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Project Total Quality Management and Performance of Road Construction in Karongi District, Rwanda

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Abstract: *This paper explores the effect of Project Total Quality Management (TQM) on road construction performance in Karongi District, with a specific focus on evaluating the impact of quality control planning on road construction projects. Anchored on TQM Theory, the study employed descriptive research design, utilizing both quantitative and qualitative approaches. A census method was used, with a sample size of 129 respondents, and purposive sampling was applied for data collection. Data was gathered through questionnaires and interviews, and analyzed using SPSS Version 21, with findings presented through descriptive statistics. The results revealed a strong positive relationship between quality control planning and road construction performance in Karongi District, with a Pearson correlation coefficient of r = 0.842. Regression analysis indicated that quality control planning is a significant predictor of project performance, with a standardized beta coefficient of 0.671 and a p-value of 0.000, confirming the statistical significance of this relationship. In conclusion, the study emphasizes the critical role of quality control planning in enhancing the performance of road construction projects, demonstrating its significant impact on project success. Based on these findings, the study recommends that project teams receive ongoing training in quality management principles, with regular workshops and professional development opportunities to ensure effective quality control throughout the project lifecycle, ultimately leading to improved project execution and fewer defects.*

Keywords: Project Total Quality Management, Project performance, Road Construction, Karongi District, Rwanda

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1. Introduction

Total Quality Management (TQM) is a global approach that focuses on improving the quality and performance of products and services through continuous improvement, customer focus, and employee involvement (Abdul-Aziz, Ismail, & Abas, 2021). In the context of road construction, TQM is crucial for ensuring that infrastructure projects meet the highest standards of safety, durability, and efficiency, while being completed on time and within budget (Hanna, Ferrada, & Sanvido, 209). Implementing TQM in road construction involves integrating quality management systems throughout the project lifecycle, which includes setting clear quality objectives, defining quality standards, and applying quality control measures at each stage of construction (Maria, 2019). Quality control planning plays a key role in this process by establishing a structured framework for monitoring and evaluating construction activities, ensuring that every task adheres to the predetermined quality standards and guidelines (Abdul-Aziz, Ismail, & Abas, 2018). When aligned with the project's goals, these quality standards and control systems ensure that construction processes consistently meet or exceed expectations (Hanna, Ferrada, & Sanvido, 2022).

Globally, TQM has become an essential component of road construction, aiming to enhance quality, reduce defects, and improve overall project efficiency (Federal Highway Administration [FHWA], 2016). In countries such as the United States, Japan, Germany, and Australia, TQM principles have been successfully integrated into road construction projects (Serena, 2019). For instance, the Federal Highway Administration (FHWA) in the U.S. advocates for the use of TQM to improve project delivery, reduce costs, and increase customer satisfaction (Federal Highway Administration [FHWA], 2016). Similarly, Japan's engineering excellence, as seen in the Shinkansen high-speed rail network, relies heavily on TQM principles, with rigorous quality control and safety protocols ensuring the project's exceptional reliability and safety (Shinkansen, 2021). Germany and Australia also use TQM to optimize construction processes, ensuring high-quality and environmentally compliant infrastructure projects (Hanna, Ferrada, & Sanvido, 2018). These countries' success stories emphasize the potential of TQM to improve road construction project performance globally (Shinkansen, 2021).

In Africa, Rwanda's construction sector plays a vital role in achieving the goals of Vision 2020 and the National Strategy for Transformation (NST1) (Rwanda Transport Development Agency [RTDA], 2015). The Rwanda Transport Development Agency (RTDA) reports significant growth in the construction industry, with projections showing an 8.7% expansion in 2017 and a steady growth rate of 6.6% annually until 2024 (RTDA, 2015). However, there is an ongoing need for investment in upgrading informal settlements, constructing affordable housing, and improving road infrastructure (Twagirayezu, 2023). As the country continues to prioritize infrastructure development, TQM has gained recognition for its potential to improve the quality and sustainability of road construction projects (Rwanda Standards Board [RSB], 2020). The RTDA encourages the adoption of TQM to enhance project management, quality control, and stakeholder engagement in road infrastructure projects (RTDA, 2020). Additionally, the Rwanda Standards Board (RSB) has established national standards and regulations to ensure compliance with quality requirements in construction materials and processes (Rwanda Standards Board [RSB], 2010). The application of TQM in road construction projects is crucial for improving project outcomes and achieving long-term infrastructure sustainability (Rwanda Standards Board, 2019).

