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INFLUENCE OF BENCHMARKING ON THE PERFORMANCE OF ROAD INFRASTRUCTURE PROJECTS IN NYARUGURU DISTRICT, RWANDA

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ABSTRACT

This study determined the influence of benchmarking on the performance of road infrastructure projects in Nyaruguru District, Rwanda. A mixed-methods approach with a descriptive and correlational design was used. Data were collected from engineers, project managers, site supervisors, procurement, finance, monitoring and evaluation and planning officers, senior infrastructure officials, and field workers through structured questionnaires, semi-structured interviews, and document review. Of the 167 questionnaires distributed, 148 were returned, giving a response rate of 88.6%. The instruments were valid (Content Validity Index = 0.936) and reliable (Cronbach's alpha = 0.893 for benchmarking and 0.852 for project performance). Respondents rated both benchmarking (composite mean = 4.42) and project performance (composite mean = 4.25) highly. Benchmarking was positively and significantly correlated with project performance ($r = .378$, $p < .001$). In a multiple regression that controlled for quality auditing, quality training, and continuous improvement, benchmarking was the strongest predictor of project performance ($B = 0.281$, $\beta = .281$, $t = 3.504$, $p = .001$), and the model was statistically significant, $F(4, 143) = 14.381$, $p < .001$, explaining 28.7% of the variation in project performance. The null hypothesis of no significant influence was therefore rejected. The study concludes that benchmarking is a significant enabler of timely, cost-efficient, high-quality, and stakeholder-satisfying road delivery at district level. It recommends that project managers and district authorities institutionalize internal and external benchmarking, build a shared knowledge base of performance data from completed projects, and benchmark against national and international standards.

Keywords: *Benchmarking, Project Performance, Road Infrastructure Projects, Quality Management, Nyaruguru District*

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BACKGROUND OF THE STUDY

Road infrastructure underpins economic growth, market access, and social inclusion, and governments are under growing pressure to deliver it on time, within budget, and to the required quality. Quality management practices, which include planning, assurance, control, and continuous improvement, are widely used to reduce errors, minimize waste, and improve project outcomes (Heller, 2022; Dale, Van der Wiele, & Van Iwaarden, 2023). Among these practices, benchmarking is the structured process of measuring an organization's practices, processes, and performance against recognized standards or leading organizations, so that performance gaps can be identified and best practices adopted (United States Department of Transportation [USDOT], 2022).

In developed countries, quality management practices are embedded in the policies that govern road delivery (Berechman, 2020). The United States Federal Highway Administration promotes comprehensive quality assurance programs that rely on data-driven performance metrics and third-party inspection (Federal Highway Administration [FHWA], 2022). The Virginia Department of Transportation has gone further by using digital dashboards that display key performance indicators across regions in real time, which makes it easier to identify outlier projects that need intervention (VDOT Annual Report, 2023; Scott, Johnson, & Patel, 2023). In Japan, the Shinkansen programme demonstrates how real-time quality monitoring, strict safety protocols, and continuous workforce training contribute to outstanding project performance (Shinkansen, 2021). In Europe, public-private partnership arrangements have incorporated benchmarking to assess contractors' adherence to lifecycle cost objectives and risk management frameworks (European Investment Bank, 2021).

In Sub-Saharan Africa, the adoption of quality management practices in road projects is gaining ground but remains uneven. Weak regulatory enforcement, limited technical expertise, and low institutional capacity continue to constrain delivery (Abdullahi, 2019). Nigeria has recorded progress through digital monitoring tools and organizational reforms (Ezenyilimba et al., 2019), while South Africa has benefited from investment in research, innovation, and staff capacity (Allen et al., 2021). Even so, inconsistent application of quality practices often results in cost overruns, extended delays, and premature degradation of roads, especially in rural and decentralized settings where oversight is weaker (Abdullahi, 2019).

In East Africa, firms in Kenya and Tanzania that adopt quality management and innovation tend to achieve better financial and operational performance (Osman et al., 2019). Kenya's devolved structure has shifted responsibility for many roads to the county level, which creates opportunities but also quality-control challenges, including weak assurance systems that lead to delays, budget increases, and compromised road safety (Zafarani, 2021; Adan, 2021). Efforts to build staff capacity and adopt strategic leadership approaches have shown promise (Terry, 2022).

