JRIIE Journal of Research Innovation and Implications in Education
Center for Research Implications & Practice

Website: www.jriiejournal.com ISSN 2520-7504 (Online) Vol.10, Iss.3, 2026 (pp. 3125 - 3132)

Effect of Project Resource Management Practices on the Success of the Rwanda Urban Development Project II in Kigali

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Abstract: *Urban infrastructure delivery in developing economies continues to struggle with schedule slippage, cost escalation, and uneven use of available resources. This study examined how project resource management practices shape the success of the Rwanda Urban Development Project II (RUDP II) in Kigali, with attention to the human, financial, material, and technological dimensions of resource management. Guided by the resource based view, human capital theory, systems theory, and contingency theory, the study adopted a mixed methods design that combined descriptive and correlational approaches. A census of 214 project personnel, including project managers, engineers, procurement officers, finance staff, and information and communication technology specialists, took part through structured questionnaires and key informant interviews. Quantitative data were analysed in SPSS using descriptive statistics, Pearson correlation, and multiple linear regression, while interview material was analysed thematically. Respondents reported a high perceived level of project success (overall mean 4.72 on a five point scale). All four resource dimensions correlated positively and significantly with project success: technological ($r = 0.847$), human ($r = 0.841$), material ($r = 0.841$), and financial ($r = 0.723$) resource management, each significant at the one percent level. The regression model explained about 79 percent of the variance in project success ($R^2 = 0.792$; $F = 199.141$, $p < 0.001$). Technological resource management was the strongest predictor ($\beta = 0.301$), followed by human ($\beta = 0.274$), material ($\beta = 0.264$), and financial ($\beta = 0.117$) resource management. The findings indicate that project success in RUDP II rests less on any single resource and more on the coordinated management of all four. The study recommends sustained investment in project technologies, continuous staff development, stronger financial and procurement systems, and an integrated approach to resource planning.*

Keywords: *Project resource management; Project success; Urban development; Human resource management; Technological resource management; Rwanda*

How to cite this work (APA):

Muhimpundu, F. & Dushimimana, J. D. (2026). Effect of Project Resource Management Practices on the Success of the Rwanda Urban Development Project II in Kigali. *Journal of Research Innovation and Implications in Education, 10*(3), 3125 – 3132. **https://doi.org/10.59765/nfe86w**

1. Introduction

Over the past two decades, the way development projects are planned and delivered has changed considerably. As projects have grown in scale and complexity, so too has the recognition that the disciplined management of resources is central to whether they succeed. Project resource management, understood here as the systematic planning, allocation, and utilisation of human, financial, material, and technological resources, has become a defining concern for organisations that wish to control costs, keep to schedule, and deliver quality (Project Management Institute, 2023). Many organisations have moved away from intuitive, ad hoc resource allocation toward more structured, data informed frameworks intended to reduce waste and strengthen delivery outcomes.

Evidence from high income economies illustrates the point. Countries such as the United States, Canada, Germany, and Australia have built resource management systems that integrate digital tools for forecasting, risk monitoring, supply chain coordination, and workforce planning. According to the PMI Pulse of the Profession report, organisations that apply structured resource management practices record fewer schedule delays and better budget performance than those with weaker planning systems (Project Management Institute, 2024). Comparable patterns appear across Europe and parts of Asia, where integrated resource planning has been linked to lower project risk and shorter execution timelines in urban renewal and infrastructure programmes.

The picture in Sub Saharan Africa is more mixed. Demand for urban infrastructure has surged with rapid population growth and urbanisation, yet inadequate resource planning, budget constraints, limited project management skills, and procurement inefficiencies continue to undermine delivery. The African Development Bank has reported that a large share of infrastructure projects in the region face delays or cost overruns, driven mainly by insufficient human capacity, weak financial management, and poor coordination of material supply chains (African Development Bank, 2023). Within the East African Community, ineffective coordination of materials, inadequate budgeting, and limited human resource capacity account for a substantial part of the gap between planned and actual project outcomes (World Bank, 2023).