In Karongi District, road construction projects are essential for improving connectivity and supporting local development (RTDA, 2015). Given the region's growing infrastructure needs, implementing TQM principles could significantly impact the performance of road construction projects by improving quality, reducing defects, and enhancing project delivery efficiency. TQM practices can help ensure that these projects are completed on time, within budget, and to the required standards, contributing to long-term sustainability and community development. The focus of this study is to examine the effect of TQM on the performance of road construction projects in Karongi District, Rwanda, by assessing how its principles influence project outcomes, including cost management, quality control, and overall project success. Through this research, the study aims to provide valuable insights into the potential benefits of TQM in improving the performance of road construction projects in the region.

1.1. Problem statement

Despite the growing emphasis on quality management practices in construction projects, there remains a significant gap in understanding how these practices specifically impact the performance of road construction projects. Tah and Jato-Espino (2021) highlight common approaches and challenges in quality management, but there is a lack of focused research on the application of these practices within the context of road construction. Quality assurance, which includes the implementation of systematic processes and procedures, ensures consistent quality throughout the project lifecycle. However, the absence of comprehensive Total Quality Management (TQM) principles, including quality control planning, can have detrimental effects on road construction projects. Without effective quality control planning, projects may experience poor quality, delays, cost overruns, and compromised safety standards (Bank, 2019).

According to the World Bank (2023), infrastructure development in Rwanda is crucial for economic growth and poverty reduction, with road construction projects playing a vital role in improving connectivity, facilitating trade, and enhancing access to essential services. Ensuring the quality of these road construction projects is critical to maximizing their long-term benefits and minimizing future maintenance costs. Despite the acknowledged benefits of quality management practices, many road construction projects in Rwanda continue to face challenges related to quality control, assurance, and improvement. These challenges often stem from inadequate quality planning processes, inconsistent implementation of quality control measures, and limited mechanisms for continuous improvement (Gharaibeh & Hamzeh, 2019). This is where quality control planning becomes key by establishing comprehensive frameworks for monitoring construction activities, it can mitigate these challenges and enhance project outcomes.

In Rwanda, statistics from the Rwanda Transport Development Agency (RTDA, 2015) indicate that a

substantial portion of road construction projects experience delays and cost overruns, often linked to quality-related issues such as material defects, workmanship errors, and design flaws. These issues are exacerbated by poor quality control planning, which affects resource allocation, budgeting, and project execution. Critical factors contributing to cost overruns in these projects include changes in the scope of work, incomplete designs at the time of tender, contractual claims for extensions of time with additional costs, lack of proper cost planning, and delays in cost monitoring for variations and additional works. Effective quality control planning could address many of these issues by setting clear guidelines and proactive measures to prevent such problems from arising (RTDA, 2015). Therefore, there is a pressing need to examine the role of quality management practices, specifically quality control planning, in road construction projects. This research aims to assess the effect of Project Total Quality Management, with a focus on quality control planning, on the performance of road construction projects in Rwanda, offering insights into how these practices can address current challenges and improve long-term project outcomes.

This study sought to achieve the following research hypothesis:

> **H_{01}:** Quality control planning has no significant effect on performance of road construction projects in Karongi District

2. Literature Review

Total Quality Management (TQM) in construction projects is a strategic approach focused on improving every aspect of the project, from planning to execution, by involving all stakeholders in the pursuit of continuous improvement (Tabona, 2023). TQM in road construction aims to ensure the highest standards of quality in safety, durability, and efficiency, which are critical for long-term success. By establishing clear quality objectives and creating a robust framework for monitoring and improving quality, TQM provides a systematic approach to achieving project goals. It integrates processes like quality control, quality assurance, and quality planning to prevent defects and improve the reliability of infrastructure (Barka & Ibraheem, 2023). When implemented effectively, TQM not only ensures compliance with industry standards but also enhances project outcomes by fostering a culture of continuous learning and improvement.

One of the core elements of TQM in road construction is quality control planning. This planning process involves setting clear quality standards, outlining specific checkpoints throughout the project, and ensuring that all aspects of construction meet these standards (Ghabban et al., 2023). Quality control planning helps prevent issues such as material defects, design flaws, and substandard workmanship, all of which can lead to costly delays and rework. Recent studies have shown that well-executed quality control measures can significantly reduce these problems, improving both the efficiency of the construction process and the final product. For example, road construction projects that integrate quality control planning from the start tend to experience fewer issues with rework and have better overall performance, including lower costs and fewer delays (Koh & Toh, 2022).

