

The Effect of Project Management Practices on Performance of Dry Construction and Green Building Projects in Rwanda: A Case Study of Kibagabaga Residential Gezana Apartment

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Abstract: Construction projects in Rwanda, including dry construction and green building initiatives, continue to face schedule delays, cost pressures, and sustainability challenges. This study examined the influence of planning performance, measurement performance, and uncertainty management on project performance at Kibagabaga Residential Gezana Apartment in Kigali City. A quantitative, descriptive and explanatory research design was adopted. Data were collected through a structured five-point Likert-scale questionnaire from 70 project managers, engineers, quantity surveyors and contractors, with all 70 responses valid. Data were analysed using descriptive statistics, Cronbach's Alpha, Pearson correlation, one-way ANOVA and regression analysis in SPSS. Planning performance significantly influenced time performance ($B = 0.794$, $R^2 = 0.164$, $p = 0.0008$), while measurement performance significantly influenced cost efficiency ($B = 0.948$, $R^2 = 0.197$, $p = 0.0002$). Uncertainty management significantly influenced sustainability outcomes ($B = 0.915$, $R^2 = 0.450$, $p < 0.0001$). The three project management performance domains jointly explained 55.8% of the variance in overall project performance. In the combined model, measurement performance ($B = 0.424$, $p = 0.0109$) and uncertainty management ($B = 0.562$, $p < 0.0001$) were significant positive predictors, whereas planning performance was not statistically significant after controlling for the other predictors ($B = -0.179$, $p = 0.2207$). The findings indicate that integrated performance measurement and proactive uncertainty management are important for improving project outcomes in dry construction and green building projects in Rwanda. The study provides empirical evidence from a Rwandan construction context and identifies practical implications for project managers, engineers, quantity surveyors, contractors and institutions concerned with sustainable construction delivery.

Keywords: Project Management Practices; Planning Performance; Measurement Performance; Uncertainty Management; Project Performance; Dry Construction; Green Building; Rwanda.

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I. INTRODUCTION

Construction is an important contributor to socioeconomic development through the provision of housing, infrastructure, employment and related economic activity. In rapidly urbanising contexts such as Rwanda, increasing demand for housing and infrastructure creates pressure for construction projects to be delivered efficiently, economically and sustainably. Conventional wet construction remains widely used, but its intensive use of water-based materials, labour and site activities can contribute to longer schedules, material waste and

environmental impacts. Dry construction and green building approaches have consequently attracted attention as alternatives that can improve resource efficiency and environmental performance (Akinsulire et al., 2024; Almusaed et al., 2024).

Dry construction involves the use of prefabricated or lightweight components, such as gypsum boards, light steel systems and modular assemblies, which can reduce dependence on wet trades and facilitate faster installation. Green building, meanwhile, seeks to reduce environmental impacts and improve resource efficiency through measures

such as energy-efficient systems, responsible material selection, water efficiency and waste reduction. However, the technical adoption of these approaches does not by itself guarantee successful project delivery. Effective project management remains necessary to coordinate scope, resources, schedules, measurement, risks and stakeholder requirements.

Project performance is commonly reflected in dimensions such as time, cost, quality and sustainability. Performance measurement provides mechanisms for tracking progress and identifying deviations, while uncertainty management supports the identification, assessment and response to events that may affect project outcomes. Recent construction research has highlighted the importance of project-level performance measurement and integrated risk management in improving delivery outcomes (Ibrahim et al., 2024; Rukundo et al., 2022). In Rwanda, project management maturity and construction performance remain important areas for empirical investigation, particularly in projects incorporating modern and sustainable construction technologies (Rugambwa et al., 2025).

Despite growing interest in sustainable construction, there is limited empirical evidence on how specific project management performance domains influence dry construction and green building project performance in Rwanda. The present study therefore examines planning performance, measurement performance and uncertainty management and their relationships with time performance, cost efficiency and sustainability outcomes at Kibagabaga Residential Gezana Apartment in Kigali City.