In Rwanda, infrastructure development remains a national priority under Vision 2050 and the National Strategy for Transformation. The country has expanded investment in roads, drainage, housing, and urban upgrading in pursuit of inclusive and climate resilient urbanisation. The Rwanda Urban Development Project II (RUDP II), financed largely by the World Bank and the Government of Rwanda, is one of the largest ongoing urban resilience initiatives, implemented in Kigali and secondary cities. Despite Rwanda's adoption of structured project management approaches, implementation reports point to recurring difficulties in timely resource mobilisation, the availability of skilled technical personnel, budget adequacy, procurement timing, and material supply (Ministry of Infrastructure, 2024). These realities make RUDP II a useful setting in which to examine how resource management practices relate to project success.

Against this background, the present study assessed the effect of project resource management practices on the success of RUDP II in Kigali. It sought to provide evidence that project managers, policymakers, and development partners can use to strengthen implementation and improve performance in urban development programmes.

1.1 Problem Statement

Development projects are expected to be completed on time, within budget, and to the required quality, while delivering their intended socio economic benefits. In practice, infrastructure delivery in Rwanda continues to face resource management challenges that constrain success. Although the country has strong development frameworks, monitoring and evaluation reports repeatedly note delayed procurement, shortages of skilled technical staff, weak institutional coordination, and uneven financing flows (Ministry of Infrastructure, 2023; Ministry of Finance and Economic Planning, 2022). Implementation status reporting indicates that several RUDP II components experienced delays, attributed to slow fund disbursement, inconsistent material availability, and limited contractor capacity (World Bank, 2024). Rapid urbanisation in Kigali has added further pressure through sharp increases in the price of key materials such as cement and steel.

Empirical work in Rwanda has documented parts of this problem. Studies have shown that weak financial planning and delayed disbursement contribute to implementation delays in donor funded road projects, that material shortages and procurement delays account for a large share of interruptions in urban upgrading, and that gaps in technical competence lead to rework and quality problems in public works (Uwimana, 2022; Niyonzima & Byiringiro, 2021; Mukandayisaba, 2020). Yet three gaps remain. First, few studies examine the direct relationship between resource management and success within complex urban development programmes. Second, few consider the four resource dimensions together, or how their combined effectiveness shapes outcomes. Third, there is little project specific evidence on resource management within RUDP II itself, despite its scale and strategic importance. This study addressed these gaps by assessing how human, financial, material, and technological resource management practices influence timeliness, cost efficiency, quality, and stakeholder satisfaction in RUDP II.

1.2 Objectives and Hypotheses

The general objective was to assess the effect of project resource management practices on the success of RUDP II in Kigali. The specific objectives were to examine the effect of human resource management, to evaluate the effect of financial resource management, to analyse the effect of material resource management, and to assess the effect of technological resource management on project success. The study tested four null hypotheses, each stating that the resource dimension in question has no significant effect on the success of RUDP II in Kigali.

2. Literature Review

2.1 Theoretical Framework

The study drew on four complementary theories. The **resource based view**, associated with Barney, holds that sustained performance stems from an organisation's ability to acquire and deploy resources that are valuable, rare, difficult to imitate, and hard to substitute. Applied to RUDP II, it implies that the efficient management of human, financial, material, and technological resources is central to timely, cost effective, and high quality delivery. **Human capital theory**, developed by Becker, emphasises that investment in the knowledge, skills, and competencies of staff raises productivity and performance, which supports the study's attention to recruitment, training, motivation, and appraisal. **Systems theory**, associated with von Bertalanffy, views a project as a set of interdependent subsystems, so that weakness in one resource area can disrupt the whole, which motivates an integrated reading of all four dimensions. Finally, **contingency theory**, in the tradition of Fiedler, argues that there is no single best approach to management and that effectiveness depends on situational factors such as regulatory conditions, supply chain circumstances, and urban growth pressures. Together these theories frame resource management as a matter of internal capability, workforce quality, interdependence, and context sensitive adaptation.