Another critical factor in the success of TQM is the role of leadership and stakeholder involvement. Effective leadership is essential to creating a culture of quality and ensuring that all team members are committed to the same high standards (Osipov et al., 2023). Leaders in construction projects are responsible for setting the tone, prioritizing quality, and ensuring that adequate resources are allocated for quality assurance activities. In addition, stakeholder engagement ensuring that all parties involved in the project, from contractors to clients, are aligned on quality goals is key to success (Yeo, 2023). When all stakeholders are on the same page, it helps identify potential problems early, ensures timely solutions, and promotes better collaboration. Ultimately, when both leadership and stakeholder engagement are effectively combined with quality control planning, TQM leads to improved project outcomes, greater stakeholder satisfaction, and more sustainable infrastructure.

In Rwanda, Project Total Quality Management (TQM) has become a critical approach to enhancing the efficiency and performance of road construction projects. TQM involves integrating quality management practices throughout the entire project lifecycle, from planning and design to construction and maintenance, with an emphasis on continuous improvement, stakeholder involvement, and customer satisfaction (Chin, 2023). One of the key components of TQM is quality control planning, which ensures that projects meet predefined standards and minimize errors, defects, and delays (Zaboulon et al., 2023). In Rwanda, where resources can be limited, effective quality control planning helps ensure timely project completion within budget, while meeting high-quality standards (Yassin, 2022). Furthermore, leadership and stakeholder engagement are crucial for successful TQM implementation.

Quality control planning

Quality control planning is an essential phase in the Total Quality Management (TQM) process, aimed at ensuring that project deliverables meet the defined quality standards throughout the project lifecycle (Bester, 2021). During this phase, project managers identify specific quality objectives, establish measurable standards, and define criteria that will guide quality control efforts. The planning process involves selecting the appropriate methods and tools for monitoring quality, such as statistical process

control techniques, checklists, and inspection protocols, which provide structure and consistency in quality assurance activities (Gido & Clements, 2018). Additionally, engaging stakeholders during this phase is crucial, as it helps project teams align quality objectives with customer expectations and regulatory requirements, ensuring that the quality control plan meets both internal and external demands (PMBOK, 2021).

A critical component of quality control planning is defining the roles and responsibilities of each team member involved in maintaining quality standards. Clear communication and detailed documentation are vital to ensure that all team members are aware of their specific tasks, processes, and procedures for quality control (PMI, 2017). When everyone on the project team understands their responsibilities and the expectations for quality, it fosters a collaborative environment in which quality is a shared goal. This proactive approach also allows the team to anticipate potential quality issues before they arise, helping to implement preventive measures that reduce the likelihood of defects, rework, and delays (Snyder et al., 2019).

The quality control plan also includes procedures for inspection, evaluation, reporting, and addressing anomalies that may occur during construction. These procedures ensure that any deviations from quality standards are detected early and corrected promptly, maintaining consistency and adherence to quality expectations (Lee, 2023). By establishing a robust framework for quality control from the outset, organizations can prevent issues before they impact project outcomes. This structured approach not only helps to improve the overall quality of the project but also enhances customer satisfaction by delivering high-quality results that meet stakeholder requirements (Kuiri, 2018).

Project Performance

Project performance is often evaluated based on several key factors, including the ability to meet deadlines, stay within budget, and deliver high-quality results. One of the most critical measures of project performance is completion time. Timely completion reflects how effectively the project team is managing their tasks within the established timeframes (Lee, 2017). Meeting deadlines is essential for satisfying client expectations, controlling costs, and maintaining a competitive edge in the industry (Nguyen, 2019; PMI, 2021). When delays occur, it can lead to higher costs, resource shortages, and even missed opportunities (Zomi, 2018). To keep track of progress and prevent delays, project managers use tools like critical path analysis, milestone tracking, and schedule variance analysis. These methods help identify potential delays early on, allowing teams to make adjustments before problems escalate (Kim, 2020).

Cost performance management is another crucial aspect of evaluating project performance. It involves closely monitoring and controlling costs throughout the project to avoid overruns and keep the project financially viable (Wang, 2019). Effective cost management starts with accurate budgeting and cost estimation, followed by ongoing cost control measures to identify discrepancies and take corrective actions (Gido & Clements, 2018). Project managers regularly assess how actual expenditures align with the planned budget and implement strategies to manage any variances. Key performance indicators (KPIs) like Cost Variance (CV) and Cost Performance Index (CPI) help managers assess the financial health of the project. A positive CV shows the project is under budget, while a negative CV signals overspending. Similarly, a CPI greater than 1 means the project is performing well financially, whereas a CPI under 1 indicates potential budget issues (Sharma, 2020).

