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Influence of Project Planning on the Successful Implementation of Road Rehabilitation and Construction Projects in Rwanda: The Case of Feeder Roads Development Project

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Abstract: *Despite efforts and investment to improve road connectivity, some projects still experience delays, cost variation, funding constraints, and implementation challenges that affect timely delivery and overall project success. This study therefore examined the influence of Schedule Management Planning, Cost Management Planning, Resource Management Planning and Risk Management Planning on successful project implementation. The study was guided by Contingency Theory, the Theory of Constraints and Scheduling Theory. A quantitative research approach was adopted. Data were collected through structured questionnaires from 176 respondents and analyzed using Pearson correlation and multiple linear regression. The findings revealed that all four planning dimensions had positive and statistically significant relationships with project success. Cost Management Planning was the strongest predictor ($\beta = 0.619$, $p < 0.001$), followed by Risk Management Planning ($\beta = 0.255$, $p < 0.001$), Resource Management Planning ($\beta = 0.181$, $p < 0.001$) and Schedule Management Planning ($\beta = 0.179$, $p < 0.001$). The model explained 69.8% of the variation in project success ($R^2 = 0.698$; adjusted $R^2 = 0.691$) and was statistically significant ($F(4, 171) = 98.659$, $p < 0.001$). Project success, measured through time, quality and cost performance, was rated more positively in quality than in timely completion and budget compliance. The study recommends strengthening integrated project planning, particularly cost estimation and control, risk management, resource mobilization and realistic scheduling, to improve road project delivery in Rwanda.*

Keywords: *Project Planning, Schedule Management Planning, Cost Management Planning, Resource Management Planning, Risk Management Planning, Successful Implementation.*

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1. Introduction

In many developing countries as part of the key contributor for socio-economic development, we have among other sectors the transport sector which facilitates the movement of goods and people. In Rwanda being a landlocked country with as well its geographic condition faces challenging infrastructure particularly the transport cost is high compared to other countries (IMF, 2023), thus, to enable that movement of different product the construction of different roads to connect people is very important to facilitate for the country economic growth.In Africa, the transport sector plays a significant role in promoting economic development, regional integration, and poverty reduction. However, road infrastructure projects across the continent continue to face challenges such as cost overruns, delays in project completion, inefficient resource utilization, and inadequate risk management. These challenges are partly associated with weaknesses in project management planning, particularly in schedule management, cost management, resource allocation, and risk identification and mitigation. According to the AfDB (2020), deficiencies in project preparation, design, and management contribute to implementation delays and cost overruns in infrastructure projects.

Among the mode of transport in Rwanda the inland transport remains the most used and the key that facilitate for the transport of goods and that connect more areas. As per the Law No. 042/2023 governing land and waterways transport, the Rwanda road network is composed with the National Roads, the District Roads and the Local roads. Considerable effort was made for the rehabilitation and maintenance of the Rwanda road network and as well construction of other roads in critical condition considering the funds availability, and this is made to make the roads in good condition for road users (MININFRA 2021).

The construction industry is a key contributor for the country economy; it facilitates creating opportunities for socio economic activities as well creating the employment to the community. Infrastructure projects require effective planning for ensuring timely delivery of the project and appropriate use of the resources, but there are projects which still delay and have cost overruns leading to increase in the project cost and associated constraints during the project implementation which could be related to gap in project planning (Rivera et al., 2020).

The Planning stage in construction consists of systematic analysis of the project scope that facilitated elaborating the work breakdown, the cost estimation, assessment of the required resources and come up with the implementation schedule. This process facilitates the project team to have a common understanding about the expected deliverables and required intervention from them for implementing the project and thus facilitates the appropriate coordination (PMI, 2021).

In 2012, the NR network was extended from 1,211 Km to 1,525.8 km with 96% of that National Roads paved network being in good condition, this highlights the government effort to improve the road network to facilitate the transport of goods and people (MININFRA, 2021). Taking into consideration made for improvement of the road network, multi-year maintenance has been put in place where three years maintenance contracts are considered to keep the National Roads in good condition; through those contracts the contractor has responsibility to keep the road services levels in line with the acceptable standards provided in the contracts (MININFRA, 2021).

To achieve the above target, it requires appropriate planning, it is with this regard that this research assessed on how appropriate consideration of planning practices contributes to ensure that road construction projects get implemented with respect to the set specifications, on time and within the planned cost. During the assessment of the above, we reviewed the available documentation and conducted the survey for the analysis on how project planning contributes to the success of roads rehabilitation and construction projects.

Transport is very key in promoting economic growth and advancing socio-economic transformation, particularly in developing countries where roads serve as the principal mode of transportation, for movement of goods and people. In Rwanda, road infrastructure facilitate trade through regional connectivity, and the accessibility to social services. However, Rwanda continues to face high transport and logistics costs due to its landlocked geographical position and dependence on regional transport corridors (IMF, 2023). To address these challenges, the Government of Rwanda continued to invest heavily in road rehabilitation and construction projects under national development strategies that seek to enhance transport efficiency and promote economic transformation.