The study had four objectives: (1) to analyse the influence of planning performance on time performance in dry construction projects; (2) to evaluate the effect of measurement performance on cost efficiency; (3) to assess how uncertainty management influences sustainability outcomes in green building projects; and (4) to determine the overall relationship between project management performance domains and construction project performance.

II. LITERATURE REVIEW

➤ *Project Management Practices and Construction Performance*

Project management practices provide the processes through which construction activities are planned, coordinated, monitored and controlled. Planning establishes project objectives, schedules, resources and anticipated risks. Measurement performance provides evidence about actual progress and deviations, while uncertainty management enables project teams to respond to changing conditions. In construction, the interaction among these practices is important because time, cost, quality and sustainability outcomes are interdependent.

Evidence from construction and infrastructure studies indicates that poor planning can contribute to delays and cost pressures, while systematic monitoring and evaluation

can improve project control. Rukundo et al. (2022), for example, examined monitoring and evaluation in Rwandan construction projects and linked monitoring practices with project performance. More broadly, construction performance measurement has been identified as an important project-level management function (Ibrahim et al., 2024).

➤ *Planning Performance and Time Performance*

Planning performance includes defining objectives, developing realistic schedules, allocating resources, identifying risks and involving stakeholders before and during implementation. Effective planning can provide a basis for sequencing activities and coordinating resources. Poor planning may lead to rework, inefficient resource deployment, changes and delays. Studies on construction planning similarly emphasise the relationship between planning quality, project duration and cost performance (SLAEAT & FATIMAH, 2024; Cyubahiro et al., 2025).

In the present study, planning performance was measured through indicators covering project objectives, schedule realism, resource allocation, risk identification, cost estimating, stakeholder participation, sustainability integration and the use of planning tools such as Gantt charts and work breakdown structures.

➤ *Measurement Performance and Cost Efficiency*

Measurement performance concerns continuous monitoring of project progress against established indicators and plans. It includes the use of key performance indicators, periodic reporting, identification of deviations, corrective action, digital monitoring and information-based decision-making. Effective measurement can provide early warning of cost and schedule deviations and support corrective action before deviations become difficult to control. Construction performance measurement research emphasises the value of systematic indicators and project-level monitoring for decision-making (Ibrahim et al., 2024).

For this study, cost efficiency was operationalised primarily through the ability to complete the project within the approved budget, alongside the broader project-performance construct.

➤ *Uncertainty Management and Sustainability Outcomes*

Construction projects operate under uncertainty arising from supply conditions, financial pressures, environmental conditions, design changes, regulatory requirements and stakeholder coordination. Uncertainty management therefore involves continuous risk identification, mitigation planning, adaptive responses and monitoring of emerging conditions. Risk response research suggests that complex projects require structured approaches that recognise relationships among risks and enable timely responses (Yang et al., 2021).

Sustainability outcomes in the present study were associated with achievement of sustainability goals and implementation of green-building principles. Rwanda's growing emphasis on green technologies and sustainable

construction provides a relevant context for examining the management processes that support these outcomes (Ntawuhongerumwanzi et al., 2025).

➤ *Research Gap and Conceptual Focus*

Existing literature provides evidence that planning, measurement and risk management can influence construction performance, but the Rwandan evidence base remains comparatively limited, particularly for projects combining dry construction and green-building features. The study addresses this gap by empirically examining three project management performance domains within one Rwandan residential development. The conceptual focus links planning performance to time performance, measurement performance to cost efficiency, and uncertainty management to sustainability outcomes, while also testing their combined relationship with overall project performance.

