

THE MODERATING EFFECT OF INFORMATION TECHNOLOGY APPLICATIONS ON THE PERFORMANCE OF AFFORDABLE HOUSING PROJECTS IN NAIROBI METROPOLITAN AREA, KENYA

Erick Omulo¹, Dr. Lucy Ngugi², Dr. Lydiah Gachengo³

^{1,2,3} Department of Management Science, School of Business, Economics and Tourism

Kenyatta University, Kenya

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Abstract: Affordable housing continues to be a significant socio-economic issue in Kenya, especially in the Nairobi Metropolitan Area (NMA), where demand substantially exceeds supply despite governmental efforts under the Big Four Agenda. Ongoing challenges of cost overruns, schedule delays, and substandard quality outcomes highlight the necessity to investigate project environmental dynamics and the possible influence of information technology (IT) applications on enhancing housing project performance. This study examined the moderating influence of IT applications on the link between project environment dynamics and the performance of affordable housing projects in the NMA. A descriptive study design was employed, focusing on 24 affordable housing developments launched between 2017 and 2024. Data were gathered from 264 respondents via a census methodology, comprising project managers, contractors, developers, architects, engineers, quantity surveyors, and construction managers. Structured questionnaires and inferential analysis, incorporating moderation tests based on the Baron and Kenny (1986) methodology, were utilized. The findings indicated that project environment dynamics had no substantial impact on project performance. Nonetheless, IT applications had a robust and statistically significant positive impact on housing project outcomes, especially in improving efficiency, stakeholder engagement, and decision-making. The interaction term between project environment dynamics and IT utilization was statistically insignificant, suggesting that IT did not modify the link between environmental dynamics and project performance. The study concludes that although IT applications directly enhance project outcomes, their moderating influence in the NMA setting is constrained by issues related to adoption, alignment, and readiness. It is advised that policy and managerial initiatives be implemented to enhance IT integration for sustainable housing delivery.

Keywords: Affordable housing, project performance, project environment dynamics, information technology.

I. INTRODUCTION

Affordable housing has become a critical social and economic issue worldwide, especially in fast urbanizing areas like sub-Saharan Africa. Kenya faces an annual housing deficit of 200,000 units, with most urban residents living in informal settlements that lack sufficient amenities (Kenya National Bureau of Statistics, 2022). The Kenyan government has highlighted affordable housing as a key component of its Big Four Agenda, with a goal of providing 500,000 housing units by 2027 (Government of Kenya, 2020). Nonetheless, despite the ambitious policy framework, affordable housing initiatives persistently encounter obstacles associated with cost overruns, delays, quality concerns, and sustainability issues. These problems underscore the necessity of comprehending the dynamics of the project environment and the potential of technical interventions to enhance performance outcomes.

Project environment dynamics denote the interaction of external and internal factors such as economic, political, social, and technological factors that affect the execution and success of development projects (Kerzner, 2019). Affordable housing initiatives in the Nairobi Metropolitan Area (NMA) function within highly dynamic contexts marked by swift population expansion, variable material expenses, land acquisition challenges, and regulatory impediments (UN-Habitat, 2020). These environmental difficulties elevate project risks and frequently compromise efficiency, time, and quality. As a result, scholars and practitioners in project management are increasingly highlighting the significance of adaptive techniques and enabling technology in improving project performance (Huemann & Turner, 2024).

Information Technology (IT) applications, especially project management software, Building Information Modeling (BIM), Geographic Information Systems (GIS), and mobile applications, are increasingly acknowledged as effective instruments for mitigating inefficiencies in construction and housing development (Marzouk & Othman, 2020). BIM facilitates real-time cooperation among stakeholders, reduces design errors, and enhances resource allocation (Succar, 2015). Mobile monitoring tools have been utilized to boost accountability and transparency in project tracking, while cloud-based solutions improve document management and stakeholder communication (Khamaksorn, 2016). In underdeveloped economies like Kenya, the usage of IT in project management is progressively increasing, however substantial obstacles such as elevated implementation costs, insufficient technical skills, and opposition to change persist (Oladapo, 2006).

The influence of IT applications on project performance is an increasingly significant topic in academic research. Project environment dynamics can positively and negatively impact affordable housing construction; nevertheless, IT applications can bolster adaptive capacity, mitigate uncertainty, and improve resistance to disturbances (Ahiaga-Dagbui, Love, Smith, & Ackermann, 2017). In situations where regulatory approval processes are protracted and bureaucratic, digital technology can accelerate approvals and diminish lead times. Likewise, when cost fluctuations in construction materials jeopardize financial viability, IT-enabled forecasting and procurement systems can enhance decision-making. Consequently, IT applications may serve as a moderating variable, mitigating the negative effects of environmental problems on housing project performance.