Previous studies conducted mainly focused on what lead to cost variations and to time extensions for road construction projects through project implementation period (Byiringiro, 2021) and the monitoring and evaluation and successful road project delivery in Rwanda. Most of the conducted studies focus mainly on project delays and cost overruns without adequately addressing how cost, schedule, resource, and risk management practices collectively contribute to project success. This creates a knowledge gap that necessitates further research to understand mow how appropriate consideration of planning process can facilitate the effective achievements of roads construction in Rwanda.

The research primarily aims at evaluating how the consideration of project planning practices including SMP, RMP, CMP and RiMP contribute to ensure the effective achievement of the road construction projects in Rwanda.

1.1 General Objective

The research primarily aims at evaluating how the consideration of project planning practices including SMP, RMP, CMP and RiMP contribute to ensure the effective achievement of the road construction projects in Rwanda.

1.2 Specific Objectives

The study examined four planning dimensions in relation to successful implementation:

1. To determine the effects of schedule Management planning on the successful implementation of road rehabilitation and construction projects in Rwanda
2. To assess the effects of cost Management planning on the successful implementation of road rehabilitation and construction projects in Rwanda
3. To assess the effects of resources Management planning on the successful implementation of road rehabilitation and construction projects in Rwanda
4. To assess the effects of risk management planning on the successful implementation of road rehabilitation and construction projects in Rwanda

2. Literature Review

The literature reviewed the theoretical foundations of project planning and previous evidence on scheduling, costs, resources, risks and implementation outcomes.

2.1 Theoretical Review

Contingency Theory, Theory of Constraints and Scheduling Theory provided perspectives for explaining the interdependence of planning practices and road-project performance.

2.1.1 Contingency Theory

Contingency Theory posits that there is no universally appropriate approach to project management, since management strategies and practices should be adapted to the specific characteristics, complexity, uncertainty, and external conditions of individual projects. Consequently, project managers need to adopt flexible management approaches that respond to changing project requirements and environmental conditions to enhance project performance (Zarghami, 2024). This perspective emphasizes the importance of selecting project management practices that fit the particular circumstances under which projects are implemented.

Contingency Theory further emphasizes that effective management depends on various situational factors, including the external environment, technological conditions, organizational characteristics, managerial competencies, and the capabilities of employees. The theory recognizes that no single management approach is universally effective; rather, management practices should be tailored to the prevailing organizational and project circumstances to achieve optimal performance. In project management, this implies that managers should adapt their leadership styles, planning processes, resource allocation strategies, and control mechanisms according to project complexity, available technologies, organizational capacity, and environmental uncertainties (Zarghami, 2024).

Similar observations are reported in the construction literature on developing countries, where rigid institutional arrangements are found to limit adaptive planning capacity. Furthermore, infrastructure projects in emerging economies are particularly exposed to institutional, regulatory, political, and environmental uncertainties, which influence project implementation and performance outcomes. These challenges reinforce the relevance of Contingency Theory, which emphasizes the need to adapt project management approaches to prevailing organizational and environmental conditions (Boroto & Fenner, 2024).

2.1.2 Theory of Constraints

The Theory of Constraints (TOC) provides a useful perspective for understanding how construction project performance can be limited by a relatively small number of critical constraints that impede the achievement of project objectives. These constraints may arise from financial limitations, inadequate resource availability, poor scheduling and coordination, contractual difficulties, institutional barriers, and managerial weaknesses. The theory emphasizes the importance of identifying and addressing these critical constraints to improve project efficiency, minimize delays, and enhance overall project performance (Masoetsa et al., 2022).

The theory emphasizes that identifying, analyzing, and systematically managing these constraints is essential for improving overall project performance. In construction environments, constraints are rarely independent; rather, they are interconnected, such that deficiencies in project scheduling, resource availability, financial management, procurement processes, or stakeholder coordination can trigger cascading effects that adversely affect quality, cost, and time performance. Consequently, effective project planning requires an integrated approach to identifying, prioritizing, and mitigating these interrelated constraints to enhance project implementation and delivery (Masoetsa et al., 2022).

2.1.3 Scheduling Theory

Scheduling Theory is based on the assumption that project activities can be systematically organized, prioritized, sequenced, and monitored to facilitate the timely completion of project objectives. Effective schedule management requires development, monitoring, and controlling of project schedules while adapting to uncertainties and changes throughout the project period (PMI, 2021). However, construction projects in developing countries often deviate from these assumptions because of uncertainty, resource constraints, and changing project conditions.

Poor scheduling practices significantly contribute to project delays in developing economies and scheduling inefficiencies at planning stage throughout the project lifecycle leads to the cost variations and extension of time (Daoud et al., 2023). This evidence suggests that scheduling in Rwanda functions more effectively when integrated with cost, resource, and risk management systems rather than as an independent planning function.

2.2 Empirical Review

Empirical studies were considered under each of the four planning dimensions to establish evidence supporting the study objectives.

2.2.1 Schedule Management Planning and Project Success

Planning and scheduling are distinct yet interdependent aspects of project management, both essential for achieving project success. Planning involves identifying and selecting appropriate policies, procedures, and strategies to achieve project objectives, while scheduling translates these plans into actionable timelines by coordinating project activities, costs, quality standards, and resource requirements into an integrated operational framework (PMI, 2021). The process of scheduling in road construction project therefore serves as a critical element for the project team, converting project goals into a structured timetable that guides execution and coordination.