Quality management is another essential component of project performance, ensuring that deliverables meet both the defined standards and stakeholders' expectations (Besterfield et al., 2021). A robust quality management system consists of planning, assurance, and control activities. Quality Planning helps identify the required standards and establishes the steps to meet them, while Quality Assurance involves ongoing monitoring and evaluations to detect any deviations from the plan. Quality Control includes testing and inspections to confirm that the project meets the agreed-upon standards (Juran, 2019). Implementing these quality management practices allows teams to spot issues early and prevent quality-related problems from affecting the project's outcome (Deming, 2021). Additionally, creating a culture of continuous improvement, where lessons learned from past projects are incorporated into future ones, significantly enhances overall performance (Taguchi, 2020).

2.2 Theoretical Review

Total Quality Management (TQM) Theory

Total Quality Management (TQM) Theory was first developed by W. Edwards Deming in the 1950s, with its foundations rooted in the concept of continuous improvement in all areas of an organization. Deming's ideas evolved from his work in Japan, where he introduced his 14 Points for Management, which emphasized the importance of quality control, leadership, and employee involvement in driving organizational success. The

development of TQM theory can be traced back to Deming's work on quality assurance processes and statistical methods for quality control, which later influenced a wide range of industries, including construction. His work laid the groundwork for a global shift towards more systematic, data-driven approaches to quality management (Papfar, 2020).

The Total Quality Management (TQM) Theory focuses on integrating quality improvement processes at every stage of an organization's operations, involving all employees and stakeholders (Halima, 2020). TQM is built on principles such as customer focus, continuous improvement, employee involvement, and systematic problem-solving. It emphasizes the need for comprehensive quality control planning that includes setting clear quality standards, defining roles and responsibilities, and using tools such as statistical methods, inspections, and feedback loops (Clavadere, 2022). The theory argues that effective quality control leads to better performance, fewer defects, lower costs, and improved customer satisfaction. In the context of construction, TQM's emphasis on involving all stakeholders in the quality control process ensures that every phase of the project, from planning to execution, meets high standards.

In the context of the research hypothesis, the TQM theory is highly relevant. TQM's emphasis on systematic quality control aligns directly with the need for well-defined quality control planning in road construction. In Karongi District, where infrastructure projects often face challenges such as delays, cost overruns, and poor quality, the application of TQM can significantly improve project outcomes. By adopting TQM principles such as continuous monitoring, employee engagement in quality control, and clear communication of quality standards, road construction projects can meet deadlines, stay within budget, and deliver high-quality infrastructure. Therefore, TQM provides a solid theoretical foundation for understanding how quality control planning can directly impact the performance of road construction projects in the district. Through structured planning and a focus on quality at every stage of the project lifecycle, TQM can drive improvements in both efficiency and effectiveness in Karongi's road construction sector.

2.3 Empirical Literature

This empirical review explores the impact of project quality management practices specifically quality control planning on project performance. By analyzing recent studies, this section highlights the relationships between that practices and key performance indicators such as efficiency, client satisfaction, and cost management. The findings emphasize how organizations that prioritize quality management can enhance their project outcomes and identify potential gaps that may affect overall performance.

Quality Control Planning and Project Performance

Quality control planning is essential in improving project performance, particularly in road construction projects in Rwanda. Research by Kaynak (2023) found that organizations with structured quality control planning achieved a 25% improvement in project outcomes compared to those without such frameworks. The study employed regression analysis and demonstrated a strong positive correlation ($R^2 = 0.65$) between quality control planning and key performance indicators, such as cost management and schedule adherence. For road construction projects in Rwanda, where challenges like delays and cost overruns are prevalent, implementing quality control planning helps to minimize defects and improve efficiency, thus enhancing overall project performance.

Further supporting this, Ahire et al. (2020) found that quality control planning led to a 30% reduction in project overruns. Their study, which surveyed a variety of manufacturing companies, highlighted the importance of leadership commitment and employee involvement in quality planning. In Rwanda's road construction sector, where stakeholder engagement is critical, these factors can lead to better adherence to budgets and timelines, ensuring more successful project delivery. The regression analysis ($R^2 = 0.58$) confirmed that focusing on quality control planning results in improved performance and cost management. This underscores the significance of involving all stakeholders from the planning phase to promote a culture of quality, which directly benefits project outcomes.

In Rwanda's road construction industry, Nahimana (2019) explored the relationship between quality control planning and project success. The study found that projects with well-structured quality control planning reported a 20% increase in client satisfaction rates. A regression score ($R^2 = 0.72$) demonstrated a significant relationship between effective quality control planning and enhanced project outcomes. These findings are particularly relevant in Rwanda, where road construction projects are vital to infrastructure development. Implementing quality control planning not only improves efficiency and reduces delays but also increases stakeholder satisfaction, which is critical for the long-term success of such projects. Thus, quality control planning is a key factor in driving positive project performance outcomes in Rwanda's road construction sector.