In Rwanda, the commitment to infrastructure development articulated in Vision 2020 and the National Strategy for Transformation (NST1) highlights the role of quality management in improving road project performance, and the Rwanda Transport Development Agency (RTDA) identifies construction as a key growth area (RTDA, 2021). The Rwanda Standards Board establishes and enforces quality standards for construction materials and processes (Rwanda Standards Board [RSB], 2020). Despite this framework, road projects have experienced delays, budget overruns, and quality deficiencies, often traced to gaps in planning, monitoring, and control (RTDA, 2022). Under the decentralization policy, districts are responsible for implementing road projects under their District Development Strategies (Ministry of Local Government [MINALOC], 2020; World Bank, 2024).

Nyaruguru District offers a practical case for examining how benchmarking affects project performance at the local level. Its roads connect rural populations to markets, health centres, and schools, so the performance of these projects directly affects livelihoods (Berechman, 2020). Considerable public resources are allocated to them, which makes it important to compare cost, time, and quality performance against comparable projects and recognized standards in order to prevent wastage and ensure value for money. This study therefore

investigated the influence of benchmarking on the performance of road infrastructure projects in Nyaruguru District.

Statement of the Research Problem

Decentralization is widely regarded as a way of empowering local governments to deliver services more efficiently and to promote equitable development. In Rwanda, the policy introduced in the early 2000s transferred decision-making authority and resources to districts so that they could implement strategic projects such as roads (MINALOC, 2020). Roads support access to markets, health facilities, and schools, and they are critical for reducing rural poverty and promoting regional integration.

Despite increased public investment in the transport sector, the performance of district road projects remains a persistent challenge. Projects continue to experience delays, cost overruns, and substandard workmanship, and some rural roads remain impassable in the rainy season, which limits access to markets and services (Mutesi, 2022; RTDA, 2022). These shortcomings waste public funds and weaken the return on investment in the sector.

Quality management practices such as quality planning, auditing, benchmarking, staff training, and continuous improvement are recognized as important drivers of infrastructure performance (Heller, 2022; Oakland, 2024). Benchmarking in particular allows project teams to compare their cost, schedule, and quality outcomes with those of similar projects, to learn from them, and to set realistic targets (Teresa, 2022; USDOT, 2022). However, most existing evidence on benchmarking comes from manufacturing, services, and multi-sector samples of firms (Ahmed & Khan, 2020; Chen & Wu, 2021; Ouma, 2020; Mwangi, 2021; Niyonzima, 2022), and Rwandan studies on road delivery have documented general quality assurance challenges (Mutesi, 2022) without testing the effect of benchmarking. Little empirical evidence exists on whether benchmarking improves the performance of road projects managed by district authorities. This gap leaves policymakers and local administrators without evidence-based guidance on whether to invest in benchmarking systems. This study therefore sought to determine the influence of benchmarking on the performance of road infrastructure projects in Nyaruguru District, Rwanda.

LITERATURE REVIEW

Empirical Review - Benchmarking and Project Performance

Evidence from many settings shows that benchmarking is positively associated with project performance outcomes such as cost control, schedule adherence, resource use, quality, and stakeholder satisfaction. Ahmed and Khan (2020) studied more than 350 projects across industries in developed and emerging markets and found that organizations that routinely applied benchmarking recorded a 30% improvement in performance metrics such as schedule adherence, quality standards, and cost control. The study concluded that benchmarking improves not only operational performance but also decision-making, risk management, and stakeholder engagement.

In Asia, Chen and Wu (2021) examined 200 infrastructure and information technology companies in China, India, and Malaysia using structural equation modelling. Firms that engaged in internal and external benchmarking recorded a 22% improvement in schedule compliance ($p < 0.01$), a 19% reduction in cost overruns ($p < 0.05$), and a 16% increase in quality outcomes ($p < 0.05$). The authors concluded that benchmarking helps firms identify industry standards and integrate best practices into project execution.

In Sub-Saharan Africa, Ouma (2020) studied 120 construction firms in Kenya, Nigeria, and Ghana. Adoption of benchmarking was associated with significant improvements in project efficiency ($\beta = 0.47$, $p < 0.01$), labour productivity ($\beta = 0.42$, $p < 0.01$), and customer satisfaction ($\beta = 0.36$, $p < 0.05$). Benchmarking allowed firms to adopt tools and techniques used by leading companies, which strengthened performance in resource-constrained environments.