The project schedule consists of timelines depicting how project activities will be executed over time, enabling managers to plan, organize, coordinate, and monitor activities in alignment with allocated resources. Scheduling is supported by various tools and methodologies that improve visibility of task dependencies, activity sequences, critical paths, and project milestones (Görsch et al., 2024). Effective schedule management planning has been linked to timely project delivery and overall project performance, as it facilitates proactive monitoring, early identification of delays, and informed decision-making (PMI, 2021).

Although previous studies have highlighted its importance, empirical evidence reveals that the schedule management planning in developing countries is often not effectively implemented. In Rwanda, road construction projects frequently experience delays despite the existence of structured schedules, in most cases these delays are attributed to weak integration of scheduling with resource provision and financial planning systems, highlighting the challenges of treating schedules as isolated management tools rather than as part of an integrated project control framework. Similarly, Daoud et al. (2023) argues that scheduling inefficiencies arise when project plans are not dynamically updated in response to ongoing implementation realities, emphasizing the need for schedules to function as adaptive control mechanisms rather than static documents.

2.2.2 Cost Management Planning and Project Success

Effective cost management is a critical component of project management, as it contributes significantly to project performance and overall success. Proper management of project costs enables organizations to allocate financial resources efficiently, monitor expenditures, maintain budgetary control, minimize cost overruns, and facilitate the successful achievement of project objectives (Elserougy et al., 2024). Effective cost planning facilitates better resource provision through the understanding of project expenditures, thereby allow the team managing the project to make informed and strategic action, identify potential savings, and communicate financial status to stakeholders throughout the project lifecycle. In construction projects, cost planning is closely linked with resource scheduling, as planned costs both fixed and variable are derived from optimized resource allocation over time. Fixed costs, such as equipment setup, occur once during the project, whereas variable costs, such as component fabrication, recur throughout the project duration (APM, 2019).

Although proper management of project cost management is recognized as essential for project success, construction projects continue to experience significant cost deviations across different regions. Elserougy et al. (2024) highlight that inaccurate cost estimation, inadequate budgeting, and ineffective financial monitoring are major factors contributing to cost overruns and poor project performance. Effective cost forecasting, continuous expenditure monitoring, and proactive cost control are therefore essential for maintaining budget discipline and achieving project objectives. These difficulties are often more severe in developing economies, where construction projects operate under conditions such as limited resources, economic instability, and institutional challenges.

Elserougy et al. (2024) found that poor cost outcomes in project often come from a broader failure of the cost control system itself, especially cost issues are weak leading to deviations going unnoticed or unaddressed until they have already affected the project. From those findings, the author recommends that organizations should invest in stronger cost control system to strengthen cost management as a way to reduce project failure rates and improve overall success of the project.

In Rwandan, road construction projects frequently experience cost overruns resulting from various factors

such as inflation, delayed payments, and inaccurate initial cost estimates. Reports by OAG Rwanda (2022) indicate recurrent budget deviations in public infrastructure projects, often linked to weak financial planning, inefficient procurement processes, and delayed fund disbursement. Comparatively, while developed economies benefit from advanced cost management systems and institutional stability, which facilitate adherence to budgetary constraints, the Rwandan road construction sector reflects the systemic challenges identified by Daoud et al. (2023).

2.2.3 Resource Management Planning and Project Success

Effective resource management which includes timely resource mobilization and appropriate allocation of human, material and equipment significantly improve project outcomes by enhancing resources utilization, minimizing delays and reducing cost overrun (Samo and Shale, 2026). Bageis (2024) established that effective financial resource allocation and timely disbursement of funds are essential for the timely completion of construction projects. Inadequate financial resources, cash-flow constraints, and delayed payments to contractors and suppliers can disrupt construction activities, delay resource acquisition, and ultimately contribute to project implementation delays. Similarly, Abdi (2020) emphasizes that comprehensive resource planning facilitates task efficiency, which help project managers to anticipate and allocate human, material, and equipment resources effectively.

Internal project factors including labor availability, material supply, equipment readiness, and process efficiency directly impact highway project performance (Rahman et al., 2020). The strategic identification and scheduling of resources allow for smoother execution and minimize the likelihood of delays due to shortages or inefficiencies.

During the feasibilities and detailed design studies for road construction, source of material to be used during construction is assessed however still uncertainties in material source during construction may occur leading to consideration of hauling distance and as well potential increase for material production cost like crushed aggregates this often led to the consideration by contractor of contingencies in their estimates. Resource management involves as well the human resources management as they team working on the project play a measure role in that planning process, therefore it is very essential to have a proper coordination of the team and as well ensuring appropriate communication to coordinate the process from material identification equipment mobilization planning, procurement of material, preparation for the storage area if required, timely provision of funds required for purchase of the materials and the supply of material at site (PMI, 2021).