III. RESEARCH APPROACH

➤ *Research Design AND Study Context*

The study adopted a quantitative, descriptive and explanatory research design. The design was selected to quantify respondents' perceptions of project management practices and statistically test relationships between the independent and dependent variables. The case study was Kibagabaga Residential Gezana Apartment in Kigali City. The dissertation describes the development as a G+2 residential project owned/developed by HOMNA Ltd and incorporating gypsum-based dry interior systems, LED lighting, efficient plumbing and water-management measures including rainwater management/harvesting and soak-away provisions.

➤ *Population, Sampling and Data Collection*

The target population comprised construction professionals directly involved in planning, execution and supervision of the case study project, including project managers, engineers, quantity surveyors and contractors. Although the calculated minimum sample was 60, questionnaires were administered to the full accessible

population of 70 professionals. All 70 questionnaires were valid and returned, producing a 100% response rate.

A structured self-administered questionnaire was used. Items were measured on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The instrument covered planning performance, measurement performance, uncertainty management and project performance. Ethical procedures included voluntary participation, informed consent and confidentiality.

➤ *Variables and Analytical Procedures*

Planning performance, measurement performance and uncertainty management were treated as independent variables. Project performance was the overall dependent construct, with time performance, cost efficiency and sustainability outcomes represented within the performance measures. Data were analysed in SPSS using descriptive statistics, Cronbach's Alpha, Pearson correlation, one-way ANOVA and simple and multiple linear regression.

The simple regression models tested the first three hypotheses. A multiple regression model was then used to estimate the combined influence of the three project management performance domains on overall project performance. Statistical significance was evaluated using $p < 0.05$.

IV. RESULTS

➤ *Respondent Response and Reliability*

All 70 administered questionnaires were valid, producing a 100% response rate. Internal consistency was assessed using Cronbach's Alpha. The four constructs recorded coefficients above the generally accepted range reported in the dissertation, with values ranging from 0.693 for measurement performance to 0.753 for project performance. These results indicated acceptable internal consistency for the study instrument.

➤ *Descriptive Statistics*

Table 1 Descriptive Statistics

Construct	Mean	SD	Interpretation
Planning performance	4.71	0.28	Very High
Measurement performance	4.74	0.26	Very High
Uncertainty management	4.69	0.34	Very High
Project performance	4.69	0.33	Very High

All four constructs were rated very highly. Measurement performance recorded the highest overall mean (4.74), followed by planning performance (4.71), while uncertainty management and project performance recorded means of 4.69. The relatively narrow spread of

scores indicates that respondents generally perceived the project management practices and project outcomes positively.

➤ *Correlation Analysis*

Table 2 Correlation Analysis

Variable	Planning	Measurement	Uncertainty	Project performance
Planning performance	1.000	0.696	0.637	0.454
Measurement performance	0.696	1.000	0.670	0.623

Uncertainty management	0.637	0.670	1.000	0.713
Project performance	0.454	0.623	0.713	1.000

All three independent variables had positive and statistically significant relationships with project performance. Uncertainty management showed the strongest bivariate association with project performance ($r = 0.713$), followed by measurement performance ($r = 0.623$) and planning performance ($r = 0.454$). The inter-correlations among the predictors were below the commonly used 0.80

threshold discussed in the dissertation, although the predictors were sufficiently related to warrant multicollinearity diagnostics in the combined regression model.

➤ Regression Analysis and Hypothesis Testing

Table 3 Regression Analysis and Hypothesis Testing

Hypothesis / relationship	B	R ²	p-value	Finding
Planning performance → time performance	0.794	0.164	0.0008	Supported
Measurement performance → cost efficiency	0.948	0.197	0.0002	Supported
Uncertainty management → sustainability outcomes	0.915	0.450	<0.0001	Supported

Planning performance significantly predicted time performance, explaining 16.4% of its variance ($R = 0.404$, $R^2 = 0.164$, $F = 12.515$, $p = 0.0008$). Measurement performance significantly predicted cost efficiency and explained 19.7% of its variance ($R = 0.443$, $R^2 = 0.197$, $F = 15.668$, $p = 0.0002$). Uncertainty management showed the

strongest simple regression relationship, explaining 45.0% of the variance in sustainability outcomes ($R = 0.671$, $R^2 = 0.450$, $F = 52.321$, $p < 0.0001$).

