

Research Article

Project Performance Diagnostic: A Framework for Evaluating Construction Performance in Kaduna

Ifeyinwa Ijeoma Obianyo^{a,*}, Victor Suchet Isaac^b, Abubakar Dayyabu^c, Anthony Muoka^d,
Adebisi Bamgbade^e, Abdulhameed Danjuma Mambo^f

Department of Civil Engineering, Nile University of Nigeria, Abuja, Nigeria

E-mail: Ifeyinwa.obianyo@nileuniversity.edu.ng^{a,*}; victor.suchet@gmail.com^b; adayyabu@nileuniversity.edu.ng^c;
anthony.muoka@nileuniversity.edu.ng^d; adebisi.bamgbade@nileuniversity.edu.ng^e;
Abdulhameed.mambo@nileuniversity.edu.ng^f

Received: 19 January 2026 | Revised: 07 April 2026 | Accepted: 17 May 2026 | Published: 23 June 2026

Abstract

Construction projects have frequently underperformed relative to their stated objectives. Against this background, this study evaluates the performance of construction projects in Kaduna, Nigeria. Structured questionnaires were used to collect primary data from construction professionals employed by the Kaduna State Ministry of Lands, Works, and Housing. Descriptive analysis showed that the system dynamics diagnostic model for construction project performance incorporates key performance indicators (KPIs), including health and safety, time, quality, and cost, as well as critical success factors (CSFs), including project management factors, procurement factors, project participant-related factors, and project-related factors. Project management practices account for 57.9% of the variance in project performance outcomes ($R^2 = 0.579$), demonstrating a statistically significant relationship ($p = 0.000$). This strong correlation indicates that adjustments in management practices directly influence overall project outcomes. Furthermore, the highly significant p -value confirms that project variables shape critical management strategies—including dynamics and resource allocation—which ultimately dictate project success. The study therefore concludes that CSFs and KPIs are distinct but complementary constructs that should be appropriately applied within the construction industry to improve project success.

Keywords: Project Performance; Key Performance Indicators; Critical Success Factors; System Dynamics Diagnostic Model; Construction Projects.

* Correspondence Author

Copyright: © 2026 by the authors. Licensee Scientific Steps International Publishing Services, Dubai, UAE. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Cite This Article: Obianyo, I. I., Isaac, V. S., Dayyabu, A., Muoka, A., Bamgbade, A., & Mambo, A. D. (2026). Project Performance Diagnostic: A Framework for Evaluating Construction Performance in Kaduna. *Steps For Civil, Constructions and Environmental Engineering*, 4(2), 25–34. <https://doi.org/10.61706/sccee12011274>

Introduction

The construction industry is a foundational sector that supports many others and contributes substantially to national economic development. Despite sustained efforts to improve project management practice, a considerable body of literature continues to report unsatisfactory performance in construction projects (Iroha et al., 2024; Obianyo et al., 2025). A project diagnostic approach can help to clarify the determinants of project success, including project management capability, team competence, resource availability, and technology adoption. It can also enable stakeholders to monitor project performance more effectively and support evidence-based decision-making that improves construction quality (Ignatius Teye Buerthey, 2016; Obianyo et al., 2021; Ushie et al., 2024). In addition, such an approach may promote transparency, accountability, and stakeholder confidence by providing a structured basis for evaluating ongoing and future projects. It also offers a benchmark against which local construction performance can be compared with global best practice, thereby highlighting areas requiring improvement.

Evaluating project performance requires measurable criteria through which project success can be assessed and managed. In recent years, several techniques and methodologies have been developed to predict and evaluate construction project performance. Among these, system dynamics modelling is particularly valuable because it can simulate the complexity of construction projects and capture how conditions evolve over time (Banihashemi et al., 2021). As noted by Omran et al. (2012), the performance of a construction project largely determines its eventual outcome. Common criteria for performance assessment include timely completion, adherence to budget, quality of work, and client satisfaction.

Unlike CSFs, KPIs function primarily as quantity tools because they indicate the level of performance achieved rather than the underlying conditions that make success possible. CSFs, by contrast, are the core conditions that determine whether high performance can be attained. In the construction sector, project managers are expected to anticipate emerging project conditions so that early signs of underperformance can be detected and addressed during implementation (Leong et al., 2014). The Nigerian construction industry continues to face significant challenges, including shortages of skilled managers, informal training arrangements for artisans, poor job security, communication breakdowns, and weak trust among contracting parties (Oladiran et al., 2024; Rogers Simeon et al., 2024). These challenges underscore the need for a robust assessment framework capable of refining construction performance in Nigeria.

Developing a project performance diagnostic requires a systematic approach that clearly defines relevant parameters, identifies meaningful performance indicators, selects appropriate data collection methods, and supports careful analysis and interpretation of findings. According to Kunkcu et al. (2022), KPIs may include project completion time, cost overruns, work quality, and client satisfaction. A key gap in the literature, however, lies in understanding the relationship between CSFs and KPIs in the context of construction project performance.