In East Africa, Mwangi (2021) investigated 80 manufacturing, service, and public-sector organizations in Rwanda, Tanzania, and Uganda. Regression analysis showed that organizations with formal benchmarking systems achieved a 26% rise in project success ($\beta = 0.41$, $p < 0.01$), a 21% rise in stakeholder engagement ($\beta = 0.38$, $p < 0.01$), and a 19% rise in responsiveness to project changes ($\beta = 0.35$, $p < 0.05$). Mwangi concluded that benchmarking is a key driver of project sustainability and resilience in dynamic policy and market environments.

In Rwanda, Niyonzima (2022) studied 60 firms in the agriculture, technology, and energy sectors and found that structured benchmarking was associated with better communication and coordination ($\beta = 0.37$, $p < 0.01$), improved resource utilisation ($\beta = 0.33$, $p < 0.05$), and higher production ($\beta = 0.39$, $p < 0.01$). Evidence from the road sector points in the same direction. Scott et al. (2023) reported that data-driven benchmarking dashboards in public infrastructure projects make it possible to identify outlier projects quickly and support accountability and evidence-based decisions, while Teresa (2022) similarly points to the value of learning from comparable large-scale road projects in setting realistic targets, allocating resources, and avoiding repeated mistakes. Taken together, these studies suggest that benchmarking improves project outcomes, but most were conducted on firms or large national programmes rather than on district-managed road projects, which is the gap this study addresses.

Theoretical Literature on Benchmarking

Benchmarking is a deliberate and structured process in which an organization compares its practices, processes, and performance metrics with recognized standards or with leading organizations inside or outside its industry (USDOT, 2022). The comparison helps project managers, engineers, and other stakeholders understand where their projects stand relative to best practice, and it reveals shortfalls, inefficiencies, and gaps in resource use that might otherwise go unnoticed. In road projects, benchmarking typically focuses on indicators such as cost per kilometre, completion timelines, quality of materials, safety records, and environmental impact. These metrics provide a quantifiable basis for setting realistic targets that are aligned with industry benchmarks (USDOT, 2022).

Two main forms of benchmarking are distinguished in the literature. Internal benchmarking compares the performance of departments, teams, or past projects within the same organization, which fosters internal learning and consistency. External benchmarking compares an organization with other organizations or with industry leaders, which exposes it to innovative practices and external standards (Oakland, 2024). Both forms depend on reliable performance measurement, a willingness to learn from the comparison, and the adoption of the best practices that the comparison reveals.

Benchmarking also serves as a strategic tool for continuous improvement and accountability. The Virginia Department of Transportation uses dashboards that display key performance indicators across regions so that outlier projects can be identified quickly and supported (VDOT Annual Report, 2023). This type of benchmarking promotes transparency and data-driven decision-making, which matter in large infrastructure projects where delays and cost overruns have significant socio-economic consequences. Public-private partnership arrangements in Europe use benchmarking to confirm that contractors meet lifecycle cost objectives and manage risk, which ensures that road networks deliver value for money throughout their operational life (European Investment Bank, 2021).

In addition, benchmarking enables knowledge transfer and the adoption of innovation. Construction firms use benchmarking results to introduce international quality standards such as ISO 9001 and Six Sigma methods, which emphasize defect reduction and process optimization (Construction Industry Institute, 2020; ISO, 2021). Innovations such as digital site monitoring, Building Information Modelling, and green construction techniques have also been identified and adapted through benchmarking exercises. In the context of this study, benchmarking is treated not merely as a measurement tool but as a mechanism for raising the standard of road projects in Nyaruguru District by aligning local teams with national and global best practice (Gonzalez, 2022).

Contingency Theory

Contingency theory emerged in the 1960s as a response to the limits of classical management theories that advocated universal solutions to organizational problems. Fiedler (1964) argued that the effectiveness of leadership styles and management practices depends largely on situational variables. The theory holds that there is no one-size-fits-all approach to management or decision-making; instead, the best strategy depends on internal and external conditions such as environmental uncertainty, organizational size, technological complexity, and task structure (Donaldson, 2001).

