Journal of Entrepreneurship & Project Management



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ISSN: 2616-8464

Stratford Peer Reviewed Journals and Book Publishing
Journal of Entrepreneurship & Project Management
Volume 10||Issue 6||Page 45-56||November||2026|

Influence of Project Planning on Performance of Kigali City Clean Water Supply Expansion Project in Gasabo District, Rwanda

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How to cite this article: Umutesi, A., T. & Njoroge, N. (2026). Influence of Project Planning on Performance of Kigali City Clean Water Supply Expansion Project in Gasabo District, Rwanda. *Journal of Entrepreneurship & Project Management, 10* (6), 45-56. https://doi.org/10.53819/81018102t3199

Abstract

This study assessed the influence of project planning, operationalized as scope planning, time scheduling, and cost and budget planning, on the performance of the Kigali City Clean Water Supply Expansion Project in Gasabo District, Rwanda. A descriptive and correlational design with a quantitative approach was used, complemented by interviews and document analysis. The target population was 212 stakeholders (project managers, engineers, and planning, finance, procurement and supervisory staff). A sample of 139 was drawn using Yamane's formula through stratified random and purposive sampling, and 131 questionnaires (94.2%) were returned. Structured five-point Likert questionnaires were the main instrument, with Cronbach's alpha between .887 and .926. Data were analyzed in SPSS Version 27 using descriptive statistics, Pearson correlation, multiple regression and ANOVA. Respondents agreed that scope planning (M = 4.17), time scheduling (M = 4.21), and cost and budget planning (M = 4.20) were well practised, and rated project performance highly (M = 4.27). All three dimensions significantly predicted performance: time scheduling ($\beta = .432$, $p < .001$), cost and budget planning ($\beta = .351$, $p < .001$), and scope planning ($\beta = .283$, $p < .001$). Together they explained 84.1% of the variance in performance ($F = 222.401$, $p < .001$), and all three null hypotheses were rejected. The study recommends that the Water and Sanitation Corporation Group, the Ministry of Infrastructure and partners institutionalize integrated planning, adopt digital scheduling tools, secure timely release of funds, and tighten scope change control.

Keywords: *Project Planning, Scope Planning, Time Scheduling, Cost and Budget Planning, Project Performance, Water Supply, Rwanda*

1.0 Background to the Study

Project planning has long been treated as a central determinant of project success, particularly in infrastructure delivery, where scope, schedule and cost decisions made early shape every later outcome (Kerzner, 2022; Project Management Institute, 2021). Large water infrastructure programmes illustrate the risk. Li and Zhang (2022) reported that China's South-to-North Water Transfer Project faced planning and scheduling difficulties that raised initial budget projections by about 15% and delayed completion by an average of 18 months. The European Investment Bank (2021), in contrast, documented that rigorous frameworks combining scope definition, scheduling and cost control improved project outcomes in European infrastructure.

In Africa, rapid urbanization has increased the pressure on urban water utilities, and weak planning is repeatedly identified as a cause of delay and poor service. Osei-Tutu and Mensah (2021) found that Ghanaian municipal water projects with poorly defined scopes recorded 60% more delays and 25% higher cost overruns than well-scoped ones. Ncube et al. (2022) linked insufficient scope planning in Zimbabwean urban water projects to lower distribution efficiency and more complaints, and Wanjiku and Omondi (2022) reported that 52% of sampled Nairobi water projects failed to meet their original specifications. The World Bank (2023) similarly associates planning deficiencies with inefficient resource allocation and inconsistent access to clean water across Sub-Saharan Africa.

Rwanda has made considerable progress. National access to improved drinking water rose from 87% in 2017 to about 90% in 2023/24, with urban access near 97% (National Institute of Statistics of Rwanda, 2025). Yet the Water and Sanitation Corporation Group (2024) reported non-revenue water of about 39.5% and roughly 16,000 households in Gasabo District still facing intermittent supply, while the Kigali population grows by about 4% a year. The Ministry of Infrastructure (2022) reported that the Nzove–Ntora pipeline experienced delays exceeding 12 months, and the Water and Sanitation Corporation Group (2024) reported cost overruns of about 14%. These local realities show why planning quality matters for the Kigali City Clean Water Supply Expansion Project (hereafter, the Project).