The Nigerian construction sector continues to experience persistent problems that contribute to project failure, including abandonment, scope creep, poor quality relative to original design specifications, and recurrent time and cost overruns. Recent studies provide substantial evidence of these concerns and suggest that there remains considerable scope for improving the performance of construction projects in Nigeria. Given the uncertainty and interdependence that characterize project environments, a diagnostic framework that can capture dynamic relationships among project variables is especially important.

Construction projects are inherently complex and should therefore be examined using approaches that can account for dynamic interactions among project variables. In Nigeria, however, construction practice often remains heavily reliant on conventional rules of thumb rather than scientifically grounded performance models. As noted by Pacagnella Junior et al. (2018) and Zia (2020), critical success factors are a limited set of variables that require sustained managerial attention if project objectives are to be achieved. These factors are closely linked to organizational priorities and should be reflected in project planning and implementation (Dolan, 2010). This is important because a project may appear successful in terms of cost, schedule, and quality, yet still fail to deliver the intended service outcomes. Innovative technologies, stakeholder involvement, effective project management practices, and efficient resource allocation are therefore central to project success. Kumar et al. (2023) identified several critical factors affecting project performance in Nigeria, including financial support, objective management, risk management, technical capacity, and design management. Adequate funding and resource availability are especially important, as they shape the extent to which project requirements can be achieved. Effective implementation also depends on leadership authority, monitoring and evaluation systems, coordination of project activities, budget and schedule control, team selection and motivation, and the competence of project managers (Ejaz et al., 2013; Omran et al., 2012; Zia, 2020).

Project participant-related factors, sometimes described as people-related or human-related variables, encompass the contributions of key stakeholders such

as clients, consultants, contractors, and subcontractors (Zia, 2020). Construction projects are also affected by external or environmental conditions that may shape project outcomes (Mtana et al., 2023). According to Yong and Mustaffa (2012), effective stakeholder management is integral to construction success. Similarly, Dolan (2010) argues that strong stakeholder commitment increases the likelihood that barriers will be removed and that project issues will be addressed promptly. Cost performance, meanwhile, reflects the degree to which project execution remains within the approved budget, typically assessed by comparing actual expenditure with the budgeted cost of completed work.

Project success is achieved when the goals defined in the project plan are met. A project may therefore be considered successful when it attains its technical objectives, is completed on schedule, and remains within budget. The importance of project management methods and tools in achieving these outcomes has long been emphasized (Pandit & Yadav, 2014; Takim & Akintoye, 2002). In construction management, the principal dimensions used to evaluate project performance are time, cost, quality, and stakeholder satisfaction. System dynamics is a modelling approach that helps researchers and practitioners understand the complex and evolving behaviour of systems by representing interactions and feedback relationships graphically and analytically (Akintunde & Osuolale, 2023). It is particularly useful for identifying gradual changes in performance that arise from interactions among system components over time. Because project systems often include delays and feedback loops, it is frequently difficult to predict the effects of interventions intended to improve performance. System dynamics was originally developed by Jay W. Forrester at the Massachusetts Institute of Technology to address the modelling challenges associated with complex organizational systems (Forrester, 1968).

According to Liu et al. (2014), systems theory provides a valuable lens through which construction projects can be understood as complex systems composed of interdependent elements and interactions. This perspective emphasizes the interconnectedness of project components and highlights the need for comprehensive approaches to performance evaluation. Using a systems perspective, researchers can examine the relationships among advanced technologies, project performance, stakeholder engagement, project management practices, and external influences. Stakeholder theory further stresses the importance of identifying and responding to the diverse interests, expectations, and levels of influence associated with the many actors involved in construction projects. In the Kaduna context, these theoretical perspectives offer a basis for examining how stakeholder participation shapes project performance.

Theories such as Diffusion of Innovation and the Technology Acceptance Model help explain the factors that shape technology uptake within the construction sector, including perceived usefulness, ease of use, social influence, and organizational readiness (Amede et al., 2025; Vitente et al., 2024). Applying these perspectives can improve understanding of the factors that support or hinder BIM adoption and of the implications of such adoption for construction performance in Kaduna. As construction projects become more dynamic and complex, the continued reliance on simplistic assessment approaches is no longer adequate. Moreover, limited understanding of the interaction between CSFs and KPIs may undermine overall project performance. Accordingly, this study evaluates the performance of construction projects in Kaduna, Nigeria.

Theoretical Analysis

Several theoretical perspectives can be used to explain how quality management contributes to improved construction outcomes. One of the most established is Total Quality Management (TQM), which focuses on continuous organizational improvement and customer satisfaction through systematic quality control mechanisms. Within the TQM tradition, quality may be modelled quantitatively through statistical process control techniques that enable the assessment and control of construction processes.

