sing, Ma, & Gu, 2025; Czarnigowska & Tomczak, 2025). These critiques highlight the challenge of balancing flexibility with the need for clear frameworks, especially in complex construction environments.

In the context of KeNHA road construction projects, contingency theory is particularly relevant as client-related variations frequently affect project implementation. Road projects often undergo scope changes due to evolving government priorities, budget reallocations, or community demands. These variations disrupt timelines and escalate costs, requiring managers to adopt flexible strategies. Contingency Theory supports incorporating buffers into budgets and schedules, enabling project teams to anticipate and mitigate client-driven changes. By applying situational approaches, KeNHA can strengthen accountability, improve coordination, and ensure timely delivery of road infrastructure. Thus, the theory provides a practical lens for managing client-related variations in road project implementation.

2.2 Empirical Review

Client-related variations remain a dominant challenge in construction projects, often arising from scope changes, delayed instructions, or evolving client needs. Jibrin, Muhammad, and Labaran (2020) examined civil engineering projects in Nigeria and found that scope changes ranked highest among causes of variation orders, while inadequate objectives ranked lowest. Their study confirmed that client-driven changes significantly disrupt timelines and inflate costs. However, the research was limited to Nigeria and did not examine road infrastructure projects in Kenya. This highlights the need for Kenya-specific evidence to understand how client-related variations affect national highway projects under KeNHA, where evolving government priorities and land disputes compound the problem.

Financial constraints are another critical driver of client-related variations. Edward-Alikor and Adiele (2025) assessed building projects in Rivers State, Nigeria, and found that client-related factors ranked highest among the causes of variation, leading to cost and time overruns. Their findings emphasize that financial difficulties and unrealistic expectations often trigger scope changes and delays. While the study provides valuable insights into client behavior, it focuses on building projects rather than road infrastructure. This leaves a gap in understanding how financial constraints affect large-scale highway projects in Kenya, where budget reallocations and funding delays are common, especially under KeNHA's Strategic Plan (2023–2027).

Decision-making inefficiencies also exacerbate client-related variations. Alenazi, Adamu, and Al-Otaibi (2022) explored Saudi construction projects and identified eight client-related causes of delay, including poor instructions and late approvals. Their findings revealed poor schedule performance, with SPI values as low as 0.71, and cost inefficiencies, with CPI values below 0.90. Although the study demonstrates the impact of client-related delays, it is situated in Saudi Arabia and linked to Vision 2030 reforms. This limits its applicability to Kenya, where governance structures and institutional capacity differ significantly, necessitating localized research on KeNHA projects to capture the unique challenges of public-sector road construction.

Regional studies further confirm the disruptive nature of client-related variations. Koirala, Thapa, Giri, and Shah (2025) examined rural road projects in Nepal and found that scope alterations and design errors were primary causes of variation orders, often leading to disputes and overruns. Their study underscores the importance of clear project objectives and early stakeholder engagement. However, the focus on rural Nepalese roads limits generalization to Kenya's national highways. This gap highlights the need for empirical validation in Kenya, where client-related variations are compounded by land acquisition disputes, evolving government priorities, and budget reallocations that directly affect KeNHA's implementation capacity.

Kenyan evidence provides important insights into mitigation strategies. Gatitu, Kabubo, and Ajwang (2020) studied KeNHA projects and recommended approaches such as adequate planning, clear scope, and resolving land disputes before tendering. Their findings emphasize proactive measures to minimize variations. However, the study did not quantify the frequency or magnitude of client-related variations, leaving the problem's scale unclear. KeNHA's Strategic Plan (2023–2027) outlines reforms such as performance-based contracting and improved planning frameworks, but empirical validation of their effectiveness is still lacking. This gap underscores the need for a Kenya-specific synthesis of client-related variations in highway projects.