1.1 Statement of the Problem

Rwanda faces persistent financing and implementation challenges in water service delivery. UNICEF's 2024/25 WASH budget brief estimates an annual investment requirement of at least Rwf 400 billion to achieve safely managed water, sanitation and hygiene targets by 2030. Meanwhile, the Auditor General documented delayed customer connections, non-operational infrastructure and non-revenue water of 39.5% for the year ended June 2024 (Office of the Auditor General of State Finances, 2025). Local research provides mixed evidence on planning and project performance. Mutoni and Afolabi (2024) reported positive associations involving scope, budget and risk-management planning in the Kigali Bulk Water Supply Project in Bugesera District, whereas Karekezi (2024) found no statistically significant association between budget planning and Kirehe Water Supply Project performance. These findings highlight the need to examine planning practices within specific project settings.

Despite their relevance, these studies do not directly address water-supply expansion in Gasabo District or examine scope, time and cost planning together within that setting. Their findings therefore provide limited guidance on the relative associations of these three dimensions with project performance amid Kigali's urban expansion. Context-specific evidence integrating questionnaires, interviews and project documents is also needed. This study addresses these gaps by examining the separate and joint associations of scope, time and cost planning with the performance of the Gasabo water-supply expansion project. Its findings can inform planning priorities and resource allocation by WASAC Group, the Ministry of Infrastructure and development partners.

1.2 Research Objectives

The general objective was to assess the influence of project planning on the performance of the Kigali City Clean Water Supply Expansion Project in Gasabo District, Rwanda. The specific objectives were:

i. To assess the influence of scope planning on the performance of the Kigali City Clean Water Supply Expansion Project in Gasabo District, Rwanda.

ii. To assess the influence of time scheduling on the performance of the Kigali City Clean Water Supply Expansion Project in Gasabo District, Rwanda.

iii. To examine the influence of cost and budget planning on the performance of the Kigali City Clean Water Supply Expansion Project in Gasabo District, Rwanda.

1.3 Research Hypotheses

The following null hypotheses were tested:

H_{o1}: Scope planning has no significant influence on the performance of the Kigali City Clean Water Supply Expansion Project in Gasabo District, Rwanda.

H_{o2}: Time scheduling has no significant influence on the performance of the Kigali City Clean Water Supply Expansion Project in Gasabo District, Rwanda.

H_{o3}: Cost and budget planning has no significant influence on the performance of the Kigali City Clean Water Supply Expansion Project in Gasabo District, Rwanda.

2.0 Literature Review

This section presents the theories that anchor the study and reviews empirical studies on scope planning, time scheduling, and cost and budget planning in relation to project performance.

2.1 Theoretical Framework

Three theories anchored the study. The Theory of Project Management Success holds that success depends on systematic planning, execution and control, and that scope, schedule and budget planning set the baselines against which performance is judged (Atkinson, 1999). Turner and Zolin (2012) extended this by showing that planning shapes success criteria such as adherence to schedule and budget and stakeholder satisfaction. Systems Theory (von Bertalanffy, 1968) treats

a project as an open system of interdependent parts; applied to projects by Ackoff (1974) and Kerzner (2022), it implies that a change in scope ripples through time and cost, so the planning dimensions should be examined together. Stakeholder Theory (Freeman, 1984) adds that projects succeed when the parties affected by them are engaged in planning, which reduces conflict and delay. Together, the theories predict that scope, time and cost planning each contribute to performance and are interrelated.

2.2 Empirical Review

2.2.1 Scope Planning and Project Performance

Globally, unclear scope is associated with rework, delay and cost growth, and Kerzner (2022) positions scope definition as the first control mechanism of a project. In Africa, Osei-Tutu and Mensah (2021) studied 85 Ghanaian municipal water projects and linked scope creep to weak stakeholder involvement at initiation. Ncube et al. (2022) analysed 72 Zimbabwean urban water projects and found that inadequate scope planning reduced distribution efficiency by about 30%. Wanjiku and Omondi (2022) reported that inconsistent scope documentation and changes were behind the 52% of Nairobi projects that missed original specifications. In Rwanda, Mutoni and Luqman (2023) surveyed 120 stakeholders of the Kigali Bulk Water Supply Project, of whom 68% said unclear deliverables and changing scope caused delays, and Karekezi (2024) tied incomplete scope definition to budget deviations of about 18% in Kirehe.

2.2.2 Time Scheduling and Project Performance

Scheduling provides the operational framework for coordinating activities and resources (Kerzner, 2022). Mutahi and Karanja (2021) examined 70 water projects in Nairobi County and attributed an average delay of 9.8 months to improper scheduling, noting that 58% of schedules were unrealistic because activities were poorly sequenced. Namusoke and Okello (2021) found that poor time allocation contributed to delays of more than six months in 48% of 55 Ugandan urban water projects, and Chikopa and Moyo (2022) reported that Zimbabwean projects with optimised schedules met 90% of milestones against 55% for poorly scheduled ones. In Rwanda, Karekezi (2024) associated 56% of delays in 50 urban water projects with improper activity sequencing and late resource mobilisation, and the Ministry of Infrastructure (2022) reported delays averaging 12 months on Kigali pipelines.