Lean Construction offers another relevant perspective, particularly in relation to waste minimization. Lean techniques often rely on optimization principles aimed at maximizing value while reducing waste. Value Stream Mapping (VSM) visually maps out work steps and data flow to spot waste, delays, and non-value-adding tasks in construction (Dara et al., 2024). Key indicators such as cycle time and throughput can then be used to quantify inefficiencies and support targeted improvement.

The Theory of Constraints (TOC) is also relevant because it assumes that every system contains at least one bottleneck that limits performance. In construction management, TOC can support the identification and analysis of constraints, including time-related bottlenecks, and thereby help managers target interventions that improve quality and reduce waste (Romo et al., 2024).

A systems dynamics perspective can also be incorporated into quality management analysis. This approach models the interdependence among project variables, such as material use, labour efficiency, and waste generation, and can help construction managers anticipate likely outcomes and select more effective strategies for waste minimization and performance improvement (Ibrahim et al., 2024; Waqar et al., 2024).

Taken together, TQM, Lean Construction, TOC, and systems dynamics provide a coherent theoretical

foundation for understanding how quality management can enhance construction performance and reduce waste. These perspectives offer both conceptual and analytical tools for improving construction processes

and promoting more sustainable project delivery. Figure 1 summarizes the principal theoretical approaches relevant to quality management in construction waste reduction.

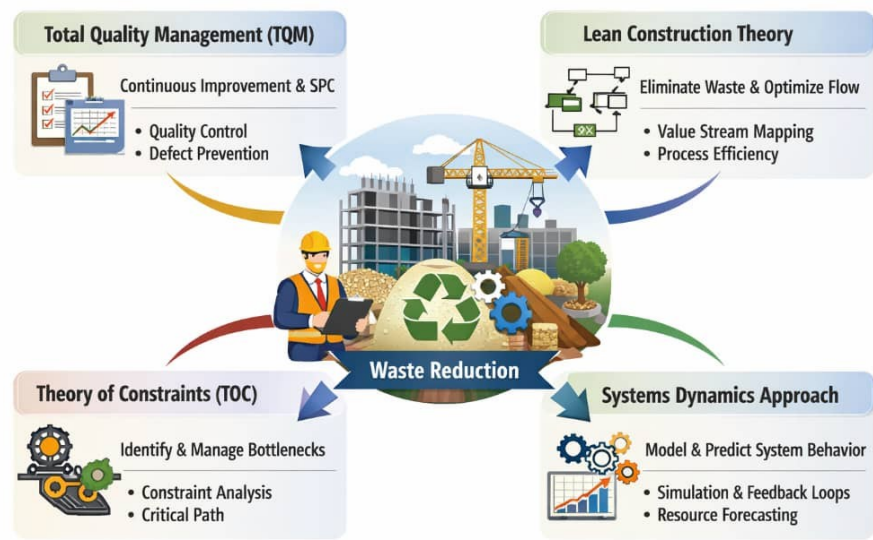


Figure 1. Theoretical Approaches for Quality Management in Construction Waste Reduction.

Methods

Research Design

This study adopted a descriptive research design. Descriptive research aims to characterize a

phenomenon and its defining attributes, emphasizing what exists rather than causal explanation. Figure 2 illustrates how critical success factors (CSFs) and key performance indicators (KPIs) interact to shape construction project performance.