Despite the known importance of resource planning, challenges persist in developing countries particularly the inadequate resource management, such as delayed provision of required material, equipment availability, and workforce constraints, remains among the main factor responsible for time overruns for roads projects in developing countries (Rivera et al., 2020). In Rwanda, road construction projects face recurring constraints, including delayed material delivery, equipment shortages, and limited availability of skilled labor. Reports from the OAG Rwanda (2022) confirm that these resource limitations frequently contribute to project delays, cost overruns, and inefficiencies. Recent studies indicate that structural resource constraints, including shortages of skilled labour, inadequate construction equipment, and weaknesses in material supply chains, continue to affect construction project performance, particularly in developing countries. These limitations disrupt construction activities, reduce productivity, increase project costs, and contribute to implementation delays (Negesa, 2022).

These findings highlight a critical gap in current practice: while resource management planning is theoretically essential for successful implementation, previous research have not covered how integrated resource planning linking human, material, and equipment management with scheduling, cost, and risk management affects road projects in Rwanda. To addressing the above gap, this research investigates the contribution of resource management planning in improving project efficiency, ensuring timely resource availability, and improving the overall implementation success of road projects in Rwandan.

2.2.4 Risk Management Planning and Project Success

Project RMP is key component for effective management of projects, it consists with identifying, assessment, and mitigating potential risks while exploiting opportunities to achieve predefined project objectives (Sisay, 2026). According to ISO 31000 principles, project risk management involves both minimizing the potential impact of uncertainties and supporting the achievement of project goals. It allows project teams to detect, analyze, and respond to risks while maintaining focus on key performance objectives, including scope, cost, time, quality, safety, sustainability, and environmental requirements (Kerzner, 2022). Effective risk management planning necessitates holistic understanding of project objectives and the systematic integration of risk processes into the overall project management framework (Sisay, 2026).

In road construction, risk is shared between the contractor, the client and sometimes the stakeholders. The contractor often experiences more risk as they are involved day to day in the execution of works with the agreed quality cost and time. Empirical studies in road construction highlight the significant contribution of constraint and uncertainties control and mitigation for the project success, Wubet et al. (2023) analyzed risk factors affecting road construction contractors and identified cashflow problem, inadequate planning, expropriation challenges that lead to delays in availing the right of way to the contractor, equipment failure, late delivery construction resources, week coordination, lack of ownership of the contractor team member and cashflow

constraints. The study found that inadequate attention to risk planning often leads to poor project outcomes, including reduced quality of deliverables, delayed project and cost variation (Wubet et al., 2023).

In developing country contexts, including Rwanda, road construction projects are particularly to internal susceptible to internal and external risks; including funding delays, inflationary pressures, resource constraints, and regulatory uncertainties. Reports from the OAG Rwanda (2022) indicate that insufficient risk identification and mitigation strategies frequently contribute to project delays and cost deviations. Similarly, Mohajeri Borje Ghaleh et al. (2021) noted that ineffective risk management practices, inadequate risk management planning contribute to delays and poor performance in road construction projects and recognized that risk management perspective can offer a comprehensive strategy for delay control.

3. Methodology

This section presents quantitative research design, study population, data collection, instrument testing, data analysis and ethical considerations.

3.1 Research Design

With reference to Creswell & Creswell (2022), quantitative research approach was used as the research consist of assessing the influence of SMP, RMP, CMP, RiMP to the successful implementation, descriptive statistics have been used to present the characteristic of the respondent involved in the research.

Further the correlational analysis was used to assess whether if the relationship between variable exists and determine the strength of that relationship between of SMP, RMP, CMP, RiMP and the successful implementation. The design used involves systematic data collection to describe the existing issue and improved understanding of actual issues. A descriptive research design is appropriate for investigations aimed at providing a systematic account of the attributes, conditions, or existing circumstances of a defined population, group, or phenomenon (Creswell & Creswell, 2022).

3.2 Study Population and Sampling

In line with Creswell & Creswell (2022); The study population was determined considering the complete group of people, organizations, or other units that possess characteristics relevant to the research and to whom the study findings are intended to apply, in this regards Project Managers in RTDA and District Engineers, Contractor Sites Engineers, Contractor Project Managers and consultant resident engineers have been considered in the study population. Thus, the population encompasses all eligible units that share the attributes required to respond to the questionnaire and draw meaningful conclusions.

The research questionnaire was administered to 180 respondents involved in road rehabilitation and construction projects in Rwanda. These included project managers from client organizations, contractors, and consultant personnel. The study specifically focused on staff who participate directly in planning and implementation of road rehabilitation and construction.

The study adopted the census approach for eligible population, whereby data were collected from all individuals of the targeted population rather than selectin a subset for analysis. This approach is suitable when the population is small and easily accessible, making it practical to obtain data from every eligible participant and ensuring full population coverage (Saunders et al., 2023).

3.3 Data Collection Instrument

Hair et al. (2022) emphasized the use of questionnaires to support efficient data collection and facilitates subsequent statistical analysis. In this research data were collected through the use of a questionnaire prepared and presented to the respondent in the same manner. The questionnaire was prepared referring to the variables to be assessed questionnaire item were prepared and a Likert-Scale response options have been used for the respondent to indicate their level of agreement to different statements.