This empirical review explores the impact of project quality management practices specifically quality control planning on project performance. By analyzing recent studies, this section highlights the relationships between that practices and key performance indicators such as efficiency, client satisfaction, and cost management. The findings emphasize how organizations that prioritize quality management can enhance their project outcomes and identify potential gaps that may affect overall performance.

3. Methodology

For this study, a descriptive research design was selected, focusing on providing a comprehensive overview of the subject without making causal inferences. Descriptive research design is commonly used to investigate and describe the characteristics of populations or phenomena (Cohen, Manion, & Morrison, 2018). It typically involves methods like surveys and case studies, which allow for the collection of data through questionnaires or interviews. This study used both quantitative and qualitative methods to explore how quality control planning influences the performance of road construction projects in Karongi District.

The target population for the study consisted of key stakeholders involved in road construction projects in Karongi District. According to Trochim and Donnelly (2018), the study population is a specific set of individuals or entities chosen based on the research objectives. In this case, the population included a project manager, two government officials, 18 Rwanda Transport Development Agency (RTDA) staff members, and 108 workers involved in the projects. This selection was based on their critical roles in planning, implementation, and monitoring of road construction projects, ensuring that their insights would contribute meaningfully to the research. The total population for the study was 129 individuals, all of whom were involved in different capacities in the projects.

For the sample design, purposive sampling was used to select participants who were specifically relevant to the study. This technique allowed for the inclusion of individuals with direct involvement in road construction projects, such as project managers, government officials, and contractors. In addition, convenience sampling was used for practical reasons, given the small target population (Bryman, 2016). A census approach was applied, including all 129 individuals in the study, which ensured a comprehensive and accurate representation of the target population.

Data collection for the study was carried out through a combination of primary and secondary methods. Primary data was obtained from structured questionnaires and face-to-face interviews with key stakeholders involved in the road construction projects. The questionnaires provided quantitative data that was analyzed statistically, while interviews offered qualitative insights into participants' views on quality management practices. Secondary data was gathered from existing documents, reports, and academic resources to support and contextualize the findings, providing a deeper understanding of the research topic (Kothari, 2004).

The research instruments, including questionnaires and interview guides, were tested for validity and reliability through a pilot study. The pilot study aimed to refine the instruments by checking for clarity, readability, and the appropriateness of the questions. Based on feedback, some items were reworded or removed to ensure that the questionnaire would be easily understood and would collect relevant data. Validity was measured through content validity, ensuring that the instruments adequately covered the research questions. Reliability was assessed using Cronbach's alpha, with a result of 0.842, indicating that the instruments were reliable for data collection (Field, 2013).

The data collected for the study was analyzed using the Statistical Package for the Social Sciences (SPSS) version 21. Both qualitative and quantitative data analysis methods were employed, with the data presented in tables. The regression model aimed to quantify the relationship between various aspects of project total quality management (TQM), such as quality control planning, quality implementation, quality assurance, and quality improvement, and their impact on the performance of road construction projects in Karongi District. The model's significance was tested using analysis of variance (ANOVA), while the goodness of fit was assessed using R^2, which determined how well the independent variables explained the variation in project performance (Pallant, 2020).

To ensure the accuracy of the analysis, data collected through questionnaires was carefully checked for completeness and clarity before being coded for analysis in SPSS and Excel. Descriptive statistics and frequency distributions were used to interpret the quantitative data. The qualitative data was analyzed and presented in a narrative report to capture the respondents' perspectives on factors influencing project performance. Multiple regression analysis was used to assess the impact of TQM on road construction performance in Karongi District, with a regression equation formulated to determine the relationships between the independent variables and the dependent variable, project performance.
The study used the following conceptual model:
$Y=f(X_1)$

$Y = \beta o + \beta 1\ X_1 + \varepsilon$
Where;
Y = Project performance
βo = intercept (constant)
X_1 = Quality Control Planning
ε = the error term (residual).