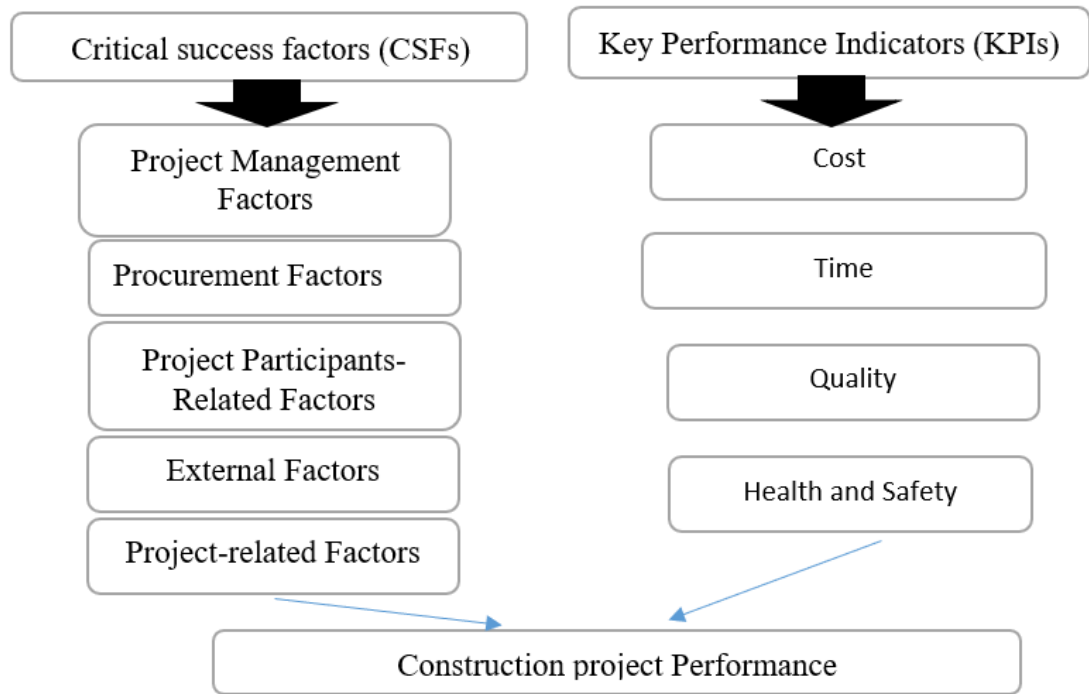


Figure 2. KPIs and CSFs

Participants in The Study

The study population comprised professionals drawn from the Kaduna State Ministry of Lands, Works, and Housing. In total, 285 professionals were identified. The sample for this study was drawn from managerial and supervisory staff within the ministry, as

these individuals were considered most relevant to the research objectives.

Sample Size

The sample size was determined from the population of 285 using Yamane’s sampling formula

(1967), which is commonly applied when a specified confidence level and margin of error are required.

A sample size of 166 respondents was determined to meet the criteria of a 95% confidence level and a 5% margin of error. These respondents were selected from professionals employed by the Kaduna State Ministry of Lands, Works, and Housing, particularly those who had at some point been involved in contractor selection procedures for construction projects in Kaduna State.

Sampling Techniques

A multi-stage sampling approach was adopted in this study, indicating that more than one sampling technique was used during respondent selection. Ultimately, purposive sampling was employed to identify professionals considered most suitable for addressing the research questions.

Method of Data Collection and Data Analysis

This mixed-methods survey utilized both primary and secondary data to address the research objectives. Primary data were collected through a structured questionnaire containing both open-ended and closed-ended items, while secondary data were gathered from academic journals, textbooks, and conference papers.

All data were analyzed using the Statistical Package for the Social Sciences (SPSS), applying descriptive statistics such as frequencies, mean item scores (MIS), and standard deviations.

Results and Discussion

Descriptive Statistics on All Research Questions

The outcome of the analysis conducted in pursuit of the study's primary goal is reported in this section. The information is based on the answers provided by the professional staff members who were chosen from the Kaduna State Ministry of Lands, Works, and Housing. This study utilized a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"), with a neutral midpoint score of 3. The mean and standard deviation for these data are presented in the following descriptive tables. To simplify interpretation, the five original response options were consolidated into two primary categories: "strongly disagree" and "disagree" responses were combined into a general "disagree" category, while "strongly agree" and "agree" responses were combined into an "agree" category. Consequently, a grand mean item exceeding three is marked as Agreed, and a grand mean item below 3 is marked as Disagreed.

Table 1. Descriptive Statistics on what are the KSFs that contribute to timely, quality, and cost-effective delivery of construction projects.

Statement	Mean	Std. Deviation	Decision	Ranking
Specified goals for the project's outcomes, such as time, money, and quality enhance effective delivery.	3.3260	.70185	Accepted	1
Project success is increased by the project management team's competency and management ability.	3.2015	.69112	Accepted	3
Appropriate safety education and training promote effective project delivery	3.1758	.74152	Accepted	4
Safety equipment acquisition and maintenance facilitate project success	3.1282	.76819	Accepted	6
Team work and control mechanism enhance project success	3.1722	.74978	Accepted	5
Site Management on Effective enforcement scheme facilitates project success	3.2125	.78982	Accepted	2

The descriptive statistics in Table 1 consistently demonstrate the importance of these factors as essential elements for the successful completion of building projects in Nigeria, as indicated by their low standard deviations and high mean importance ratings. Enhancing these areas can result in better project outcomes, ensuring that projects are completed to the appropriate quality standards, on schedule, and within budget.

However, from the findings in Table 1, the majority of the respondents agreed with the statement that "Specified goals for the project's outcomes, such as time, money, and quality, enhance effective delivery," with a mean score of 3.3260 and a standard deviation of .70185. Project success is increased by the project

management team's competency and management ability (mean score = 3.2015, Std. Deviation = .69112). Safety equipment acquisition and maintenance facilitate project success (mean score = 3.1758, Std. Deviation = .74152). Appropriate safety education and training promote effective project delivery (mean score = 3.1282, Std. Deviation = .76819). Teamwork and control mechanisms enhance project success (mean score = 3.1722, Std. Deviation = .74978). Site management and effective enforcement schemes facilitate project success (mean score = 3.2125, Std. Deviation = .78982). The analysis implies that the mean scores of these indicators are greater than the benchmark mean of 3; therefore, they were all accepted and ranked 1st, 3rd, 4th, 6th, 5th, and 2nd, respectively.