The questionnaire instrument was selected because it allows the systematic collection of quantitative information from respondents while maintaining uniformity in the measurement of the study variables and was designed in a way to facilitate systematic data collection and provide quantitative information for analyzing the influence of the study variables.

3.4 Pilot Study, Validity and Reliability

Prior to the main data collection, the survey questionnaire was piloted and tested for validity and reliability. The pilot study involved 32 members of project implementation teams responsible for road rehabilitation and construction projects in districts without the Feeder Roads Development Project and the districts of the City of Kigali (CoK). The pilot study involved respondents with similar characteristics to the participants with similar to those of the target population; and have been excluded in the survey population to prevent their prior exposure from influencing the final responses. The observations and suggestions gathered during the pilot phase were used to refine the questionnaire through modification of unclear items, removal of possible sources of confusion, and improvement of the instrument's overall effectiveness before the actual data collection.

From the above presented results, the level of internal consistency reliability across all the study constructs was found satisfactory. Risk Management Planning demonstrated the highest coefficient ($\alpha = 0.852$), followed by Schedule Management Planning ($\alpha = 0.816$), Cost Management Planning ($\alpha = 0.794$), Resource Management Planning ($\alpha = 0.767$), and Successful Implementation of Road Rehabilitation and Construction Projects ($\alpha = 0.701$).

3.5 Data Analysis

Collected questionnaire responses were processed and analyzed using SPSS. Prior to performing statistical tests, the collected responses were examined to identify incomplete entries, inconsistencies, and possible data errors to enhance the reliability of the dataset.

Pearson's correlation coefficient was calculated to check evidence for hypotheses related to the relationship between the SMP, RMP, CMP RiMP and the implementation success of road rehabilitation and construction projects. The analysis focused on determining the direction and degree of relationships among the study variables. In addition, inferential statistics were performed to establish whether the observed relationships were statistically significant.

Multiple linear regression was used to assess how schedule, cost, resource, and risk management planning practices accounted for differences in the implementation succcess of road projects in Rwanda.

$$Y = \beta_0 + \beta_1(SMP) + \beta_2(CMP) + \beta_3(RMP) + \beta_4(RiMP) + \varepsilon$$

3.6 Ethical Considerations

Before commencing the distribution of the questionnaire, authorization has been secured from the university academic authorities and permission was sought from RTDA involved in road projects in Rwanda, and this was done with respect to compliance with institutional research requirements.

For the respondents' privacy, the questionnaire did not require filling of names and answers to the questionnaire. In addition to this, for transparency a brief on the purpose of the research was provided in the introduction to the questionnaire for the respondents' consideration prior to providing their responses.

Respondents' privacy was considered during questionnaire administration by avoiding the collection of identifying details. The information provided was treated as research data only and was used exclusively to address the objectives of the study, with appropriate measures taken to prevent unauthorized use

Finally, the study ensured honesty, transparency and integrity in data collection, analysis, and reporting. All findings were presented accurately without fabrication, falsification, or misrepresentation of results.

4. Results and Discussions

The following sections present the response rate and inferential findings, followed by hypothesis decisions and an objective-based discussion.

4.1 Response Rate

Table 1: Response Rate

Questionnaires	Frequency	Percentage (%)
Returned complete	176	97.8
Not returned/usable	4	2.2
Total	180	100.0

Source: Field Data (2026)

The target population comprised 180 staff that works for road projects in different districts of the country, that consists of contractor's project managers, resident engineers, district engineers, contractor engineers, consultants, and supporting technical staff. Responses were received from 176 respondents, reflecting a response rate of 97.8%. The satisfactory level of response rate can be associated with the accessibility of the online questionnaire and follow up to the respondents to submit their responses.

4.2 Inferential Statistics

Pearson correlation and multiple linear regression were used to examine the associations and combined statistical contributions of the four planning practices.

4.2.1 Correlation Analysis

Table 2: Pearson Correlation Analysis (2-tailed)

Variables	Successful implementation of road project	SMP	CMP	RMP	RiMP
Successful implementation of road project	1				
Sig. (2-tailed)	-				
N	176				
SMP Pearson Correlation	.423**	1			
Sig. (2-tailed)	.000	-			
N	176	176			
CMP Pearson Correlation	.739**	.283**	1		
Sig. (2-tailed)	.000	.000	-		
N	176	176	176		
RMP Pearson Correlation	.509**	.307**	.388**	1	
Sig. (2-tailed)	.000	.000	.000	-	
N	176	176	176	176	
RiMP Pearson Correlation	.284**	.054	-.006	.129	1
Sig. (2-tailed)	.000	.479	.934	.088	-
N	176	176	176	176	176

Source: Field Data (2026)

The correlation analysis established positive and statistically significant relationships between all four project planning dimensions and successful implementation of road rehabilitation and construction projects. Cost Management Planning recorded the strongest positive correlation ($r = 0.739$, $p < 0.001$), indicating a strong association with successful project implementation. Resource Management Planning followed with a moderate positive correlation ($r = 0.509$, $p < 0.001$), while Schedule Management Planning also demonstrated a positive relationship ($r = 0.423$, $p < 0.001$). Risk Management Planning recorded the weakest, although statistically significant, positive correlation ($r = 0.284$, $p < 0.001$).