In project and quality management, contingency theory implies that practices such as benchmarking must be adapted to the project environment. Tools, standards, and approaches should vary with a project's scope, available resources, stakeholder needs, risk levels, and regulatory requirements. A rural road project with limited funding and difficult logistics, for example, may require a different quality-control and comparison approach than a similar project in a metropolitan area.

The theory is directly relevant to the objective of this study. It suggests that the effectiveness of benchmarking depends on contextual factors such as organizational structure, resource availability, institutional capacity, and environmental conditions. For road projects in Nyaruguru District, benchmarking can improve performance only if it is aligned with local realities, including government regulations, terrain challenges, budget constraints, and stakeholder expectations. Comparing practices and performance indicators with those of other successful projects therefore has to be customized to the characteristics of the district if it is to yield meaningful improvements in quality, efficiency, and delivery (Gonzalez, 2022).

The theory also has limitations. It does not specify precisely which contextual factors matter most or how they should be weighted, which can make it difficult to apply in practice. Nevertheless, it provides a flexible and adaptive lens for explaining why benchmarking might improve performance in a decentralized, resource-constrained setting such as Nyaruguru, and it justifies the use of tailored benchmarking strategies that respond to the district's specific project environment.

Conceptual Framework

This study is anchored in a conceptual framework that treats benchmarking as the independent variable and the performance of road infrastructure projects as the dependent variable. Benchmarking is operationalized through four dimensions: internal benchmarking, external benchmarking, the application of performance comparison metrics, and the adoption of best practices identified through benchmarking. Internal benchmarking allows teams to assess their performance against other departments or past projects within the same organization, which fosters learning and consistency. External benchmarking facilitates the identification and integration of innovative practices used by industry leaders (Oakland, 2024).

Project performance is measured through timely project completion, cost efficiency (staying within budget), compliance with quality standards and technical specifications, and stakeholder satisfaction. The framework posits that when performance metrics are systematically compared and best practices are adopted, projects are better positioned to improve efficiency, reduce errors, and optimize resource allocation, which leads to timely delivery, cost control, improved quality, and greater stakeholder satisfaction (Gonzalez, 2022; PMI, 2021). Figure 1 illustrates the hypothesized relationship.

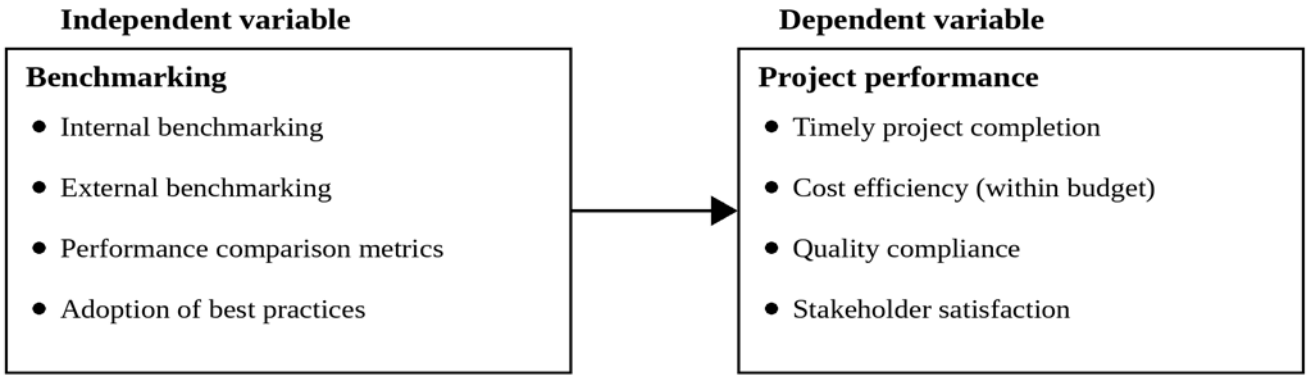


Figure 1: Conceptual framework
Source: Researcher, 2026

Following contingency theory, the relationship is expected to be shaped by the local context of Nyaruguru District, including institutional capacity, terrain, and budget constraints. Other quality management practices, namely quality auditing, quality training, and continuous improvement, are also expected to influence project performance, and they were therefore included as control variables in the regression analysis so that the specific influence of benchmarking could be isolated.