2.3 Empirical Gap

The reviewed literature confirms that client-related variations are a pervasive challenge in construction projects across diverse contexts. Studies from Nigeria (Jibrin et al., 2020; Edward-Alikor & Adiele, 2025), Saudi Arabia (Alenazi et al., 2022), and Nepal (Koirala et al., 2025) consistently highlight scope changes, financial constraints, and delayed approvals as primary drivers of variation orders. Kenyan evidence (Gatitu et al., 2020) provides useful mitigation strategies, while KeNHA's Strategic Plan (2023–2027) outlines reforms, including performance-based contracting. However, several empirical gaps remain. First, most studies are outside Kenya, limiting contextual applicability to national highway projects. Second, existing Kenyan studies emphasize mitigation but do not quantify the frequency or magnitude of client-related variations. Third, contradictions persist between theoretical perspectives that frame variations as adaptive opportunities (Contingency Theory) and empirical findings that consistently show them as disruptive. Finally, empirical validation of KeNHA's 2023–2027 reforms remains limited, leaving unanswered questions about their effectiveness in reducing variation orders. Addressing these gaps requires Kenya-specific quantitative evidence linking client-related variations to cost, time, and quality outcomes in road infrastructure projects.

3. Methodology

This study employed a descriptive research design to investigate the influence of client-related variations on project implementation within Kenya National Highways Authority (KeNHA) projects. The design was chosen because it enables systematic data collection and analysis to describe existing conditions and relationships without manipulating variables. As Mugenda and Mugenda (2003) explain, descriptive designs are particularly effective at capturing the characteristics of individuals, organizations, and phenomena, making them suitable for studies that document and analyze real-world practices.

The target population comprised 50 ongoing KeNHA road projects, with 600 respondents drawn from contractors, consultants, client agencies, and regulatory bodies. These respondents included project managers, site agents, engineers, directors, surveyors, and environmental officers. The study adopted a census sampling approach because the population size was manageable and it sought to capture perspectives from all relevant stakeholders. This approach eliminated sampling error and ensured inclusivity, thereby providing a holistic view of variation orders and their impact on project implementation.

Data were collected using a structured questionnaire developed from validated instruments in prior studies on variation orders (Arain, Assaf, & Pheng, 2016; Gatitu, Kabubo, & Ajwang, 2020). The questionnaire was divided into sections covering client-related variations, risk management practices, and project implementation outcomes. Items were measured on a five-point Likert scale ranging from "Strongly Disagree (1)" to "Strongly Agree (5)." Sample items included statements such as: "Scope changes affected project schedule," "Risk

identification systems were consistently applied," and "Project quality met contractual specifications."

To ensure reliability and validity, the researchers conducted a pilot study with 30 respondents from similar road projects. The results confirmed strong internal consistency, with Cronbach's alpha values exceeding 0.7 across all constructs: client-related variations ($\alpha = 0.812$), risk management framework ($\alpha = 0.846$), and project implementation outcomes ($\alpha = 0.879$). Non-response bias was assessed by comparing early and late respondents; no significant differences were observed, confirming the representativeness of the achieved response rate achieved of 73.8%.

Quantitative data were coded and analyzed using SPSS version 29 for advanced statistical modeling. Descriptive statistics, including frequencies, percentages, means, and standard deviations, summarized the data. Inferential analysis included multiple regression models to test the direct effects of client-related variations on project implementation, moderation analysis to assess the role of risk management frameworks, and ANOVA to compare the impacts of variation across stakeholder groups. Hypothesis testing was conducted at a significance threshold of $p < 0.05$. A power analysis using G*Power 3.1 confirmed the adequacy of the sample size, with the achieved sample of 443 respondents exceeding the minimum requirement of 138 for detecting a medium effect size.

Ethical considerations were central to the study. Approval was obtained from the University Institutional Review Board (IRB) and the National Commission for Science, Technology and Innovation (NACOSTI). All participants received informed consent forms outlining the study's purpose, confidentiality measures, and their right to withdraw at any stage. The team anonymized and securely stored data, ensuring compliance with ethical standards and protecting respondent rights. Appendix I includes a copy of the questionnaire instrument, including all scale items, demographic questions, and instructions, to support transparency and replicability.