2.2 Empirical Review

A consistent body of evidence links each resource dimension to project performance. On human resources, studies in project based construction settings report that training, teamwork, and motivation are closely associated with better delivery and higher stakeholder satisfaction (Uwase et al., 2024). On financial resources, timely release of funds, realistic budgeting, transparent reporting, and effective monitoring have been shown to reduce overruns and support continuity (Musoni & Nkurunziza, 2023; Habimana, 2024). On material resources, availability, procurement efficiency, and inventory control strongly influence delays and cost outcomes, particularly in construction (Mbabazi et al., 2022; Uwimana et al., 2024). On technology, modern project management tools, reliable information systems, and well maintained equipment have been associated with improved workflow, more accurate reporting, and better decision making (Nsengiyumva & Niyonsenga, 2023; Musabyimana, 2024).

Although this literature is broadly consistent, much of it treats the resource dimensions in isolation, focuses on road construction or education projects rather than multi component urban programmes, or draws on contexts outside Rwanda. Few studies examine all four dimensions simultaneously within a single large scale national programme, and fewer still connect them to a full set of success indicators. This study addresses that gap by analysing the four dimensions together in the specific setting of RUDP II.

2.3 Conceptual Framework

The study conceptualised project resource management as the independent variable, comprising four dimensions: human resource management (recruitment, training, appraisal, motivation, and leadership), financial resource management (budgeting, allocation, planning, and expenditure monitoring), material resource management (procurement, storage, utilisation, and maintenance), and technological resource management (use and upkeep of tools, equipment, and systems). Project success, the dependent variable, was measured through timeliness, cost efficiency, quality of deliverables, and stakeholder satisfaction. The framework proposes that effective management of each dimension improves success directly, while systems theory suggests that the dimensions also reinforce one another, and contingency theory implies that their effectiveness varies with context.

3. Methodology

The study used a mixed methods design that combined descriptive and correlational approaches. The descriptive component documented how resource management is practised within RUDP II, while the correlational component examined the relationships between the four resource dimensions and project success. Combining quantitative and qualitative evidence allowed measurable patterns to be interpreted alongside the practical experience of project personnel.

The target population comprised 214 professionals directly involved in planning, coordinating, implementing, and overseeing RUDP II in the City of Kigali. These included project managers and coordinators, engineers and site supervisors, procurement and logistics officers, finance and accounting staff, information and communication technology and monitoring personnel, district engineers from Gasabo, Kicukiro, and Nyarugenge, and representatives of the Local Administrative Entities Development Agency and the City of Kigali. Because the population was manageable and accessible, a census was used, so that all 214 individuals were invited to participate rather than a sample. A census reduces sampling error and captures the views of every professional category involved in managing project resources.

Primary data were collected through structured questionnaires and key informant interviews. The questionnaire used five point Likert scale items organised into sections covering demographics and each of the four resource dimensions, together with project success indicators. Key informant interviews with senior project managers, district engineers, agency officials, and monitoring specialists provided qualitative depth and helped to explain the patterns observed in the quantitative

data. Secondary data were drawn from project progress reports, financial statements, procurement records, and related documentation, and were used to triangulate and validate the primary evidence.

Content validity was established by expert review of the instruments, and reliability was assessed using Cronbach's alpha, which returned a coefficient of 0.882 across 21 items, comfortably above the conventional threshold of 0.70 and indicating strong internal consistency. Quantitative data were analysed in SPSS version 23 using descriptive statistics, Pearson correlation, and multiple linear regression. The regression model took the form $Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \varepsilon$, where Y is project success and X_1 to X_4 are human, financial, material, and technological resource management respectively. Qualitative data were analysed thematically. Participation was voluntary and informed, responses were treated confidentially and used only for academic purposes, and no personal identifiers were recorded.

4. Results and Discussion

4.1 Response Rate and Respondent Profile

All 214 targeted respondents took part, giving a complete response rate that strengthens the reliability of the findings. Respondents were spread fairly evenly across age groups, with the largest share aged 41 to 50 years (32.2 percent). Men made up 62.1 percent and women 37.9 percent. Most respondents were well qualified: 56.5 percent held a bachelor's degree, 30.8 percent a diploma or certificate, 9.8 percent a master's degree, and 2.8 percent a doctorate. The engineering and technical team formed the largest occupational group (22.4 percent), followed by project coordination and management staff (19.6 percent) and agency and city representatives (16.8 percent). This spread across functions means the study captured perspectives from every part of the resource management chain.