Table 2. Descriptive Statistics on how project variables could influence the construction process and predict project performance

Statement	Mean	Std. Deviation	Decision	Ranking
Employment of Competent and Skillful Workforce predict project performance	3.2527	.70074	Accepted	2
Technical and Management capacity of the contractor predicts project performance	3.2601	.70329	Accepted	1
Client's Project Financing for regular cash flow to predict project performance	3.1722	.74486	Accepted	4
Use of innovations such as BIM and e-tendering impacts on project performance	3.1172	.83633	Accepted	5
Contractor's Ability to Manage Designs	3.1832	.76419	Accepted	3

The significance of every variable in forecasting project performance is demonstrated by these data. Nigerian construction projects can obtain better results in terms of timeliness, quality, and cost-effectiveness by concentrating on enhancing these crucial areas. Table 2 shows that respondents generally agreed that these factors help predict project performance. The technical and management capacity of the contractor scored the highest with a mean of 3.2601 and a standard deviation of 0.70329. The employment of a competent and skillful workforce followed closely with a mean of 3.2527 and

a standard deviation of 0.70074. Lastly, the client's project financing for regular cash flow also scored high as a predictor, with a mean of 3.1722 and a standard deviation of 0.74486. The use of innovations such as BIM and e-tendering impacts project performance (mean score = 3.1172, Std. Deviation = .83633). Contractor's ability to manage designs (mean score = 3.1832, Std. Deviation = .76419). The analysis, therefore, implies that the mean scores of these indicators are greater than the benchmark mean of 3; therefore, they were all accepted and ranked 2nd, 1st, 4th, 5th, and 3rd, respectively.

Table 3. Descriptive Statistics on how a System Dynamics Project Performance Diagnostic Model influences construction project performance in Kaduna

Statement	Mean	Std. Deviation	Decision	Ranking
System dynamics models offer a forecast of construction project performance	3.1685	.65935	Accepted	5
Simulating how production pressure affects construction projects' safety performance	3.1978	.71053	Accepted	3
Risk evaluation during construction project design	3.1795	.74312	Accepted	4
Establishing the rework's structure	3.2271	.66399	Accepted	2
Examining the performance of the project's dynamic behaviour	3.2454	.73404	Accepted	1
Increasing the project's productivity	3.1682	.23436	Accepted	6
Using risk management simulation to enhance project performance	3.0203	.02521	Accepted	7

The descriptive data in Table 3 give an overview of the ways in which several areas of construction project performance in Kaduna are impacted by the application of a System Dynamics Project Performance Diagnostic Model. Key performance metrics such as stakeholder satisfaction, project duration, cost management, quality control, and risk management are included in the analysis. However, from the findings in Table 3, the majority of the respondents agreed with the statement that "System dynamics models offer a forecast of construction project performance," with a mean score of 3.1685 and a standard deviation of .65935. Simulating how production pressure affects construction projects' safety performance (mean score = 3.1978, Std. Deviation = .71053), risk evaluation

during construction project design (mean score = 3.1795, Std. Deviation = .74312), establishing the rework structure (mean score = 3.2271, Std. Deviation = .66399), examining the performance of the project's dynamic behaviour (mean score = 3.2454, Std. Deviation = .73404), increasing the project's productivity (mean score = 3.1682, Std. Deviation = .23436), and using risk management simulation to enhance project performance (mean score = 3.0203, Std. Deviation = .02521) were all accepted. The analysis, therefore, implies that the mean scores of these indicators are greater than the benchmark mean of 3, and they were ranked 5th, 3rd, 4th, 2nd, 1st, 6th, and 7th, respectively.

Regression Model (Testing of Hypothesis)

During this study, two hypotheses were put forward to support or refute the claims made using information acquired from the survey respondents' responses. The data were analysed using descriptive statistics and the hypotheses were tested with a regression model. To evaluate the hypotheses, the null hypothesis (H_0) was retained if the p-value was greater than the specified 0.05 alpha level of significance. Conversely, if the p-value was less than or equal to 0.05, the null hypothesis was rejected in favor of the alternative hypothesis (H_1).

Testing Hypothesis One.

H01: The project variables influence project dynamics, resource allocation, and overall project management strategies which will influence the success rate.

The computed regression analysis used to determine specifically which of the system dynamics diagnostic model variables significantly relate to project dynamics, resource allocation, and overall project management strategies in construction project performance in Kaduna. First, the model summary indicates that $R^2 = 0.321$, showing that 32.1% of the variation in the dependent variables, namely project dynamics, resource allocation, and overall project management strategies, is explained by the independent variable, namely the system dynamics diagnostic model, while 67.9% cannot be explained by these variables, with only a 0.444488 margin of error. This implies that the relationship between project dynamics, resource allocation, and overall project management strategies and the system dynamics diagnostic model is statistically significant; thus, any change in the system

dynamics diagnostic model will also affect project dynamics, resource allocation, and overall project management strategies in construction project performance in Kaduna. Also, the regression coefficient result shows a positive value of 0.566, which supports the fact that both variables directly influence each other.