In the Nairobi Metropolitan Area, where affordable housing initiatives face a fluctuating political economy, constrained land availability, and infrastructure shortcomings, the incorporation of information technology into project management procedures offers both advantages and obstacles. Research indicates that when effectively executed, IT improves efficiency, fosters stakeholder collaboration, and facilitates superior monitoring of project schedules (Seun, Babajide, Taye, Aderonke & Olabode, 2023). Nonetheless, a deficiency persists in empirical research explicitly investigating how information technology moderates the relationship between project environment dynamics and performance within the affordable housing industry. Understanding this deficiency is essential for informing evidence-based policy, directing private developers, and guaranteeing the achievement of the government's affordable housing objectives.

This study aims to examine the moderating influence of IT applications on the performance of affordable housing projects in the Nairobi Metropolitan Area. The emphasis is on comprehending how IT technologies may alleviate environmental risks and improve project performance regarding cost, quality, timing, and stakeholder satisfaction. The results are anticipated to enhance both theoretical understanding and practical application by illustrating the strategic significance of IT in project management within dynamic and resource-limited contexts.

Statement of the Problem

Affordable housing continues to be one of the most urgent socio-economic issues confronting Kenya at present. The swift urbanization of the Nairobi Metropolitan Area has markedly heightened the need for adequate and affordable housing; yet, supply has not kept pace due to increased building costs, inadequate financing alternatives, and inefficiencies in project execution (UN-Habitat, 2020). Notwithstanding the Government of Kenya's dedication through the Big Four Agenda to deliver 500,000 affordable housing units by 2022, the performance results have consistently fallen short of expectations (Government of Kenya, 2018). Numerous housing projects in Nairobi have delays, budget overruns, and substandard outputs, prompting concerns over the success rate of conventional project management methodologies (Ahiaga-Dagbui *et al.* 2017).

Applications of information technology (IT) such as Building Information Modelling (BIM), Enterprise Resource Planning (ERP) systems, and project management software have been recognized as enablers of efficiency, transparency, and collaboration in the delivery of construction projects (Succar, 2015; Marzouk & Othman, 2020). Nonetheless, their uptake and integration into affordable housing developments in Kenya remain limited and disjointed (Seun *et al.*, 2023). Studies

in many situations indicate that IT solutions can enhance cost management, scheduling, and stakeholder communication (Khamaksorn, 2016; Oladapo, 2006). However, in the Nairobi Metropolitan Area, there exists a paucity of empirical information about the moderating role of IT in the relationship between project environment dynamics such as stakeholder engagement, regulatory frameworks, and resource availability and housing project performance.

The absence of empirical insight constitutes a significant research gap. Without comprehending the moderating influence of information technology, policymakers and practitioners jeopardize the optimal utilization of a potential catalyst for efficiency in housing delivery. This disparity compromises the effective implementation of the affordable housing component of the Big Four Agenda and the Sustainable Development Goals (SDG 11: Sustainable Cities and Communities). Resolving this issue necessitates an econometric analysis of how IT applications might enhance the relationship between project environment dynamics and the performance of affordable housing initiatives in Nairobi. This investigation is essential for offering practical advice to project managers and policymakers aiming to improve housing availability in Kenya's metropolitan areas (Turner, 2020; Kerzner, 2019).

II. LITERATURE REVIEW

Theoretical Literature Review

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), established by Davis (1989), outlines the processes by which individuals and organizations embrace and utilize technology, highlighting two major factors: perceived usefulness and perceived ease of use. Within the realm of affordable housing initiatives in the Nairobi Metropolitan Area, TAM offers a framework for comprehending the extent to which project stakeholders such as contractors, consultants, and government entities adopt information technology (IT) applications. Project teams are more inclined to use and integrate IT solutions such as Building Information Modeling (BIM), Enterprise Resource Planning (ERP) systems, and project management software when they recognize their utility in enhancing efficiency, communication, and cost management. Resistance may arise when IT applications are viewed as complicated, expensive, or incompatible with current practices, therefore constraining their influence on project performance (Davis, 1989; Venkatesh & Davis, 2000)

This study highlights the significance of TAM in understanding the moderating influence of IT applications on project performance. Affordable housing initiatives frequently face limitations due to restricted resources, stringent deadlines, and intricate stakeholder collaboration. When IT applications are seen as user-friendly and advantageous, they enhance the connection between project environment dynamics such as regulatory frameworks, resource accessibility, and stakeholder involvement and the overall project performance results. Real-time communication platforms and digital project monitoring systems can reduce delays and increase accountability, therefore enhancing cost-effectiveness and ensuring the timely delivery of affordable housing units. The Technology acceptability Model (TAM) offers a theoretical framework for analyzing how the acceptability of IT tools affects their capacity to influence project environmental elements and facilitate the successful execution of housing projects (Venkatesh & Bala, 2008; King & He, 2006).