4. Results

Out of 600 targeted participants, 443 completed the questionnaire, yielding a 73.8% response rate. This exceeds the 70% threshold, considered excellent (Mugenda & Mugenda, 2003). A non-response bias check comparing early and late respondents showed no significant differences, confirming representativeness. Respondents came from diverse professional categories, including contractors' directors, consultants, KeNHA project managers, site agents, engineers, surveyors, superintendents, environmental officers, government officers, and regulatory representatives. This demographic spread ensured balanced representation across stakeholder groups, enhancing validity.

4.1 Client-Related Variations

The table below presents respondents' ratings of different client-related factors that contribute to project variations, measured using mean scores and standard deviations. Respondents strongly agreed that client-related variations disrupt project implementation. Changes in specifications during the construction phase scored highest ($M = 4.259$), highlighting disruptions as the most critical source of variation orders. Inadequate project objectives ($M = 4.042$), financial problems experienced by the client ($M = 4.028$), and replacement of materials, methodologies, or procedures ($M = 4.093$) were also significant. Change of project schedule ($M = 3.996$) was moderately rated, while complicated contract documentation and client expectations ($M = 3.983$) scored lowest but remained relevant. The mean score of 4.067, with a standard deviation (SD) of 0.755, confirms agreement among respondents.

EdinBurg Peer-Reviewed Journals and Books Publishers
Journal of Entrepreneurship & Project Management
Vol. 6||Issue 2||pp 29-42||September||2026
Email: info@edinburgjournals.org||ISSN: 2789-2115

Table 1: Client-Related Variations

Statement	Mean	STDev
Change of project schedule	3.996	0.812
Financial problem experienced by the client	4.028	0.764
Replacement of material, methodologies or procedures	4.093	0.817
Changes in specifications	4.259	0.718
Inadequate project objectives	4.042	0.749
Complicated contract documentation and client expectations	3.983	0.769
Average	**4.067**	**0.755**

4.2 Project Implementation

The results presented show respondents' perceptions of the importance of different project implementation parameters, including scope, specifications, quality, budget, schedule, and planning. Respondents rated project implementation parameters highly, reflecting their importance to successful delivery. Project scope (M = 4.269, SD = 0.710) was the most critical determinant, highlighting the need to clearly define objectives. Project specifications (M = 4.084) and quality (M = 4.032) also scored highly, emphasizing the importance of technical clarity and adherence to standards. Budget (M = 4.018) and schedule (M = 3.995) were acknowledged as critical, underscoring the role of adequate resource allocation and timely execution. Project planning (M = 3.973) was rated slightly lower, suggesting its effectiveness depends on integration with scope, specifications, and budgeting. The mean score of 4.062, with moderate variability (SD = 0.763), confirms strong consensus among respondents.

Table 2: Project Implementation

Factor	Mean	SD
Project schedule	3.995	0.802
Project budget	4.018	0.758
Project specifications	4.084	0.807
Project scope	4.269	0.710
Project quality	4.032	0.742
Project planning	3.973	0.761
Average	4.062	0.763

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Vol. 6||Issue 2||pp 29-42||September||2026
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4.3 Regression Analysis

Regression analysis examined the effect of contractor-related variations on project implementation. The model produced $R^2 = 0.603$, meaning contractor-related variations explained 60.3% of the variance in project implementation outcomes. Adjusted R^2 (0.602) confirmed stability after accounting for sample size. The correlation coefficient ($R = 0.776$) indicates a strong positive relationship. Diagnostics confirmed no multicollinearity (VIF < 2), and residual plots approximated normality, validating the robustness of the model.

Table 3: Model Summary for Client-Related Variations

Model	R	R^2	Adjusted R^2	Std. Error
1	.776	.603	.602	.99264

The ANOVA test confirmed the regression model's significance. The F-statistic (668.555) was highly significant ($p < 0.001$), showing that client-related variations robustly explain project implementation outcomes. The low residual mean square (0.098) indicates minimal unexplained variance, further validating the model's strength.