These findings indicate that cost management and resource management practices have stronger individual associations with successful project implementation compared with schedule and risk management planning. However, the statistically significant relationship observed for all four dimensions demonstrates that each planning area is relevant to project implementation performance.

The relatively weak correlation for Risk Management Planning should not be interpreted to mean that risk management is unimportant. Rather, it indicates that its individual linear association with project success was weaker than that of the other three dimensions in this sample. Its relative contribution when considered together with the other planning dimensions is examined further through multiple regression analysis.

4.2.2 Regression Analysis

The fitted multiple regression model assessed the joint predictive value of Schedule, Cost, Resource and Risk Management Planning.

Table 3: Multicollinearity Coefficients

Model	Collinearity Statistics	
	Tolerance	VIF
Schedule Management Planning (SMP)	0.874	1.145
Cost Management Planning (CMP)	0.816	1.225
Resource Management Planning (REMP)	0.793	1.261
Risk Management Planning (RIMP)	0.979	1.022

[a] Dependent variable: Successful implementation of road rehabilitation projects.

Source: Field Data (2026)

The results indicated values of 1.145 for Schedule Management Planning (SMP), 1.225 for Cost Management Planning (CMP), 1.261 for Resource Management Planning (REMP) and 1.022 for Risk Management Planning (RiMP). Since all values were below the recommended threshold of 5, multicollinearity was not considered a concern. Therefore, all four independent variables were retained in the regression

model. The findings for multicollinearity testing are presented in the following table.

Table 4: Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.835[a]	.698	.691	.35583

Source: Field Data (2026)

Multiple regression results show a strong and positive relationship between the combined project planning dimensions; RMP, CMP, SMP, and RiMP and the successful implementation of projects. The obtained R= 0.835 indicates that the values estimated by the regression equation correspond closely with the observed values of the dependent variable. This result suggests that the four planning dimensions, when considered collectively, have a substantial relationship with the road rehabilitation and construction implementation success.

The model R^2 is 0.698, showing that the four planning dimensions RMP, CMP, SMP, and RiMP jointly account for 69.8% of the observed variance for roads project successful implementation. Thus, a considerable proportion of the variation in the outcome can be associated with the predictors that have been considered in the model. The adjusted R^2 is 0.691, which provides a more conservative estimate of the model's explanatory capacity after taking into consideration the number of predictors and the sample size. The small value difference of 0.007 between the R^2 and adjusted R^2 values indicate that the model retains a similar level of explanatory performance after adjustment.

The regression standard error is 0.35583, representing the extent to which the observed values differ from those estimated by the regression model. The magnitude of this error is relatively small, suggesting that the model's predicted values are reasonably close to the actual observations of the dependent variable. This result provides further indication that the regression model offers a satisfactory level of predictive performance for the data analyzed.

Taken together, the regression results show that the four project planning dimensions included in the analysis are substantially associated with the dependent variable. The model accounts for 69.8% of the observed variation, while 30.2% remains outside the explanatory scope of the predictors incorporated into the regression equation. The unexplained proportion may reflect the influence of other project-related conditions, contextual factors, measurement differences, or random variation that were not considered in the present model. With regards to road rehabilitation and construction projects context in Rwanda, the above results therefore indicate that planning-related practices constitute an important component of project performance, although they do not represent the only factors that determine the outcome.

Table 5: ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	49.966	4	12.491	98.659	.000[b]
Residual	21.651	171	.127		
Total	71.617	175			

Source: Field Data (2026)

The obtained results $F(4, 171) = 98.659$, $p < 0.001$ reveal that the calculated F-Statistic I quite large which indicate that the variation for contribution of RMP, CMP, SMP, and RiMP for successful implementation of roads projects is much greater thatn the unexplained variation and the $p < 0.001$ indicates that SMP, RMP, CMP, and RiMP collectively predicted the successful implementation. SMP, RMP, CMP, and RiMP, when entered into the model simultaneously, significantly improve the explanation of successful project implementation. For road rehabilitation and construction projects in Rwanda, the result indicates that the set of project planning dimensions examined in this study is significantly related to the successful implementation of road rehabilitation and construction projects.

The ANOVA results show that the regression component accounts for 49.966 units of variation in successful project implementation, whereas 21.651 units remain in the residual component. In other words, a greater share of the total variation is captured by the predictors than remains unexplained by the model. Consistent with the R^2 result reported above, these findings indicate that SMP, RMP, CMP, and RiMP together account for 69.8% of the variation in successful project implementation, with the remaining proportion reflecting variation not captured by the predictor included in the regression model.

The statistically significant F-test indicates that the estimated model fits the observed data substantially in a better way compared to a model that excludes the explanatory variables. This result demonstrates that RMP, CMP, SMP, and RiMP, when considered collectively, have a statistically significant effect on the successful implementation of road rehabilitation and construction projects in Rwanda.

The F-statistic and its corresponding significance value further confirm that incorporating these four planning

dimensions produces a meaningful improvement in the explanatory capacity of the regression model. Their combined contribution helps account for differences in project implementation outcomes, suggesting that effective planning across scheduling, costs, resources, and risks are crucial components in determining the success of road projects in Rwanda.