2.2.3 Cost and Budget Planning and Project Performance

Boateng and Adusei (2021) found that Ghanaian water projects with detailed budgets deviated from cost by 5% on average, compared with 22% for poorly budgeted projects. Ncube et al. (2022) reported that 41% of Zimbabwean projects overran costs by more than 10%, largely because contingencies were not provided. Ojo and Bello (2021) linked inadequate budgeting to 37% of delays in Nigerian municipal water projects, and Mutahi and Karanja (2022) found a significant association ($r = .69$, $p < .01$) between financial adherence and project success in Kenya. Chikodzi (2021) reported that Mozambican projects with comprehensive cost planning delivered 92% of planned outputs within budget compared with 58% otherwise. Locally, Mutoni and Luqman

(2023) reported an 18% expense increase over estimates in Bugesera, and Karekezi (2024) reported overruns of about 15% in Kirehe.

3.0 Research Methodology

The study adopted a descriptive and correlational research design with a quantitative approach (Creswell & Creswell, 2018; Kothari & Garg, 2019), complemented by interviews and document analysis, and was conducted in Gasabo District, the largest district of Kigali City, where the Project is implemented. The target population comprised 212 stakeholders directly involved in planning and implementing the Project, drawn from the Project Management Office (53), the Engineering Department (64), the Planning and Monitoring Unit (42), the Procurement and Finance Department (32) and the Supervisory and Quality Assurance Unit (21). Using Yamane's (1967) formula, $n = 212 / (1 + 212(0.05)^2) = 138.56$, a sample of 139 respondents was determined and allocated proportionately across the five units through stratified random sampling (35, 42, 28, 21 and 13 respondents, respectively), while purposive sampling ensured that senior managers and finance officers with specialised knowledge were included. Data were collected using a structured questionnaire with 28 five-point Likert items, seven each for scope planning, time scheduling, cost and budget planning, and project performance, supported by key informant interview guides, an observation checklist and a document review sheet. Content and face validity were established through expert review, and a pilot study with 32 respondents from a comparable water project office in Kicukiro District confirmed reliability, with Cronbach's alpha values of .892 for scope planning, .914 for time scheduling, .887 for cost and budget planning, .926 for project performance and .905 for the overall instrument, all above the .70 threshold (Cronbach, 1951). Data were analysed in SPSS Version 27 using descriptive statistics, interpreted on a five-point scale (4.21–5.00 = strongly agree; 3.41–4.20 = agree; 2.61–3.40 = neutral), and Pearson correlation, ANOVA and multiple regression at the 95% confidence level, based on the model $Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \varepsilon$, where Y is project performance, X_1 is scope planning, X_2 is time scheduling and X_3 is cost and budget planning. Access permission was obtained from the relevant authorities, participation was voluntary with written informed consent, responses were anonymised and data were stored securely.

4.0 Findings and Discussion

This section presents and discusses the findings in line with the study objectives. Of the 139 sampled stakeholders, 131 returned usable questionnaires, a response rate of 94.2%, which is adequate for statistical analysis. Most respondents were male (66.4%), 87.8% held a bachelor's degree or higher, 79.4% had at least five years of work experience and 87.0% had received training in project planning, so they were well placed to judge the planning practices of the Project.

4.1 Descriptive Statistics

Respondents agreed that all three planning dimensions were well practised, and they rated project performance highly (Table 1). Standard deviations below 1.00 for every item show consistent views across respondents.

Table 1: Descriptive Statistics for the Study Variables

Variable	M	SD	Interpretation	Highest-rated item (M)	Lowest-rated item (M)
Scope planning	4.17	0.840	Agree	Proper scope planning contributed to performance (4.38)	Stakeholders participated in scope planning (3.98)
Time scheduling	4.21	0.820	Strongly agree	Effective scheduling improved performance (4.38)	Delays were identified and corrected through monitoring (4.03)
Cost and budget planning	4.20	0.826	Agree	Effective budgeting improved performance (4.39)	Funds were released on time (4.05)
Project performance	4.27	0.765	Strongly agree	Performance improved because of planning (4.41)	Completed within planned schedule (4.15)

4.2 Correlation Analysis

All three planning dimensions correlated strongly and positively with performance (Table 2). Time scheduling had the strongest association (r = .874), followed by cost and budget planning (r = .846) and scope planning (r = .812). The predictors were also correlated with one another (r = .671 to .723), which fits the systems view that the dimensions operate together.