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METHODOLOGY

This study employed a mixed-methods case study approach with a descriptive and correlational design to determine the influence of benchmarking on the performance of road infrastructure projects in Nyaruguru District, Rwanda. Benchmarking was measured through internal benchmarking, external benchmarking, performance comparison metrics, and the adoption of best practices, while project performance was measured through timely completion, cost efficiency, quality compliance, stakeholder satisfaction, and overall efficiency and sustainability. The target population comprised 288 personnel involved in planning, execution, oversight, and evaluation of road projects, namely engineers and technical officers, project managers, site supervisors, procurement officers, finance officers, monitoring and evaluation officers, planning officers, senior infrastructure officials, and support and field workers. Using Yamane's (1973) formula at a 5% margin of error, a sample of 167 respondents was determined and allocated proportionally across categories using stratified random sampling, with census sampling for monitoring and evaluation officers and site supervisors. Data were collected using structured questionnaires on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree), semi-structured interviews with senior infrastructure officials, project managers, and planning officers, and a documentary analysis checklist. The instruments were pilot-tested on 10 respondents in Gisagara District, which was excluded from the main study. Content validity was established through expert review (Content Validity Index = 0.936), and internal consistency was confirmed through Cronbach's alpha ($\alpha = 0.893$ for benchmarking and $\alpha = 0.852$ for project performance), both above the 0.70 threshold (Tavakol & Dennick, 2011). Quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS) through descriptive statistics, Pearson correlation, and multiple regression, after tests for multicollinearity, autocorrelation, heteroskedasticity, and normality (Hair, Black, Babin, & Anderson, 2019), while interview data were analyzed thematically. Ethical protocols, including access permissions, informed consent, confidentiality, anonymity, and voluntary participation, were strictly observed throughout the study.

RESULTS AND FINDINGS

Descriptive Results on Benchmarking

Of the 167 questionnaires distributed, 148 were returned and usable, which represents a response rate of 88.6% and provides a sound basis for analysis. Of the respondents, 52.7% were female and 47.3% were male; 45.3% were aged 35 to 44 years; and 48.6% held a diploma and 37.2% a bachelor's degree, which suggests that most respondents had the experience and education needed to give informed views on benchmarking in road projects.

This section presents respondents' views on benchmarking practices in road infrastructure projects in Nyaruguru District. Table 1 summarizes the responses on a five-point Likert scale (SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree).

Table 1: Respondents' views on Benchmarking

Statement on Benchmarking	SD	D	NS	A	SA	Mean	Std Dev.
Internal benchmarking is regularly conducted within our organization to improve project processes.	0.7%	2.0%	5.4%	45.3%	46.6%	4.35	0.736
External benchmarking is used to compare our projects with similar projects in other organizations.	1.4%	1.4%	6.8%	56.1%	34.5%	4.21	0.740
Performance comparison metrics are applied to assess the effectiveness of project activities.	0.7%	2.0%	2.0%	33.1%	62.2%	4.54	0.704
Best practices identified through benchmarking are adopted and implemented in our projects.	1.4%	1.4%	1.4%	42.6%	53.4%	4.45	0.722
Benchmarking has contributed to improving project quality, reducing delays, and enhancing cost efficiency.	1.4%	1.4%	1.4%	32.4%	63.5%	4.55	0.722
Composite mean / Composite Std Dev.						**4.42**	**0.725**

Source: **Study data** (2026).

Respondents agreed overwhelmingly that benchmarking is practised in road projects in the district. Combined agreement (Agree and Strongly Agree) was 91.9% for regular internal benchmarking (Mean = 4.35, SD = 0.736) and 90.6% for the use of external benchmarking to compare projects with similar projects in other organizations (Mean = 4.21, SD = 0.740). External benchmarking recorded the lowest mean, which suggests that comparison with other organizations is somewhat less established than comparison within the organization. These findings are consistent with Oakland (2024), who emphasizes benchmarking as an approach for identifying performance gaps and promoting improvement.

Respondents also strongly supported the use of performance comparison metrics to assess project activities (95.3% agreement; Mean = 4.54, SD = 0.704) and the adoption of best practices identified through benchmarking (96.0% agreement; Mean = 4.45, SD = 0.722). These results indicate that benchmarking was not limited to comparison but was also used to set measurable performance standards and to transfer effective practices into projects, in line with the emphasis of ISO (2021) on evidence-based evaluation and performance monitoring.