These findings provide strong evidence of the overall validity and the extent to which the model explain the outcome and justify further examination of the individual regression coefficients to check the specific contribution of SMP, RMP, CMP, and RiMP to successful implementation.

Table 6: Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-.849	.242		-3.515	0.001
SMP	.231	.058	.179	3.973	0.001
CMP	.566	.043	.619	13.302	0.001
RMP	.211	.055	.181	3.840	0.001
RiMP	.221	.037	.255	5.997	0.001

Source: Field Data (2026)

Y= -0.849 + 0.231 (SMP) + 0.566 (CMP) + 0.211 (RMP) + 0.221 (RiMP)

Estimates reported in Table 5 show that SMP, CMP, RMP, and RiMP were each positively associated with successful project implementation, with the corresponding coefficient tests indicating that these relationships were statistically significant. Cost Management Planning was the strongest statistical predictor of successful implementation ($\beta = .619$, $p < .001$). This finding suggests that effective cost estimation, budgeting, expenditure monitoring, and cost control are essential to ensure successful implementation of road rehabilitation and construction projects.

Risk Management Planning was the second most influential predictor ($\beta = .255$, $p < .001$), indicating that structured identification, assessment, and mitigation of project risks significantly enhance project performance. Resource Management Planning also exerted a positive and significant influence on successful implementation ($\beta = .181$, $p < .001$), suggesting that effective allocation and utilization of project resources contribute to improved implementation outcomes. Similarly, Schedule Management Planning had a positive and statistically significant influence on successful implementation ($\beta = .179$, $p < .001$), implying that realistic scheduling and effective monitoring of project timelines facilitate successful project delivery.

Using the obtained regression coefficients, the equation becomes:

Y= -0.849 + 0.231 (SMP) + 0.566 (CMP) + 0.211 (RMP) + 0.221 (RiMP)

The regression equation indicates that a one-unit increase in SMP, CMP, RMP, and RiMP would increase successful implementation by 0.231, 0.566, 0.211, and 0.221 units, respectively, holding all other factors constant.

The findings demonstrate that project planning significantly influenced the successful implementation of road rehabilitation and construction projects in Rwanda. Among the planning dimensions examined, Cost Management Planning was found to have the highest influence on successful implementation, followed by RiMP, RMP, and SMP.

4.3 Decision on Null Hypotheses

The null hypotheses were assessed using the regression coefficient significance values at the 5% level.

Table 7: Decision on Null Hypotheses

Hypothesis	Statement	β	p-value	Decision
H01	Schedule Management Planning has no significant influence on the successful implementation of road rehabilitation and construction projects in Rwanda.	0.179	<0.001	Rejected
H02	Cost Management Planning has no significant influence on the successful implementation of road rehabilitation and construction projects in Rwanda.	0.619	<0.001	Rejected
H03	Resource Management Planning has no significant influence on the successful implementation of road rehabilitation and construction projects in Rwanda.	0.181	<0.001	Rejected
H04	Risk Management Planning has no significant influence on the successful implementation of road rehabilitation and construction projects in Rwanda.	0.255	<0.001	Rejected

Source: Field Data (2026)

The coefficient estimates show that Schedule Management Planning (SMP) was positively related to successful project implementation, with a β equal to 0.179 and p- value below 0.001. Because the probability value is below the 0.05 decision criterion, H01 was rejected. The result indicates that variations in schedule management were significantly associated with differences in the implementation outcomes of road rehabilitation and construction projects.

Cost Management Planning (CMP) recorded the largest β among the predictors (β = 0.619, p < 0.001). This statistically significant positive relationship led to the rejection of H02. The finding indicates that cost-related planning practices, including the preparation and management of project budgets and expenditure, have a particularly strong association with successful project implementation.

Resource Management Planning also exhibited a positive and statistically significant influence on successful implementation (β = 0.181, p < 0.001), thus null hypothesis (H03) was rejected. This finding demonstrates that effective allocation and utilization of project resources significantly enhance project implementation outcomes.

Risk Management Planning produced a positive standardized coefficient of 0.255, with p < 0.001. The evidence therefore supported the rejection of H04. This finding indicates that systematic attention to project risks is significantly associated with successful implementation, highlighting the relevance of risk identification, assessment, and response within the planning process.

The hypothesis-testing results provide evidence that all four project planning dimensions examined in the study have statistically significant positive relationships with successful implementation. The standardized coefficients indicate differences in their relative contributions within the regression model. Cost Management Planning had the largest coefficient (β = 0.619), followed by Risk Management Planning (β = 0.255), Resource Management Planning (β = 0.181), and Schedule Management Planning (β = 0.179). Thus, among the planning dimensions considered, cost management planning showed the strongest relative association with the successful implementation of road projects in Rwanda.

4.4 Discussion of Research Findings

Findings are discussed against the theoretical perspectives and previous empirical studies, with attention to the separate contribution of each planning dimension.

4.4.1 Schedule Management Planning and Project Success

Schedule Management Planning contributes to effective project implementation by establishing the sequence, timing, and coordination of construction activities. The Project Management Institute (2021) explains that planning translates project objectives into procedures and operational arrangements. Görsch et al. (2024) likewise emphasize that project schedules provide visibility over task dependencies and critical paths, helping the project team anticipate delays and coordinate the execution of activities.