Table 4: ANOVA Results for Client-Related Variations

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	658.753	1	658.753	668.555	.000
Residual	434.534	441	.098		
Total	1093.287	442			

4.4 Moderation Analysis: Risk Management

Hierarchical regression tested the moderating effect of risk management. The explanatory power of the models increased substantially, with R^2 rising from 0.573 in Model 1 (variations only) to 0.882 in Model 2 (variations + risk management), and further to 0.889 in Model 3 (including the interaction term). Although the interaction coefficient was small ($\beta = 0.010$), it was statistically significant. This indicates that risk management practices, such as proactive risk identification, quantification, and mitigation, reduce the disruptive impact of contractor-related variations. Projects with strong risk management systems showed flatter slopes in interaction plots, meaning variations had less severe effects on scope, schedule, budget, and quality.

Table 5: Moderation Analysis (Risk Management)

Model	R^2	β (Variations)	β (Risk Mgmt)	β (Interaction)	Sig.
1	0.573	0.433	–	–	0.000
2	0.882	0.433	0.356	–	0.000
3	0.889	0.433	0.356	0.010	0.000

Robustness Checks: Project Size

This table presents regression results disaggregated by project size, showing how variations affect small, medium, and large projects differently. Regression analysis by project size showed that larger projects were more susceptible to variations. Large projects had the strongest relationship ($\beta = 0.782$, $R^2 = 0.645$), indicating that poor scheduling and inadequate equipment mobilization have more disruptive effects on large-scale projects than on smaller ones. Medium projects ($\beta = 0.701$, $R^2 = 0.563$) and small projects ($\beta = 0.612$, $R^2 = 0.498$) also showed significant effects, but to a lower extent. This confirms that project scale amplifies the impact of client-related variations.

Table 6: Regression Results by Project Size

Project Size	β (Variations)	R^2	Sig.
Small (< 1 km)	0.612	0.498	0.000
Medium (1–10 km)	0.701	0.563	0.000
Large (> 10 km)	0.782	0.645	0.000

Robustness Checks: Project Location

This table presents regression results by project location, comparing urban, semi-urban, and rural projects to determine how context influences the severity of client-related variations. Location analysis revealed that rural projects were most vulnerable to contractor-related variations. Rural projects exhibited the strongest effect ($\beta = 0.745$, $R^2 = 0.602$), suggesting that limited infrastructure and logistical challenges amplify the impact of variations. Semi-urban projects ($\beta = 0.701$, $R^2 = 0.574$) showed moderate vulnerability, while urban projects ($\beta = 0.655$, $R^2 = 0.521$) were more resilient, benefiting from better access to resources and oversight. This confirms that project location significantly influences the severity of variation impacts, with rural contexts requiring stronger risk management interventions.

Table 7: Regression Results by Project Location

Project Location	β (Variations)	R^2	Sig.
Urban	0.655	0.521	0.000
Semi-urban	0.701	0.574	0.000
Rural	0.745	0.602	0.000

Moderation by Risk Management in Large and Rural Projects

For large projects, client-related variations had the strongest direct effect ($\beta = 0.782$), reflecting the complexity and scale of such undertakings. When risk management was introduced, the moderating effect ($\beta = 0.012$) reduced the severity of disruptions, thereby raising the model's explanatory power to $R^2 = 0.691$. This shows that risk management practices, such as planning and scheduling controls, financial oversight, contractual clarity, resource management, and continuous monitoring, mitigate the negative impacts of client-related factors on project implementation outcomes. These practices moderate project performance and reduce delays, cost overruns, and disputes.

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Journal of Entrepreneurship & Project Management
Vol. 6||Issue 2||pp 29-42||September||2026
Email: info@edinburgjournals.org||ISSN: 2789-2115

For rural projects, variations also had a strong effect (β = 0.745), amplified by logistical challenges and limited infrastructure. The moderation coefficient (β = 0.011) indicated that risk management reduced vulnerability, thereby improving the explanatory power to $R^2 = 0.648$. This indicates that proactive risk management is essential in rural contexts, where external factors such as resource scarcity and weaker oversight amplify the impact of contractor-related variations.