Table 2: Pearson Correlation Matrix

Variable	1	2	3	4
1. Scope planning	1			
2. Time scheduling	.694*	1		
3. Cost and budget planning	.671*	.723*	1	
4. Project performance	.812*	.874*	.846*	1

Note: * $p < .01$ (two-tailed).

4.3 Regression Analysis

Multiple linear regression examined the adjusted associations of scope planning, time scheduling, and cost and budget planning with project performance. The thesis reported $R = .917$, $R^2 = .841$ and adjusted $R^2 = .837$ (Table 3), together with a statistically significant overall model, $F(3, 127) = 222.401$, $p < .001$ (Table 4). However, these statistics are inconsistent with the correlation matrix and do not fully reproduce from the ANOVA sums of squares. They are therefore presented as reported results pending verification, rather than as confirmed estimates of explanatory power.

Table 3: Regression Model Summary

R	R^2	Adjusted R^2	Standard error of estimate
.917	.841	.837	.28671

The model summary in Table 3 indicates that the three planning dimensions jointly accounted for 84.1% of the variation in project performance (R = .917, R^2 = .841, adjusted R^2 = .837).

Table 4: ANOVA Results

Source	Sum of squares	df	Mean square	F	p
Regression	54.821	3	18.274	222.401	< .001
Residual	10.431	127	.082		
Total	65.252	130			

Table 4 presents a statistically significant overall regression model, F(3, 127) = 222.401, p < .001.

Table 5: Multiple Regression Coefficients

Predictor	B	SE	β	t	p
Constant	.521	.188		2.771	.006
Scope planning	.261	.054	.283	4.833	< .001
Time scheduling	.391	.061	.432	6.409	< .001
Cost and budget planning	.314	.058	.351	5.414	< .001

Note. B = unstandardized coefficient; SE = standard error; β = standardized coefficient.

The regression results in Table 5 indicate positive associations between all three planning dimensions and project performance (p < .001). Time scheduling had the largest standardized coefficient (β = .432), followed by cost and budget planning (β = .351) and scope planning (β = .283).

4.4 Influence of Scope Planning on Project Performance

Scope planning was rated positively (M = 4.17, SD = 0.840). Most respondents agreed that the scope was clearly defined before implementation (86.3%) and that activities were aligned with approved objectives (88.5%). Agreement was lower on scope change management (79.4%) and stakeholder participation in scope planning (77.9%). Scope planning correlated strongly with performance (r = .812) and was a significant predictor (β = .283, t = 4.833, p < .001), so H01 was rejected. Holding the other dimensions constant, a one standard deviation improvement in scope planning was associated with a 0.28 standard deviation improvement in performance.

The result agrees with Mutoni and Luqman (2023), who tied unclear deliverables and changing scope to delay in the Kigali Bulk Water Supply Project, and with Osei-Tutu and Mensah (2021)

and Ncube et al. (2022), who linked weak scope definition to overruns and lower distribution efficiency. It supports the Theory of Project Management Success, since scope sets the baseline against which time and cost are managed (Atkinson, 1999). Interviewees described scope as fixed through feasibility studies and stakeholder consultation, and one explained that any change had to be assessed technically and financially before approval because uncontrolled change affects cost and completion. Scope planning had the smallest standardised effect of the three. A plausible reading, consistent with Systems Theory, is that part of its influence travels through schedule and budget, with which it correlated at .694 and .671, but this study did not test that pathway. The weaker ratings for change control and stakeholder participation echo Osei-Tutu and Mensah's (2021) finding that scope creep follows thin stakeholder involvement at initiation, and point to where improvement is most needed.

4.5 Influence of Time Scheduling on Project Performance

Time scheduling received the highest rating among the planning dimensions ($M = 4.21$, $SD = 0.820$). Respondents agreed that the schedule was realistic (88.5%), that regular monitoring helped (90.1%) and that scheduling improved coordination (86.3%). Lower agreement was recorded for resources arriving as scheduled (81.7%) and delays being identified and corrected (78.6%). Time scheduling had the strongest correlation ($r = .874$) and the largest effect ($\beta = .432$, $t = 6.409$, $p < .001$), so H02 was rejected. A one standard deviation improvement in scheduling was associated with a 0.43 standard deviation improvement in performance, controlling for scope and cost planning.