Table 1. Reliability statistics

Cronbach's Alpha	Number of Items
0.882	21

Source: Field data (2026)

4.2 Descriptive Findings on the Study Variables

Perceptions of all four resource dimensions were high and consistent. Human resource management recorded an overall mean of 4.63, with teamwork, staff motivation, and the availability of skilled personnel rated most highly, and training and role clarity slightly lower. Financial resource management scored an overall mean of 4.74, reflecting confidence in timely disbursement, transparent reporting, and effective cost monitoring. Material resource management recorded an overall mean of 4.72, with timely delivery, material quality, and minimal disruption from shortages standing out. Technological resource management scored an overall mean of 4.73, driven by the perceived contribution of modern tools, reliable information systems, and well maintained equipment. Project success itself recorded an overall mean of 4.72, with strong ratings for schedule adherence, budget performance, quality of works, stakeholder satisfaction, and goal attainment. The consistently high means and low standard deviations indicate that positive perceptions were widely shared.

Table 2. Summary of descriptive statistics for the study variables

Variable	N	Overall Mean	Std. Deviation
Human resource management	214	4.626	0.617
Financial resource management	214	4.736	0.537
Material resource management	214	4.723	0.507
Technological resource management	214	4.735	0.485
Project success	**214**	**4.722**	**0.511**

Source: Field data (2026)

4.3 Correlation Analysis

Pearson correlation showed strong, positive, and statistically significant relationships between each resource

dimension and project success at the one percent level. Technological resource management was most strongly associated with success (r = 0.847), followed closely by human resource management (r = 0.841) and material resource management (r = 0.841), and then financial resource management (r = 0.723). The composite measure of resource management practices correlated very strongly with success (r = 0.877). These results indicate that improvements in any resource dimension tend to accompany better project outcomes, with technology, human resources, and materials showing the closest links.

Table 3. Correlations between resource management dimensions and project success

Resource dimension	r with success	Sig. (2-tailed)
Human resource management	0.841**	0.000
Financial resource management	0.723**	0.000
Material resource management	0.841**	0.000
Technological resource management	0.847**	0.000
Composite resource management	0.877**	0.000

*Note: ** Correlation is significant at the 0.01 level (2-tailed). Source: Field data (2026)*

4.4 Regression Analysis

Multiple linear regression tested the combined and individual effects of the four dimensions on project success. The model fitted the data well, with R = 0.890 and $R^2 = 0.792$, meaning that approximately 79.2 percent of the variance in project success is explained by the four predictors. The adjusted R^2 of 0.788 confirms the model's robustness, and the Durbin Watson statistic of 1.960 indicates no serious autocorrelation. The analysis of variance was significant (F = 199.141, $p < 0.001$), confirming that the predictors jointly have a meaningful effect on project success.

Table 4. Model summary

R	R Square	Adjusted R^2	Std. Error	Durbin-Watson
0.890	0.792	0.788	3.154	1.960

Source: Field data (2026)

Table 5. Analysis of variance (ANOVA)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	7926.305	4	1981.576	199.141	0.000
Residual	2079.681	209	9.951		
Total	10005.986	213			

Note: Dependent variable is project success; predictors are the four resource dimensions. Source: Field data (2026)

The coefficients show that all four dimensions had positive and statistically significant effects on project success. Technological resource management was the strongest predictor ($\beta = 0.301$, $p = 0.002$), followed by human resource management ($\beta = 0.274$, $p < 0.001$), material resource management ($\beta = 0.264$, $p < 0.001$), and financial resource management ($\beta = 0.117$, $p = 0.001$). Collinearity diagnostics were within acceptable limits, with tolerance values above 0.19 and variance inflation factors below the conventional ceiling of 10, indicating that multicollinearity did not distort the estimates. On this evidence, all four null hypotheses were rejected.