An analysis of variance (ANOVA) evaluated the relationships between project dynamics, resource allocation, project management strategies, and the system dynamics diagnostic model. Because the resulting p-value (0.000) fell below the 5% significance level, the null hypothesis was rejected. This confirms that project variables significantly influence project dynamics, resource allocation, and management strategies, ultimately driving project success. Additionally, the regression results ($F = 70.373$, $p = 0.000$) confirm the model is appropriate, fit, and statistically reliable.

The regression result obtained shows the result obtained in determining the relationship between the system dynamics diagnostic model and project dynamics, resource allocation, and overall project management strategies. The result revealed a positive relationship between project variables and project dynamics, resource allocation, and overall project management strategies, with $r = 0.164$ tested at the 0.05 level of significance, indicating that the result is statistically significant.

Testing Hypothesis Two.

H02: There is a positive correlation between effective project management practices and project performance outcomes, and identifying and addressing key barriers to effective project management can improve project success rates

Table 4. Regression Model Summary: Project Management Practices and Project Performance

Model	R	R Square	Adjusted R-squared	Std Error of the Estimate
1	.761	.579	.577	0.50517

Table 5. ANOVA Results for the Regression Model

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	51.694	1	51.694	202.566	.000
Residual	37.514	135	.255		
Total	89.208	136			

Table 6. Regression Coefficients for Project Management Practices

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-.448	.349		-1.283	.202
Project management practices	.153	.011	.761	14.233	.000

Table 4 explains the percentage of the dependent variable (i.e., project performance outcomes) that can be determined by the independent variable (i.e., project management practices). According to this model summary, the independent variable accounts for 57.9% ($R \text{ Square} = 0.579$) of the dependent variable, while the

remaining 42.1% can be explained by other factors outside the scope of this model. This implies that the relationship between the dependent and independent variables is statistically significant; thus, any change in project management practices will also affect project performance outcomes in construction project performance in Kaduna. The statistical analysis

confirms a strong relationship between project management practices and project performance outcomes in construction projects in Kaduna. The regression model shows a positive correlation coefficient ($R = 0.761$), indicating a strong direct link between the two variables. To ensure these model results are reliable, an analysis of variance (ANOVA) was conducted. The test established a p-value of 0.000, which is well below the specified 5% significance level ($\alpha = 0.05$). Because the p-value is lower than the significance threshold, the null hypothesis was rejected, and the alternative hypothesis was accepted. This confirms that effective project management practices positively influence project performance, and that identifying and resolving key barriers can directly improve project success rates. Furthermore, the ANOVA regression results validate that the statistical model is both fit and appropriate for this data. This is supported by an F-statistic of 202.566 and a significance value of 0.000, which proves that the findings of this test are highly reliable. Finally, the detailed regression results indicate that the coefficient for the independent variable is -0.153. While this coefficient is negative, the overall statistical data successfully establishes a significant, measurable relationship between project management practices and performance outcomes within the Kaduna construction sector.

Discussion of Findings

This study evaluated project performance diagnostics as a framework for assessing construction performance in Kaduna. Specifically, it sought to identify and examine the critical success factors and key performance indicators most relevant to construction project evaluation. The findings showed that the p-value obtained for the first hypothesis (0.000) was below the 5% significance level; accordingly, the null hypothesis was rejected. This indicates that project variables significantly influence project dynamics, resource allocation, and overall project management strategies, all of which affect project success. For the second hypothesis, the p-value was likewise 0.000, which led to the rejection of the null hypothesis and acceptance of the alternative hypothesis. This confirms a positive relationship between effective project management practices and project performance outcomes and suggests that identifying and addressing barriers to effective project management can improve project success rates. These findings are consistent with those reported by Unegbu et al. (2022).

Conclusion

The findings indicate that changes in project management practices are likely to influence project performance outcomes in construction projects in Kaduna. The regression analysis indicates that project management practices account for 57.9% of the variance in project performance outcomes ($R^2 = 0.579$),

leaving 42.1% attributable to external variables. This confirms a statistically significant, direct relationship between project management practices and performance, as evidenced by the regression coefficient. Furthermore, the study links project variables to project dynamics, resource allocation, and broader management strategies. Ultimately, these findings substantiate that robust project management enhances performance outcomes, and that mitigating systemic barriers can significantly boost success rates. Finally, the research reinforces that Critical Success Factors (CSFs) and Key Performance Indicators (KPIs) function as distinct yet complementary frameworks within the construction industry.