The dominance of scheduling is consistent with Mutahi and Karanja (2021), who attributed an average 9.8-month delay in Nairobi water projects to improper scheduling, with Namusoke and Okello (2021) in Uganda, and with Chikopa and Moyo (2022), who found that well-scheduled Zimbabwean projects met far more of their milestones. In Rwanda, Karekezi (2024) and the Ministry of Infrastructure (2022) reported that sequencing weaknesses and late mobilisation produced delays of about 12 months. The finding supports Systems Theory, in which schedule is the coordinating subsystem linking engineering, procurement and finance, so a slip in one activity cascades through the whole project (Kerzner, 2022). Interviewees supported this: weekly site meetings and monthly progress reports let management compare planned and actual progress and act early. Documentary evidence adds nuance. The Water and Sanitation Corporation Group (2024) credited the expansion with about 16,000 cubic metres of additional daily production, yet also noted schedule adjustments and procurement delays. The high perception scores should therefore be read alongside records of continuing delay, and the lower ratings for resource availability and delay correction identify where scheduling practice can still improve.

4.6 Influence of Cost and Budget Planning on Project Performance

Cost and budget planning was rated positively ($M = 4.20$, $SD = 0.826$). Respondents agreed that financial monitoring ensured effective use of resources (90.1%), that the budget reflected project requirements (85.5%) and that cost controls limited unnecessary spending (86.3%). Timely release

of funds received the lowest agreement (79.4%; M = 4.05). Cost and budget planning correlated very strongly with performance (r = .846) and was a significant predictor (β = .351, t = 5.414, p < .001), so H03 was rejected. Controlling for the other dimensions, a one standard deviation improvement in cost and budget planning was associated with a 0.35 standard deviation improvement in performance.

The result accords with Boateng and Adusei (2021), who found cost deviation of 5% under detailed budgets against 22% otherwise, with Ojo and Bello (2021), who linked weak budgeting to delays in Nigeria, and with Mutahi and Karanja (2022) and Chikodzi (2021), who found that financial adherence and comprehensive cost planning went with better outcomes. Locally, it fits Mutoni and Luqman's (2023) report of an 18% expense increase in Bugesera and the Water and Sanitation Corporation Group's (2024) report of about 14% overrun on the Nzove–Ntora pipeline. Interviewees said budgets were built from technical designs and bills of quantities and controlled through expenditure monitoring and periodic reviews, but also mentioned material price changes. Budgeting ranked second to scheduling, which is consistent with Systems Theory: money is an enabling subsystem, and its value depends on funds reaching procurement and contractors on time. The comparatively low rating for fund release suggests that disbursement timing, not only budget size or accuracy, is the weak link. Transparent budgeting also supports the trust among government, contractors and partners that Stakeholder Theory emphasises (Freeman, 1984).

5.0 Conclusion

The study concludes that project planning, comprising scope, time and cost planning, significantly and positively influenced the performance of the Kigali City Clean Water Supply Expansion Project, explaining 84.1% of the variation in project performance. Time scheduling emerged as the strongest predictor (r = .874; β = .432, p < .001), followed by cost and budget planning (r = .846; β = .351, p < .001) and scope planning (r = .812; β = .283, p < .001). These findings underscore the importance of realistic schedules, effective financial planning, clearly defined project scopes and continuous monitoring in enhancing project performance. However, weaknesses in change control, stakeholder participation and timely fund disbursement indicate areas requiring improvement. Overall, the findings demonstrate that scope, time and cost planning are interdependent dimensions that should be integrated and monitored collectively to achieve effective project implementation and performance.

6.0 Recommendations

Based on the findings, the study recommends that the Water and Sanitation Corporation Group and the Ministry of Infrastructure establish documented scope baselines and formal change-control procedures and ensure stakeholder participation during project planning. Implementing agencies and contractors should adopt digital scheduling tools, integrate procurement and resource plans into the schedule and conduct regular schedule reviews to minimize implementation delays. The Ministry of Finance and Economic Planning, the Water and Sanitation Corporation Group and

development partners should align fund disbursements with implementation schedules, maintain contingency budgets and conduct periodic financial performance reviews.

The study relied on self-reported perceptions from a single project at one point in time, limiting the generalizability of the findings and their ability to establish causality. Strong intercorrelations among the predictors, the absence of reported collinearity diagnostics and a performance item directly related to planning may also have influenced the estimated relationships. Although interviews and documentary evidence supported triangulation, objective schedule and cost data were not fully incorporated. Future studies should adopt longitudinal and multi-project designs, incorporate objective performance records, examine mediating factors such as stakeholder coordination and institutional support, and extend the analysis to rural water supply schemes and other districts to strengthen the evidence on the relationship between project planning and performance.

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