Table 6. Regression coefficients

Predictor	B	Std. Error	Beta	Sig.
(Constant)	6.478	2.555		0.002
Human resource management	1.033	0.263	0.274	0.000
Financial resource management	0.440	0.183	0.117	0.001
Material resource management	1.090	0.289	0.264	0.000
Technological resource management	1.097	0.259	0.301	0.002

Note: Dependent variable is project success. Source: Field data (2026)

4.5 Qualitative Findings

Interview accounts reinforced the quantitative results. Participants credited strong teamwork and skilled staff with keeping delivery on track, and described a supportive environment that sustained commitment. On finance, respondents noted that funds were generally released on time, that budgeting was realistic, and that reporting and monitoring built trust and helped contain spending. On materials, they pointed to reliable delivery and quality control. On technology, they highlighted faster planning and execution, more accurate data for decisions, and fewer delays and reworks. Project records added factual weight: RUDP II operated on an estimated budget of about USD 205 million, financed mainly by the World Bank and the Government of Rwanda, and most infrastructure works were reported as delivered within the planned timeline, with only limited extensions for specific components.

4.6 Discussion

The results show that project resource management is strongly and positively associated with the success of RUDP II, and that the four dimensions together explain the large majority of the variation in perceived success. This is consistent with the resource based view, which treats the effective deployment of internal resources as the foundation of performance, and with systems theory, which anticipates that the dimensions reinforce one another rather than acting in isolation.

Technological resource management emerged as the strongest predictor, which reflects the growing role of digital tools, information systems, and well maintained equipment in coordinating complex urban works, supporting real time monitoring, and improving the accuracy of reporting and decision making. This aligns with recent Rwandan evidence that modern project technologies improve workflow efficiency and reduce delays (Nsengiyumva & Niyonsenga, 2023). Human resource management was the second strongest predictor, underlining that competent, motivated, and well coordinated staff remain decisive for implementation quality, in line with human capital theory and with prior findings on training and teamwork (Uwase et al., 2024). Material resource management also contributed significantly, confirming that timely procurement, quality control, and inventory management protect both schedule and standards.

Financial resource management, while positive and significant, had the smallest standardised effect. This does not mean finance is unimportant. Rather, it suggests that in a project with relatively strong disbursement and reporting systems, the marginal contribution of further financial improvement is smaller than that of technology, people, or materials, and that financial resources exert much of their influence by enabling the other dimensions to function. Read through contingency theory, the ordering of effects is itself context dependent: in a setting where financing is comparatively stable, attention shifts to the resources that remain binding constraints. The central message is that success in RUDP II is not the product of any single dimension but of their coordinated management.

5. Conclusion and Recommendations

5.1 Conclusion

This study set out to assess the effect of project resource management practices on the success of RUDP II in Kigali. The evidence is clear: human, financial, material, and technological resource management each have a positive and significant effect on project success, and together they account for close to four fifths of the variation in perceived success. Technological and human resources were the most influential, followed by material resources, with financial resources significant but comparatively smaller in marginal effect. Project success is best understood as the outcome of an integrated approach in which the four dimensions are managed in concert.

5.2 Recommendations

Based on the findings of the study, several recommendations were made;

1. First, stakeholders should sustain investment in project management technologies, including geographic information systems and integrated project management software, and ensure regular upgrades and technical support.

2. Second, continuous professional development should be institutionalised, combining technical training, leadership development, and motivation strategies to retain and strengthen skilled staff.

3. Third, financial systems should be reinforced through timely budget approval, efficient disbursement, and robust monitoring, supported where possible by digital financial management tools.

4. Fourth, procurement should be made more efficient through better planning, supplier evaluation, and inventory management. Fifth, project managers should adopt a holistic approach that aligns human skills, financial resources, material availability, and technology with project objectives and timelines.

5. Future research could adopt longitudinal designs, compare resource management across sectors, and examine how leadership, governance, and emerging technologies such as data analytics further shape project outcomes.

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