➤ Combined Regression Model

Table 4 Combined Regression Model

Predictor	B	t	p-value	VIF
Constant	0.891	1.689	0.0963	–
Planning performance	-0.179	-1.237	0.2207	2.160
Measurement performance	0.424	2.625	0.0109	2.327
Uncertainty management	0.562	4.873	<0.0001	2.020

The combined multiple regression model was statistically significant, $F(3,62) = 26.092$, $p < 0.001$, with $R = 0.747$ and $R^2 = 0.558$. Thus, the three project management performance domains jointly explained 55.8% of the variance in overall project performance, while the adjusted R^2 was 0.537. Measurement performance and uncertainty management remained statistically significant positive predictors. Uncertainty management had the largest coefficient ($B = 0.562$), followed by measurement performance ($B = 0.424$). Planning performance did not retain a statistically significant independent effect in the combined model ($B = -0.179$, $p = 0.2207$). All VIF values were below 5.

V. DISCUSSION

The results provide empirical evidence that project management performance domains are associated with construction project outcomes at the case study project. The very high descriptive ratings indicate that respondents perceived planning, measurement and uncertainty-management practices as extensively applied. This is consistent with the broader construction-management literature, which identifies planning, performance measurement and risk management as important mechanisms for controlling project delivery.

The significant relationship between planning performance and time performance supports the first

hypothesis. The coefficient indicates that higher planning-performance scores were associated with higher time-performance scores. This finding is consistent with research that identifies planning deficiencies as contributors to construction delays and cost pressures (SLAEAT & FATIMAH, 2024). It also supports the relevance of structured project planning in construction environments where resources, sequencing and stakeholder coordination must be managed simultaneously.

The significant effect of measurement performance on cost efficiency supports the second hypothesis. Performance measurement enables project teams to compare actual progress with planned targets, identify deviations and take corrective action. The result is consistent with the emphasis placed on project-level performance measurement in construction research (Ibrahim et al., 2024). For quantity surveyors, project managers and commercial teams, the finding reinforces the importance of timely cost information, variation monitoring, reporting and control.

Uncertainty management had the strongest simple relationship with sustainability outcomes and remained the strongest predictor in the combined model. This finding indicates that sustainability performance at the case study project was closely associated with the capacity of project teams to identify risks, prepare mitigation responses and adapt to unexpected conditions. The result is relevant to green-building projects because sustainability objectives can

be affected by procurement, materials, environmental conditions, regulatory requirements and implementation decisions.

The combined regression model provides an important additional finding. Planning performance was significant when examined against time performance in the simple regression, but it did not retain an independent statistically significant effect on overall project performance after measurement performance and uncertainty management were included. This difference suggests that planning may operate alongside or through other management mechanisms rather than acting as an isolated determinant of overall performance. The moderate correlations among the predictors also indicate that the project management domains are interconnected.

The findings should nevertheless be interpreted within the study's methodological boundaries. The analysis is based on 70 respondents from one case study project and relies on self-reported questionnaire data. Therefore, the results provide contextual empirical evidence rather than a statistical basis for generalising to all Rwandan construction projects. Longitudinal and multi-project studies would provide stronger evidence regarding causal relationships and external validity.

VI. CONCLUSIONS AND PRACTICAL IMPLICATIONS

The study concludes that project management performance domains are significantly related to the performance of dry construction and green building projects in the case study. Planning performance had a significant positive relationship with time performance. Measurement performance significantly influenced cost efficiency. Uncertainty management significantly influenced sustainability outcomes and was the strongest predictor in the combined model. Together, the three domains explained 55.8% of the variance in overall project performance.