Table 8: Moderation by Risk Management in Large and Rural Projects

Context	β (Variations)	β (Risk Mgmt)	β (Interaction)	R^2
Large Projects	0.782	0.365	0.012	0.691
Rural Projects	0.745	0.342	0.011	0.648

4.5 Discussion

This study examined how client-related variations affect the implementation of Kenya National Highways Authority projects and assessed the moderating role of project risk management. Findings indicated that client-related variations, including scope changes, specification modifications, delayed instructions, and financial constraints, significantly affect project outcomes. Respondents consistently rated poor prioritization and the absence of validated work programs as the most critical sources of disruption. Regression analysis showed that contractor-related variations explained approximately 61.2% of the variance in project implementation outcomes, highlighting their dominant role in shaping project performance. However, due to the cross-sectional design, these associations should be interpreted as correlations rather than causal relationships (Hirose & Creswell, 2025; Creswell & Creswell, 2023).

Hierarchical regression further revealed that project risk management significantly moderated the relationship between client-related variations and project implementation. Although the interaction coefficients were small (β ≈ 0.010–0.012), they were statistically significant, indicating that proactive risk practices such as risk identification, quantification, and contingency planning mitigate the disruptive effects of client-driven changes. The explanatory power of the models increased substantially when risk management was included, confirming its importance in enhancing project resilience, particularly in large-scale and rural projects where variations are most impactful (Moore & Vining, 2023).

5. Conclusion

The study concludes that client-related variations significantly influence project implementation within Kenya National Highways Authority projects, with scope changes, specification modifications, delayed instructions, and financial constraints standing out as the most dominant challenges. The study concludes that poor prioritization and the absence of validated work programs are particularly critical sources of disruption, reinforcing the need for stronger planning and clarity at the outset of projects. The findings also reveal that variations are not isolated issues but central determinants of project performance. The study shows that risk management plays a vital moderating role, reducing the severity of variations through proactive practices such as risk identification, quantification, and contingency planning. This resilience is especially crucial in large-scale and rural projects, where complexity and logistical limitations amplify the impact of variations. Overall, robust risk management enhances sustainability and project success.

6. Recommendations

To strengthen project delivery under the Kenya National Highways Authority (KeNHA), the Authority should institutionalize comprehensive risk management frameworks. Risk management improves project outcomes by reducing delays and cost overruns and moderating the effects of client-related variations (Mbogori & Mutuku, 2025; Machira & Kising'u, 2024). Practices such as proactive risk identification, quantification, and mitigation supported by risk units and digital monitoring tools enhance project resilience (Ali, 2024; KeNHA, 2023). Embedding risk management in Public-Private Partnership (PPP) contracts ensures private partners share responsibility for scope changes and financial constraints (Fatima, Mubin, & Masood, 2024; KeNHA, 2023).

Active stakeholder engagement during design and planning can prevent misinterpretations and improve alignment of objectives (Kakw'u & Sang, 2024; Alnhari & Qureshi, 2024). Contractual provisions that limit scope changes and include penalties for delayed instructions can reduce disruptions. Strengthening financial oversight through real-time cash flow monitoring, alongside capacity building in project risk units using tools such as scenario analysis and digital dashboards, will further improve project performance (Acebes et al., 2024; Mbogori & Mutuku, 2025). These measures align with KeNHA's strategic priorities of efficiency, stakeholder engagement, and sustainable financing (KeNHA, 2023).

Effective implementation of the study's recommendations requires a phased approach balancing urgency, feasibility, and alignment with KeNHA's strategic goals. Short-term actions include institutionalizing risk management, staff training, maintaining risk registers, monitoring cash flow, and engaging stakeholders. Medium-term priorities focus on revising contracts, integrating risk management into PPPs, and expanding capacity with advanced training and digital tools (Acebes et al., 2024). Long-term priorities extend risk management to other infrastructure sectors, harmonize procurement laws, and establish longitudinal monitoring to track effectiveness (Ali, 2024; Machira & Kising'u, 2024). These measures enhance project resilience, reduce disruptions from client-related variations, and support efficiency, stakeholder engagement, and sustainable financing (Mbogori & Mutuku, 2025; KeNHA, 2023).

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