Finally, the statement that benchmarking contributed to improving project quality, reducing delays, and enhancing cost efficiency recorded the highest mean (4.55, SD = 0.722), with 95.9% of respondents in agreement. The composite mean of 4.42 and composite standard deviation of 0.725 show strong agreement

across all statements and limited variation in opinion. Overall, benchmarking is widely practised and highly valued in road infrastructure projects in Nyaruguru District (ISO, 2021; PMI, 2021).

Descriptive Results on Project Performance

Respondents also rated the performance of road infrastructure projects in the district on timely completion, cost efficiency, quality compliance, stakeholder satisfaction, and overall efficiency and sustainability. The results are presented in Table 2.

Table 2: Respondents' views on Project Performance

Statement on Project Performance	SD	D	NS	A	SA	Mean	Std Dev.
Projects are completed within the planned timelines (timely project completion).	0.7%	2.0%	0.0%	45.3%	52.0%	4.46	0.674
Projects are executed cost-effectively, staying within budget.	3.4%	1.4%	0.0%	47.3%	48.0%	4.35	0.848
Road infrastructure projects meet the required quality standards and technical specifications.	6.8%	4.1%	1.4%	52.0%	35.8%	4.06	1.070
Stakeholders, including beneficiaries and clients, are satisfied with project outcomes.	9.5%	2.7%	5.4%	40.5%	41.9%	4.03	1.201
Overall project performance demonstrates efficiency, effectiveness, and sustainability.	1.4%	1.4%	3.4%	47.3%	46.6%	4.36	0.739
Composite mean / Composite Std Dev.						**4.25**	**0.906**

Source: **Study data** (2026).

Table 2 shows that respondents generally perceived project performance to be high (composite mean = 4.25, composite SD = 0.906). Time and cost performance were rated most favourably: 97.3% agreed that projects were completed within the planned timelines (Mean = 4.46, SD = 0.674) and 95.3% agreed that projects were executed cost-effectively and within budget (Mean = 4.35, SD = 0.848). Overall project performance, in terms of efficiency, effectiveness, and sustainability, was also rated highly (93.9% agreement; Mean = 4.36, SD = 0.739).

Quality compliance (87.8% agreement; Mean = 4.06, SD = 1.070) and stakeholder satisfaction (82.4% agreement; Mean = 4.03, SD = 1.201) recorded the lowest means and the highest standard deviations, which indicates that views on these two dimensions were more varied. These results imply that, although road projects in the district are perceived to perform well, there is more room for improvement in meeting technical specifications and in satisfying beneficiaries and clients, which are important aspects of integrated project success (PMI, 2021).

Correlation and Regression Results for Benchmarking and Project Performance

Pearson's correlation coefficient was first used to establish the strength and direction of the relationship between benchmarking and project performance. Table 3 shows that the relationship was positive, moderate, and statistically significant ($r = .378$, $p < .001$). Benchmarking recorded the strongest correlation with project performance among the four quality management practices studied (quality auditing $r = .333$, quality training $r = .345$, continuous improvement $r = .307$). Benchmarking alone therefore accounts for about 14.3% of the variation in project performance ($r^2 = .143$). Benchmarking was moderately related to quality auditing ($r = .418$, $p < .001$), weakly to quality training ($r = .169$, $p = .040$), and not significantly to continuous improvement ($r = -.015$, $p = .856$), which indicates that it was not redundant with the other practices.

Table 3: Correlation between Benchmarking and Project Performance

Variables	Pearson r	Sig. (2-tailed)	N
Benchmarking and Project Performance	.378**	.000	148

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

Source: **Study data** (2026).

Multiple regression analysis was then conducted to determine the influence of benchmarking on project performance while controlling for quality auditing, quality training, and continuous improvement. Diagnostic tests showed no serious multicollinearity (for benchmarking, tolerance = .778 and VIF = 1.285) and a Durbin-Watson statistic of 2.580, which is close to the acceptable range. The Breusch-Pagan test, however, indicated heteroskedasticity ($\chi^2 = 16.355$, $p < .001$), and some subgroup tests of normality fell below the 0.05 threshold. The regression results are therefore reported alongside the correlation evidence and should be interpreted with appropriate caution (Hair et al., 2019).