In the Rwandan road construction context, scheduling should be considered alongside resource provision and financial planning rather than as an isolated management tool. Daoud et al. (2023) argue that scheduling inefficiencies arise when project plans are not updated in response to implementation conditions. The findings support the importance of adaptive scheduling practices that facilitate appropriate coordination, monitoring, and timely corrective action.

4.4.2 Cost Management Planning and Project Success

Cost Management Planning was particularly important for successful road project implementation, emphasizing the need for realistic cost estimating, timely budgeting,

and continuous expenditure monitoring. Elserougy et al. (2024) found that ineffective cost-control systems can allow financial deviations to remain undetected or unaddressed until project performance has already been affected. Cost forecasting and the timely implementation of corrective measures are therefore essential for effective financial management.

The association between cost planning and project success is also consistent with the project-management framework of the Project Management Institute (2021), which identifies estimating, budgeting, and cost control as closely connected planning processes. Asiedu and Ameyaw (2021) also discuss the financial and institutional pressures associated with construction performance in developing contexts. In road rehabilitation projects, financial planning must be synchronized with procurement, scheduling, and resource allocation to support implementation within the approved budget.

4.4.3 Resource Management Planning and Project Success

Resource Management Planning is important for identifying, acquiring, allocating, and monitoring the personnel, materials, and equipment needed for road project implementation. The Project Management Institute (2021) emphasizes coordination among the resources required for project activities. In addition, Ndahiro and Amolo (2025) highlight resource-mobilization challenges and workforce skills gaps in the construction industry, underscoring the need for careful resource planning.

The findings demonstrate the practical relevance of timely material supply, appropriate equipment allocation, and coordination of labour with the project schedule. Resource availability cannot be separated from cost and schedule management, since deficiencies in one planning component can impede implementation in another. The Theory of Constraints, as discussed by Masoetsa et al. (2022), likewise stresses identifying and managing critical bottlenecks that hinder project progress. Effective resource planning therefore facilitates better utilization and reduces avoidable interruptions.

4.4.4 Risk Management Planning and Project Success

Risk Management Planning supports project success through the identification, assessment, and mitigation of uncertainties that may disrupt road construction and rehabilitation. Kallow et al. (2023) describe systematic risk-management practices as a means of improving decision-making and the likelihood of achieving project objectives. In the road sector, project risk may involve price fluctuations, delayed funding, design changes, adverse weather, procurement constraints, and material shortages.

Risk management should be integrated with schedule, cost, and resource planning rather than treated as a separate administrative requirement. Rwagasana et al. (2019) identify weaknesses in the integration of construction risk management with other project-management processes in Rwanda. Masoetsa et al. (2022) further explain that financial, resource, and scheduling constraints can interact and create cascading implementation challenges. These perspectives support proactive risk planning and continuous monitoring throughout the project cycle.

5. Conclusions and Recommendations

The conclusions and recommendations are based on the reported associations, regression results and hypothesis decisions for the four project planning practices.

5.1 Conclusion

The analysis found that SMP, RMP, CMP and RiMP have considerable relevance to the implementation of road rehabilitation and construction projects in Rwanda. SMP, RMP, CMP and RiMP collectively explained 69.8% variance in successful implementation, with Cost, Risk, Resource, and Schedule Management Planning jointly contributing to the model's explanatory capacity. The remaining 30.2% was not explained by these predictors, suggesting that other project-specific, organizational, or contextual conditions may also be associated with differences for successful implementation of roads rehabilitation and construction projects.

The study concludes that successful implementation of road rehabilitation and construction projects in Rwanda depends on an integrated planning approach that effectively combines cost, risk, resource, and schedule management practices. Despite having all four planning dimensions significantly contributing to the successful implementation of road construction and rehabilitation projects, their relative influence varies, where cost management and risk management represented the high influence on road projects success.

5.2 Recommendations

Based on the study findings, the following recommendations are proposed to improve the planning and successful implementation of road rehabilitation and construction projects in Rwanda.

1. Road project teams should strengthen Risk Management Planning by systematically identifying, assessing, and mitigating implementation risks. Risk registers should be reviewed regularly, and mitigation measures should address funding uncertainties, material-price fluctuations, design changes, adverse weather, and other constraints that may affect project delivery.
2. Resource Management Planning should ensure the timely mobilization and efficient allocation of personnel, construction materials, and equipment. Project managers should prepare resource schedules that correspond with planned activities, monitor resource availability, and address supply and workforce constraints before they interrupt implementation.

3. Schedule Management Planning should be strengthened through realistic activity durations, clear project milestones, regular schedule reviews, and timely corrective action. The planning and monitoring of project schedules should be coordinated with cost, resource, and risk management to reduce implementation delays.
4. RTDA, district authorities, contractors, and supervising consultants should adopt an integrated planning approach that links schedules, budgets, resources, and risk management throughout the project lifecycle. Coordinated reviews and effective communication among stakeholders should support project completion within planned time, cost, and quality requirements.

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