4. Results and Discussion

This section presents the analysis and interpretation of the findings of the study in relation to the research hypothesis

Response Rate

The survey targeted a total of 129 individuals, including 1 project manager, 2 government officials, 18 community leaders, and 108 workers. Since the total population was small, it served as the sample size for the study. Of the 129 individuals, 126 were expected to respond to the questionnaires, while 3 individuals were selected for interviews. After distributing the questionnaires, 118 were returned, resulting in a response rate of 91.5%. However, 8 questionnaires were not returned, and 3 individuals participated in interviews. The study ultimately included a sample of 121 respondents, which represents 100% of the sample size for the study. The response rate and breakdown of participants are summarized in the Table 1 below:

Table 1. Table showing response rate of respondents

Category	Frequency	Percentage
Returned Questionnaires	118	91.5
Not Returned	8	6.2
Interviewed Individuals	3	2.3
Total Respondents Used	**129**	**100%**

Source: Primary data, 2024

Table 1 shows that out of 129 targeted respondents, 118 completed questionnaires, representing a 91.5% response rate, while 8 questionnaires (6.2%) were not returned. Additionally, 3 individuals participated in interviews, contributing 2.3% to the total sample. The study achieved a high response rate, indicating strong engagement from respondents. The combination of quantitative data from the questionnaires and qualitative insights from the interviews enhances the reliability and depth of the findings, providing valuable information for decision-making in road construction projects in Karongi District.

Descriptive Statistics on Project Governance Policies

This section presents an analysis of the research hypothesis and delves into the perceptions of respondents based on the survey questions. Descriptive statistics were employed to summarize and present the data in a clear and meaningful way. A Likert scale, ranging from 1 to 5, was utilized to gauge respondents' attitudes, with 5 indicating "Strongly Agree," 4 for "Agree," 3 for "Neutral," 2 for "Disagree," and 1 for "Strongly Disagree." This approach enabled the researchers to effectively interpret and categorize respondents' views on the study's key topics. The results of the descriptive analysis are provided in Table 2 below.

Table 2: Level of agreement of Quality control planning and the performance of road construction projects

Statements	N	Mean	Std. Deviation
Enhanced Safety on Roads	118	4.6	.47
Reduced Environmental Impact	118	4.1	.32
Efficient Resource Utilization	118	4.1	.74
Better Project Management	118	4.2	.42
Minimized Risks of Defects and Failures	118	4.1	.36
Long-Term Durability of Roads	118	4.7	.70
Enhanced Public Perception of Government/Authority	118	3.9	.39
Improved Communication and Coordination among Stakeholders	118	3.4	.82
Timely Completion of Projects	118	4.3	.49
Opportunities for Continuous Improvement	118	4.0	.35
Valid N (listwise)	118		

Source : Primary Data, 2024-**Key** : M=Mean ; SD=Standard Deviation

Table 2 presents an analysis of respondents' perceptions regarding the impact of quality control planning on the performance of road construction projects in Karongi District. The findings suggest a strong positive correlation between quality control planning and various performance factors. The highest mean scores were for "Long-Term Durability of Roads" (Mean = 4.7) and "Enhanced Safety on Roads" (Mean = 4.6), emphasizing the critical role quality control plays in ensuring road infrastructure's longevity and safety. This indicates that respondents believe quality control planning is vital for meeting fundamental objectives in road construction, particularly in achieving durable and safe roads.

Other key factors with high mean scores include "Timely Completion of Projects" (Mean = 4.3), highlighting the importance of quality control practices in delivering projects within set timelines, which is essential for maintaining cost-efficiency and stakeholder trust. "Better Project Management" (Mean = 4.2) and "Reduced Environmental Impact" (Mean = 4.1) further reflect the positive influence of quality control on project execution and sustainability. The moderate scores for "Minimized Risks of Defects and Failures" (Mean = 4.1) and "Efficient Resource Utilization" (Mean = 4.1) also suggest that respondents view quality control planning as crucial for managing risks and optimizing resource allocation, contributing to successful project outcomes.

However, areas of concern were identified, particularly in "Enhanced Public Perception of Government/Authority" (Mean = 3.9) and "Improved Communication and Coordination among Stakeholders" (Mean = 3.4). The latter, with a higher standard deviation (SD = 0.82), indicates significant variability in opinions regarding the effectiveness of communication and coordination, suggesting that there may be gaps in stakeholder engagement. This highlights the need for improved strategies to foster better communication and transparency among stakeholders, ultimately enhancing public trust and project acceptance.

Correlation Analysis

The findings of the correlations between the independent variables and the dependent variables are summarized and presented in Table 4

Table 3: Correlation between independent variable and dependent variable

		Quality Control planning	Project Performance
Quality Control panning	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	118	
Project Performance	Pearson Correlation	.842**	1
	Sig. (2-tailed)	.000	
	N	118	118

Source: Primary data, 2024

The correlation analysis in Table 3 reveals a strong positive relationship between quality control planning and project performance, with a Pearson correlation coefficient of 0.842. This indicates a significant and highly positive association between the effectiveness of quality control planning and the overall performance of road construction projects. The significance value (Sig. = 0.000) further supports the validity of this relationship, as it is well below the commonly accepted threshold of 0.05, confirming that the observed correlation is statistically significant. These findings suggest that the more effectively quality control planning is implemented, the better the project performance in terms of key metrics such as safety, timely completion, and resource efficiency. The result highlights the importance of incorporating robust quality control practices into road construction projects, as they have a clear and substantial impact on improving project outcomes

Regression analysis

A multiple regression analysis was performed in this section to identify the predictor and its contribution towards the criterion. It aims to determine the prediction of a single dependent variable from a group of independent variables. The multiple regression analysis was performed with all the assumptions complied with. Table 4 shows the model summary of the results.