Table 4 shows that the model produced an R value of 0.536, indicating a moderate positive relationship between the predictors and project performance. The R Square of 0.287 shows that approximately 28.7% of the variation in project performance is explained by the model, and the Adjusted R Square of 0.267 confirms its explanatory power after accounting for the number of predictors. The remaining 71.3% may be attributed to factors not included in the model, such as risk management, procurement practices, and contractor capacity.

Table 4: Model Summary for Benchmarking and Control Variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.536a	.287	.267	.21828

a. Predictors: (Constant), Benchmarking, Quality auditing, Quality training, Continuous improvement.

b. Dependent variable: Project performance.

Source: **Study data** (2026).

The ANOVA results in Table 5 confirm that the regression model is statistically significant, $F(4, 143) = 14.381$, $p < .001$, which means that benchmarking and the control variables jointly predict variation in project performance. The regression sum of squares (2.741) is smaller than the residual sum of squares (6.813), which is consistent with the modest R Square and with the fact that much of the variation in performance is explained by other factors.

Table 5: ANOVA results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.741	4	.685	14.381	.000b
	Residual	6.813	143	.048		
	Total	9.554	147			

a. Dependent variable: Project performance.

b. Predictors: (Constant), Benchmarking, Quality auditing, Quality training, Continuous improvement.

Source: **Study data** (2026).

Table 6 presents the regression coefficients. Benchmarking had a positive and statistically significant influence on project performance ($B = 0.281$, $SE = 0.080$, $\beta = .281$, $t = 3.504$, $p = .001$). Holding quality auditing, quality training, and continuous improvement constant, a one-unit increase in benchmarking is associated with a 0.281-unit increase in project performance. Benchmarking had the strongest standardized effect among the four predictors, ahead of quality training ($\beta = .197$), continuous improvement ($\beta = .192$), and quality auditing ($\beta = .162$). Because the p-value (.001) is below the 0.05 significance level, the null hypothesis

that there is no significant influence of benchmarking on the performance of road infrastructure projects in Nyaruguru District was rejected.

Table 6: Coefficient results

Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	.820	.483		1.699	.091
	Benchmarking	.281	.080	.281	3.504	.001
	Quality auditing	.129	.064	.162	2.022	.045
	Quality training	.227	.093	.197	2.431	.016
	Continuous improvement	.167	.071	.192	2.353	.020

a. Dependent variable: Project performance.

Source: **Study data** (2026).

The overall regression equation can be represented as:

Project Performance = 0.820 + 0.281 Benchmarking + 0.129 Quality Auditing + 0.227 Quality Training + 0.167 Continuous Improvement

The equation shows that, with the other practices held constant, each additional unit of benchmarking adds 0.281 units to the project performance score. The constant of 0.820 represents the predicted level of project performance when all four practices score zero, a situation that is theoretically unlikely in practice. These findings indicate that strengthening benchmarking, in particular through the systematic comparison of cost, time, and quality indicators with those of similar projects, is associated with better road project performance in the district.

Discussion of the Findings - Benchmarking and Project Performance

The findings confirm that benchmarking has a significant positive influence on the performance of road infrastructure projects in Nyaruguru District. Benchmarking was highly practised (composite mean = 4.42), correlated significantly with project performance ($r = .378$, $p < .001$), and was the strongest predictor of performance in the regression model ($\beta = .281$, $p = .001$). The null hypothesis was therefore rejected. The result is consistent with the earlier evidence reviewed in this study. Chen and Wu (2021) found that firms engaging in internal and external benchmarking achieved significant improvements in schedule compliance and cost reduction in infrastructure projects, and Ouma (2020), Mwangi (2021), and Niyonzima (2022) reported significant positive effects of benchmarking on efficiency, project success, and coordination in African firms. The present study extends this evidence to district-managed road projects.

Qualitative evidence from interviews supports the statistical results. A Senior Infrastructure Official explained, *"Benchmarking enables us to compare what we are doing with similar road projects and identify areas where we need to improve, particularly in cost, time and quality."* A Project Manager noted, *"We use lessons from previous and similar projects when preparing new projects, especially when estimating costs and setting realistic implementation schedules,"* and a Planning Officer added, *"Benchmarking data helps us determine realistic timelines and resource requirements because we can learn from the performance of projects already implemented."* These accounts show how comparison with similar projects helps management identify performance gaps, estimate costs, and set realistic schedules, which is the mechanism through which benchmarking improves time and cost performance (Oakland, 2024; PMI, 2021).