Based on the findings, the study recommends that consultants, contractors, and clients adopt reliable project performance diagnostic techniques to assess project strengths and weaknesses more systematically. To support high-quality and successful project delivery while minimizing rework, stakeholders should foster a culture of quality, invest in workforce training, and ensure strict compliance with contractual requirements, industry best practices, and clearly defined safety, health, and scheduling standards. Project performance can also be strengthened through more robust resource management and through the purposeful use of key performance indicators and critical success factors in project design and execution. Collectively, these measures can improve productivity, enhance project outcomes, and support long-term operational sustainability.

Declarations

Authors' Contributions

I.I.O: Conceptualization, Methodology, Writing of the original draft, Writing – review & editing, Writing – review & editing, Project administration.

V.S.I: Conceptualization, Methodology, Formal analysis, Formal analysis, Data curation, Writing of the original draft.

A.D: Writing – review & editing, Project administration.

A.M: Validation, Project administration.

A.B: Validation, Visualization.

A.D.M: Writing – review & editing.

Conflict of Interest

The authors declare that there are no conflicts of interest.

Funding

The authors declare that this research received no external funding.

Declaration on The Use of Generative AI And AI-Assisted Technologies

The authors declare that generative artificial intelligence was used for language assistance and to improve the writing of the manuscript. The authors reviewed and edited the generated content as necessary and take full responsibility for the content of the publication.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Acknowledgement

The authors declare that there is no acknowledgement to be made.

Ethics

This study did not involve human participants or animals; hence, no ethical approval was required.

REFERENCES

- Akintunde, A. E., & Osuolale, O. M. (2023). The application of agricultural wastes to improve lateritic soil performance: a review. *International Journal of Environmental Engineering*, 12(2), 123–145. <https://doi.org/10.1504/IJEE.2023.132631>
- Amede, E. A., Woldesenbet, A. K., Bahiru, A. K., Tibebe, F. T., & Hailemariam, L. M. (2025). Transforming construction in emerging economies: overcoming barriers to the adoption of industrialized building systems. *Discover Applied Sciences*, 7(7). <https://doi.org/10.1007/s42452-025-06963-w>
- Banihashemi, S. A., Khalilzadeh, M., Zavadskas, E. K., & Antucheviciene, J. (2021). Investigating the environmental impacts of construction projects in time-cost trade-off project scheduling problems. *Sustainability (Switzerland)*, 13(19).
- Dara, H. M., Raut, A., Adamu, M., Ibrahim, Y. E., & Ingle, P. V. (2024). Reducing non-value added (NVA) activities through lean tools for the precast industry. *Heliyon*, 10(7), e29148. <https://doi.org/10.1016/j.heliyon.2024.e29148>
- Dolan, K. (2010). Addressing Project Failure through PRINCE2™. *Best Management Practice for Portfolio, Programme, Project, Value, Risk and Service Management*, (August).
- Ejaz, N., Hussain, J., Shabbir, F., Shamim, M. A., Naeem, U. A., Tahir, M. F., Ahmad, N., & Farooq, Q. U. (2013). Assessment of most critical success factors for mega construction projects in Pakistan. *Life Science Journal*, 10(SPL.ISSUE10), 255–261.
- Forrester, J. W. (1968). Industrial Dynamics—After the First Decade. *Management Science*, 14(7), 398–415. <https://doi.org/10.1287/mnsc.14.7.398>
- Ibrahim, A., Zayed, T., & Lafhaj, Z. (2024). Enhancing Construction Performance: A Critical Review of Performance Measurement Practices at the Project Level. *Buildings*, 14(7). <https://doi.org/10.3390/buildings14071988>
- Ignatius Teye Buerter, J. (2016). Stakeholder Management on Construction Projects: A Key Indicator for Project Success. *American Journal of Civil Engineering*, 4(4), 117. <https://doi.org/10.11648/j.ajce.20160404.11>
- Iroha, E. V., Watanabe, T., & Satoshi, T. (2024). Flawed Institutional Structures: Project Managers Underutilized in Nigeria's Construction Industry. *Buildings*, 14(3), 1–29. <https://doi.org/10.3390/buildings14030807>
- Kumar, V., Pandey, A., & Singh, R. (2023). Project success and critical success factors of construction projects: Project practitioners' perspectives. *Organization, Technology and Management in Construction*, 15(1), 1–22. <https://doi.org/10.2478/otmcj-2023-0001>
- Kunkcu, H., Koc, K., Dagou, H. H., & Gurgun, A. P. (2022). Using Key Performance Indicators in Construction Project Literature. *Proceedings of International Structural Engineering and Construction*, 9(2), 1–6. [https://doi.org/10.14455/ISEC.2022.9\(2\).CON-12](https://doi.org/10.14455/ISEC.2022.9(2).CON-12)
- Leong, T. K., Zakuan, N., Mat Saman, M. Z., Ariff, M. S. M., & Tan, C. S. (2014). Using project performance to measure effectiveness of quality management system maintenance and practices in construction industry. *The Scientific World Journal*, 2014. <https://doi.org/10.1155/2014/591361>
- Liu, H., Wang, M., Skibniewski, M. J., He, J., & Zhang, Z. (2014). Identification of Critical Success Factors for Construction Innovation: From the Perspective of Strategic Cooperation. *Frontiers of Engineering Management*, 1(2), 202. <https://doi.org/10.15302/j-fem-2014027>
- Mtana, M., Mwaluko, G., & Matindana, J. (2023). Current and Future Trends of Construction Project Performance Models: A Review. *Tanzania Journal of Engineering and Technology*, 42(1), 58–71. <https://doi.org/10.52339/tjet.v42i1.888>
- Obianyo, I. I., Ihekwe, G. O., Mahamat, A. A., Onyelowe, K. C., Onwualu, A. P., & Soboyejo, A. B. O. (2021). Overcoming the obstacles to sustainable housing and urban development in Nigeria: The role of research and innovation. In *Cleaner Engineering and Technology* (Vol. 4). Elsevier Ltd. <https://doi.org/10.1016/j.clet.2021.100226>