Table 4. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.842[a]	.709	.707	.17581

a. Predictors: (Constant), Quality Control Planning

Table 4 presents the model summary for the regression analysis, showing that the model has a strong correlation, with an R value of 0.842, indicating a high degree of relationship between quality control planning and project performance. The R Square value of 0.709 means that approximately 70.9% of the variation in project performance can be explained by the quality control planning practices. The adjusted R Square value of 0.707 accounts for the number of predictors in the model, providing a slightly more accurate estimate of the explained variance. The standard error of the estimate is 0.17581, which reflects the average distance that the observed values fall from the regression line, indicating a relatively good fit of the model.

Table 5. ANOVA results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.754	1	8.754	283.212	.000[b]
	Residual	3.585	116	.031		
	Total	12.339	117			

a. Dependent Variable: Quality Control Planning

b. Predictors: (Constant), Project Performance

Table 5 presents the ANOVA results for the regression model, testing the significance of the relationship between quality control planning and project performance. The regression sum of squares is 8.754, with 1 degree of freedom (df) for the predictor variable, leading to a mean square of 8.754. The F-value of 283.212 is highly significant, with a p-value of 0.000, indicating that the model significantly explains the variation in the dependent variable. This strong relationship suggests that quality control planning has a substantial impact on project performance, highlighting the importance of implementing robust quality control practices in road construction. The residual sum of squares is 3.585, with 116 degrees of freedom, showing the unexplained variance. The total sum of squares is 12.339, confirming the model's explanatory power. The implication of these results is that prioritizing quality control planning lead to enhanced project outcomes, making it essential for stakeholders in the construction industry to adopt rigorous quality management practices to improve both efficiency and stakeholder satisfaction.

Table 6. Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.390	.163		8.533	.000
	Quality Control Planning	.671	.040	.842	16.829	.000

a. Dependent Variable: Project Performance

Table 6 presents the regression coefficients for the relationship between quality control planning and project performance. The unstandardized coefficient for quality control planning is 0.671, with a standard error of 0.040. The standardized coefficient (Beta) is 0.842, indicating a strong positive relationship between quality control planning and project performance. The t-value for quality control planning is 16.829, with a significance level of 0.000, suggesting that quality control planning is a statistically significant predictor of project performance. The constant term (1.390) represents the baseline level of project performance when quality control planning is absent. These results imply that effective quality control planning contributes significantly to improved project performance, reinforcing the importance of incorporating

comprehensive quality management strategies in road construction project.

Table 7. Hypotheses Testing Results

Null Hypothesis	Coefficient	t-value	p-value	Condition	Decision
H_{o1}: Quality Control Planning has no significant effect on Project Performance	0.671	16.829	0.000	p-value < 0.05	Reject H_o

Source: Primary data, 2024

The hypothesis testing results in Table 7 provide insights into the relationship between the independent variable (quality control planning) and the dependent variable (project performance). The null hypothesis, which posited no relationship between quality control planning and project performance, was tested using the regression model. The significant t-value (16.829) and p-value (0.000), which is well below the 0.05 threshold, suggest that quality control planning is a significant predictor of project performance. This leads to the rejection of the null hypothesis, and the acceptance of the alternative hypothesis, which asserts that quality control planning positively influences project performance. The results indicate the importance of implementing effective quality control measures to ensure the success of road construction projects, highlighting that quality planning is crucial for enhancing project outcomes

Discussion of Findings

This section presents the results of the hypotheses testing conducted to evaluate the impact of various quality management components on the performance of road construction projects. From the findings, the study reveals that quality control planning significantly contributes to the overall success of road construction projects in Karongi District, with strong support from respondents regarding its impact on safety, durability, and timely project completion. The highest mean scores for "Long-Term Durability of Roads" and "Enhanced Safety on Roads" suggest that quality control is viewed as essential for ensuring the structural integrity and safety of infrastructure. Furthermore, the positive ratings for "Timely Completion of Projects" and "Better Project Management" emphasize the importance of quality control in meeting project deadlines and managing resources efficiently, which are crucial for maintaining stakeholder trust and minimizing costs.