The results are also consistent with contingency theory. By comparing their own performance with that of similar projects, Nyaruguru project teams are able to adapt national or global best practices to local terrain and resource constraints rather than applying them unchanged (Gonzalez, 2022). The use of performance comparison metrics, which respondents rated highly (Mean = 4.54), supports the finding of Scott et al. (2023) that data-driven benchmarking in public infrastructure makes it possible to identify outlier projects quickly

and encourages accountability and evidence-based decisions. By learning from comparable projects, road teams can also set realistic targets, optimize resource allocation, and avoid repeated mistakes (Teresa, 2022).

Two points call for caution. First, benchmarking explained a moderate share of the variation in project performance: the full model explained 28.7%, and benchmarking alone about 14.3%, so benchmarking is an important but not a sufficient driver of performance. Second, the lowest ratings for project performance were for quality compliance (Mean = 4.06) and stakeholder satisfaction (Mean = 4.03), and external benchmarking had the lowest mean among the benchmarking items (Mean = 4.21), which suggests that wider external comparison could help to close these gaps. The data are also based on respondents' perceptions, and the regression results should be read in light of the heteroskedasticity detected in the diagnostic tests.

CONCLUSIONS AND RECOMMENDATIONS

This study establishes that benchmarking has a significant positive influence on the performance of road infrastructure projects in Nyaruguru District, Rwanda. Respondents reported that both internal and external benchmarking are practised, that performance comparison metrics are used to assess project activities, and that best practices identified through benchmarking are adopted. Benchmarking was significantly correlated with project performance ($r = .378$, $p < .001$) and was the strongest predictor of performance among the four quality management practices examined ($\beta = .281$, $p = .001$), even after controlling for quality auditing, quality training, and continuous improvement.

The study therefore concludes that benchmarking is a practical enabler of timely completion, cost efficiency, quality compliance, and stakeholder satisfaction in district road projects. Comparing project costs, timelines, and technical standards with those of similar projects allows management to identify performance gaps, make informed decisions, and adopt proven practices. However, benchmarking works alongside other management practices and contextual factors rather than in isolation, and its benefits depend on how well it is adapted to local conditions.

It was recommended that Nyaruguru District, contractors, and project managers institutionalize both internal and external benchmarking as a mandatory pre-project and ongoing activity in all road infrastructure projects. Project teams should set cost, time, quality, and stakeholder-satisfaction indicators at the start of each project and compare actual performance with those of similar completed projects at regular intervals. A simple performance dashboard, similar to those used in the Virginia Department of Transportation, would help district managers to identify underperforming projects early and take corrective action (Scott et al., 2023).

A centralized knowledge-sharing framework or database should be established to document and transfer best practices from successfully completed projects, such as the Huye-Nyaruguru road upgrade, to upcoming feeder and district road projects. Project teams should also benchmark systematically against national standards set by the Ministry of Infrastructure and the Rwanda Standards Board, and against international good practice such as FIDIC and ISO standards, so that local road construction meets recognized durability and safety standards. Because quality compliance and stakeholder satisfaction recorded the lowest performance ratings, benchmarking efforts should give special attention to these two dimensions and should broaden the use of external benchmarking. Finally, capacity-building should be provided to technical and planning staff on benchmarking methods and on the use of performance data.

Suggestions for Further Studies

Benchmarking and the other quality management practices together explained 28.7% of the variation in project performance, leaving 71.3% attributable to other factors. Further research should therefore examine variables such as risk management, procurement practices, contractor capacity, stakeholder engagement, leadership, financial management, technology adoption, and monitoring and evaluation. Comparative studies across districts in Rwanda would show whether the influence of benchmarking varies with geographical, institutional, or project characteristics.

Longitudinal studies could assess how benchmarking influences performance over different stages of the project life cycle, and studies that use objective performance records, such as actual cost and schedule variances from audit and monitoring reports, would complement the perception-based data used in this study. Finally, qualitative or mixed-methods studies involving contractors, consultants, and beneficiaries could provide deeper explanations of how benchmarking works in practice, and studies that test benchmarking separately for internal and external forms could show which form contributes more to road project performance.

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