Obianyo, I. I., Saulawa, B., Mambo, A., Dayyabu, A., & Amuda, A. (2025). Quality Management as a Tool to Minimize Construction Waste Towards a Sustainable Built Environment: The Consultants' Perspective. *Steps For Civil, Constructions and Environmental Engineering (SCCEE)*, 3(4), 1–11. <https://doi.org/https://doi.org/10.61706/sccee1201124>

Oladiran, O. J., Ibrahim, B., & Waziri, A. M. (2024). Communication Strategies and Construction Projects' Outcomes in Nigeria. *Lecture Notes in Civil Engineering*, 480(2000), 69–79. https://doi.org/10.1007/978-3-031-56544-1_5

Omran, A., Abdalrahman, S., Hamid, A., & Pakir, K. (2012). Project Performance in Sudan Construction Industry: A Case Study. *Academic Research Journals*, 1(1), 55–78.

Pacagnella Junior, A. C., Paschoal, M. S., & Pacifico, O. (2018). Identification and evaluation of Critical Success Factors for construction projects. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, 2018(SEP), 426–439.

Pandit, D., & Yadav, S. M. (2014). Project Control Factors at Front End: Indian Perspective. *American Journal of Civil Engineering and Architecture*, 2(2), 77–82. <https://doi.org/10.12691/ajcea-2-2-4>

Rogers Simeon, D., Joseph Oladiran, O., & Abiodun, O. J. (2024). Exploring the importance of quality management practices and influencing factors of construction projects' quality in Nigeria. In *Journal of Science and Technology © KNUST 2024 Journal of Science and Technology* (Vol. 42, Number 1).

Romo, R., Alejo-Reyes, A., & Orozco, F. (2024). Statistical Analysis of Lean Construction Barriers to Optimize Its Implementation Using PLS-SEM and PCA. *Buildings*, 14(2). <https://doi.org/10.3390/buildings14020486>

Takim, R., & Akintoye, A. (2002). Performance Indicators for Successful. *18th Annual ARCOM Conference*, 2(September), 2–4.

Unegbu, H. C. O., Yawas, D. S., & Dan-asabe, B. (2022). An investigation of the relationship between project performance measures and project management practices of construction projects for the construction industry in Nigeria. *Journal of King Saud University - Engineering Sciences*, 34(4), 240–249. <https://doi.org/10.1016/j.jksues.2020.10.001>

Ushie, E., Muoka, A., Mogbo, O., Bamgbade, A., Obianyo, I., & Mambo, A. (2024). The Impact Of Site Management on The Success of Construction Project In Abuja. *Nile Journal of Engineering and Applied Science*, 2(1), 1. <https://doi.org/10.5455/njeas.188745>

Vitente, L. S., Ong, A. K. S., & German, J. D. (2024). Assessment of Adoption and Acceptance of

Building Information Modeling for Building Construction among Industries in Qatar. *Buildings*, 14(5), 1–17. <https://doi.org/10.3390/buildings14051433>

Waqar, A., Alrasheed, K. A., & Benjeddou, O. (2024). Enhancing construction management outcomes through the mitigation of robotics implementation barriers: A sustainable practice model. *Environmental Challenges*, 16(June), 100989. <https://doi.org/10.1016/j.envc.2024.100989>

Yong, Y. C., & Mustaffa, N. E. (2012). Analysis of factors critical to construction project success in Malaysia. *Engineering, Construction and Architectural Management*, 19(5), 543–556. <https://doi.org/10.1108/09699981211259612>

Zia, M. N. (2020). A Review Paper on Identification of Critical Success Factors (CSFs) for Successful Project Management of Construction Projects. *Journal of Management Practices, Humanities and Social Sciences*, 4(2), 29–36. <https://doi.org/10.33152/jmphss-4.2.2>