For construction professionals, the findings support the integration of realistic planning, continuous performance measurement and proactive uncertainty management. Project teams should establish clear objectives and schedules, allocate resources systematically, monitor key performance indicators, identify deviations promptly and maintain active risk and uncertainty registers. Sustainability considerations should be embedded in planning and monitoring rather than treated as separate activities.

For institutions and policymakers, the results indicate the value of strengthening project-management capacity and performance-monitoring systems in sustainable construction. Further research should extend the model to other project management domains, including stakeholder management, procurement practices, contract administration and digital construction technologies such as Building Information Modelling, and should examine multiple projects over time.

VII. LIMITATIONS AND FUTURE RESEARCH

The principal limitation is the use of a single case study and a relatively modest sample of 70 respondents. The questionnaire also captures perceptions at a particular point in time and may therefore be affected by self-reporting bias. Future research should use longitudinal designs that follow projects from inception to completion, include objective time and cost records where available, and compare several dry construction and green-building projects across Rwanda. Future studies may also incorporate additional project management performance domains and digital construction practices.

REFERENCES

- [1]. Akinsulire, U., Adetola, N. A., Idemudia, M., Courage, V., Okwandu, I., Azubuike, S., et al. (2024). Strategic planning and investment analysis for affordable housing: Enhancing viability and growth. *Magna Scientia Advanced Research and Reviews*, 11(2), 119–131.
- [2]. Almusaed, H., Amjad, T., Yitmen, J., Ibrahim, A., Myhren, C., Jonn, A., et al. (2024). Assessing the impact of recycled building materials on environmental sustainability and energy efficiency: A comprehensive framework for reducing greenhouse gas emissions. *Buildings*, 14(6), 1566.
- [3]. Cyubahiro, A., Félicien, K., Dushimimana, J. d., & Jean, H. (2025). Effect of project planning on performance of social protection project: A case of Kirawigire Project in Gakenke District, Rwanda. *African Quarterly Social Science Review*, 2(1), 229–238.
- [4]. Ibrahim, Z., Abdelazim, R., Zayed, A., Tarek, E., Lafhaj, K., Lafhaj, P., & Zoubair, M. (2024). Enhancing construction performance: A critical review of performance measurement practices at the project level. *Buildings*, 14(7), 1988.
- [5]. Ntawuhongerumwanzi, C., Cyprien, T., Richard, M., MIND'JE, H., Twagirimana, F., Dieudonne, I., et al. (2025). Contribution of green technologies on infrastructure performance in Rwanda, a case of green buildings constructed in the Green Gicumbi Project. *International Journal of Environment, Agriculture and Biotechnology*, 10(2), 609299.
- [6]. Rugambwa, A., Emile, B., Gwaya, O., Abednego, O., Wanyona, H., & Githae, U. (2025). Assessment of project management maturity in the construction industry of Rwanda. *Africa Habitat Review*, 20(2), 3396–3408.
- [7]. Rukundo, J., Rogers, N., Kamande, G., & Mercyline, T. (2022). Monitoring and evaluation and construction project performance in Rwanda: A case study of Musanze and Rwamagana Road Project. *Journal of Entrepreneurship & Project Management*, 6(5), 21–31.

- [8]. SLAEAT, Z., & FATIMAH, H. (2024). The impact of poor planning on the duration and cost of the projects: The implications of poor planning on the projects. *Mesopotamian Journal of Civil Engineering*, 2024, 60–81.
- [9]. Toochukwu, I., & Abugu, G. C. (2025). Sustainable construction practices: Balancing cost efficiency, environmental impact, and stakeholder collaboration. *International Research Journal of Modernization in Engineering Technology and Science*, 7(1), 4118–4140.
- [10]. Yang, M., Lin, F., Lou, Q., Wang, J., Zhao, X., & Xianbo, K. (2021). Risk response of complex projects: Risk association network method. *Journal of Management in Engineering*, 37(4), 05021004.