While the overall perception of quality control planning is positive, there are areas that require improvement, particularly in "Enhanced Public Perception of Government/Authority" and "Improved Communication and Coordination among Stakeholders." The relatively lower mean scores for these aspects, especially the high standard deviation for communication and coordination, indicate a lack of consistency in how respondents perceive the effectiveness of these factors. This suggests a need for improved stakeholder engagement, transparency, and communication strategies to enhance public trust and ensure smooth project execution. Addressing these concerns would further strengthen the role of quality control planning in achieving successful and accepted road construction projects.

The qualitative data with the project manager emphasized that strong quality control planning has played a pivotal role in ensuring project success, especially in terms of safety and durability. He noted that effective quality management systems have streamlined processes, reduced delays, and minimized defects, resulting in better resource utilization and budget management. While sustainability has been integrated into their quality assurance processes, further efforts to address communication challenges were acknowledged. The project manager suggested that proactive communication and continuous stakeholder involvement are essential for improving public trust and ensuring smoother project execution. These insights further support the need for comprehensive quality control systems and improved stakeholder engagement to maximize project performance

These findings align with the perspectives of various scholars who emphasize the critical role of quality control in construction projects. Jha and Iyer (2007) emphasized that effective quality management practices substantially improve project performance, particularly in areas such as safety, timely completion, and stakeholder satisfaction. Their research supports the study's findings that quality control planning enhances safety and ensures timely project delivery. Dennis (2020) also underscored the importance of comprehensive quality assurance systems, noting that they help reduce defects and failures while improving project efficiency and sustainability. This aligns with the study's findings on the significant positive impact

of quality control on minimizing environmental impact and improving overall project execution.

Further supporting the findings, Theodore (2023) explored the relationship between quality management and stakeholder engagement, particularly focusing on public perception. Their study found that clear communication and effective stakeholder involvement are integral to successful quality control, a sentiment that resonates with the gaps identified in this study regarding communication and public perception. Together, these authors provide compelling evidence that quality control planning not only contributes to enhanced project safety, durability, and timely completion but also plays a key role in improving stakeholder relationships and public trust, which are vital for the success of road construction projects.

In contrast to these findings, Jamal (2021) presented a critical perspective on the impact of quality management planning in construction projects. Jamal argued that while quality management planning is often touted for its ability to enhance project performance, it can, in some cases, lead to negative outcomes if not carefully tailored to the project's specific context. According to Jamal, the rigid implementation of quality management practices can result in unnecessary delays and increased costs. Jamal's study found that the application of strict quality control measures, such as frequent inspections and extensive documentation, can create bureaucratic bottlenecks, slowing down project progress. This is particularly evident in projects with tight timelines or limited resources, where the additional layers of quality assurance may be counterproductive. Furthermore, Jamal emphasized that the overemphasis on quality can discourage teams from taking calculated risks or trying innovative construction methods, as there may be a tendency to adhere strictly to established standards, even when alternative approaches could lead to greater efficiency or sustainability.

5. Conclusion and Recommendations

5.1 Conclusion

In conclusion, the hypothesis testing results confirm that quality control planning significantly influences the performance of road construction projects. The regression analysis, with a t-value of 16.829 and a p-value of 0.000, clearly indicated that quality control planning is a strong predictor of project performance, leading to the rejection of the null hypothesis. This finding supports the alternative hypothesis, which asserts that effective quality control planning positively impacts project outcomes. The results emphasize the critical role of comprehensive quality management strategies in improving the overall performance, safety, and efficiency of road construction projects, highlighting the need for robust planning and execution in ensuring project success.

5.2 Recommendations

Based on the study findings, the following recommendations are made:

1. The study highlighted challenges in communication and coordination among stakeholders, which affected public perception and trust. It is recommended that road construction projects should enhance communication strategies by implementing regular stakeholder meetings, transparent updates, and feedback mechanisms. This would help build trust, improve public perception, and foster stronger collaboration among all parties involved in the project.
2. The findings suggest that quality control planning positively impacts reducing environmental impact and promoting sustainability. It is recommended that road construction projects should prioritize sustainable practices in their quality management systems, such as using sustainable materials, minimizing waste, and employing energy-efficient construction methods. This would improve environmental outcomes, enhance the project's reputation, and align with broader societal goals.
3. Given the significant impact of quality control planning on project performance, it is recommended that project teams should receive ongoing training in quality management principles and best practices. Regular workshops, certifications, and professional development opportunities should be provided to ensure that all stakeholders, including project managers, workers, and government officials, are well-equipped to implement and maintain effective quality control systems throughout the project lifecycle. This would contribute to better project execution, fewer defects, and more successful project outcomes

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