Empirical Literature Review

Kabiru *et al.* (2022) conducted an empirical investigation on the moderating influence of information technology (IT) skills on the relationship between business process reengineering (BPR) elements and organizational performance within the Nigerian banking industry. The research utilized a field survey design conducted in a natural setting, concentrating on a diverse sample obtained from commercial banks, microfinance institutions, and leading home loan providers. Hierarchical regression analysis was performed with SPSS software for analytical purposes. The findings demonstrated that IT skills significantly affected the relationships among essential BPR components: namely, change management, customer orientation, management commitment, and organizational performance. The relationship between IT investment and management commitment profoundly affects customer service results in the financial services industry. These results underscore the strategic importance of IT expertise in enabling reengineering initiatives aimed at performance improvement.

Md Ab Malik *et al.* (2019) examined the moderating effects of information technology (IT) utilization and project responsibilities on the relationship among project quality, engagement, management practices, and project performance. This research employed a case study from a transformation initiative at a Malaysian public institution and applied a survey method to examine the influence of strategic project components on outcomes. The results emphasized the importance of strategic management in improving project performance, indicating that the utilization of IT and project positioning

significantly differentiate successful from unsuccessful project outcomes. The study revealed a substantial positive correlation between project involvement and performance, particularly from the perspective of project directors. Furthermore, the integration of IT evidenced enhancements in project quality and performance, underscoring the notion that digital tools and platforms are vital enablers of effective project execution.

Rani *et al.* (2018) emphasized IT skill as a vital determinant of organizational success, underscoring the importance of technological competencies in improving project outcomes. Ilmudeen and Bao (2017) contended that an organization's capacity to devise and execute innovative methods for performance improvement is profoundly influenced by its IT competence, particularly when synchronized with critical IT governance elements. Their study employed structural equation modeling (SEM) with partial least squares (PLS) to analyze data collected from 176 IT and business executives in Chinese firms. The empirical findings demonstrated that IT components, particularly value governance, portfolio management, and investment management, significantly improve IT management performance and serve as crucial moderators in the relationship between IT infrastructure and company success. This study presents concrete proof that IT skills can improve performance outcomes.

Zhao *et al.* (2016) examined the moderating effect of information technology (IT) capabilities on the relationship between organizational responsiveness and supply chain collaboration (SCC) among Chinese manufacturing enterprises. The study analyzed 300 organizations and using Harman's one-factor test for data evaluation. The findings demonstrated that IT competency significantly affected the relationship between supply chain cooperation (SCC) and organizational responsiveness, suggesting that firms with advanced IT skills were more proficient in adjusting to changing supply chain environments. The findings of the study were validated by Chakravarty *et al.* (2018), who found that IT competence enhances the processes of information intake, assimilation, and application necessary for converting external knowledge into intellectual capital. This learning capacity, therefore, improves an organization's agility and overall effectiveness.

Hang *et al.* (2022) investigated the moderating effect of Information Technology (IT) governance on the relationship between board characteristics and business continuity effectiveness during the COVID-19 pandemic. The study utilized a quantitative cross-sectional survey method, employing Structural Equation Modelling (SEM) to assess organizational responses during crises. The findings, however, indicated no significant moderating influence of IT governance on the correlation between board characteristics and performance results. This suggests that IT governance frameworks, if misaligned with thorough strategic involvement and decision-making processes, may be insufficient to improve results in key project contexts (Nasution *et al.*, 2024).

Zardari and Tai (2021) investigated the moderating influence of digital communication platforms, such as Slack and Jira, on the relationship between team agility and project delivery performance. The study investigated software development project teams and using Partial Least Squares Structural Equation Modelling (PLS-SEM) for data analysis. The findings indicated that merely providing digital collaboration tools did not significantly enhance project performance in environments typified by inadequate communication and limited team agility. The researchers concluded that digital technologies are beneficial only when critical project conditions, such as team cohesion and clearly delineated responsibilities, are in existence.

Melnick *et al.* (2020) investigated the moderating influence of electronic health record (EHR) system usability on the relationship between efficiency strategies and physician satisfaction. The study employed a moderated mediation analysis of survey data collected from physicians across the United States. The findings revealed that the usability of EHRs did not consistently enhance satisfaction ratings across different user groups. This suggests that technological interventions may fail to deliver anticipated benefits if they are not tailored to the specific needs and contextual factors of their users.

III. RESEARCH METHODOLOGY

The study employed a descriptive research design. The study focused on twenty-four affordable housing projects launched in the Nairobi Metropolitan Area between 2017 and 2024. A total of 264 respondents participated, comprising 24 project managers, 24 contractors, 24 developers, 48 architects, 48 engineers, 48 quantity surveyors, and 48 construction managers. The study utilized a census of 24 affordable housing projects due to the limited population size. Structured questionnaires were employed to gather primary data for the study. A pilot study was done on the Buxton Affordable Housing Project in Mombasa County to allow the census of all affordable housing efforts among the counties composing the Nairobi Metropolitan Area. The content validity assessment was employed to ascertain the validity of the research instruments.

Cronbach's alpha was employed to compute a correlation coefficient to assess the internal consistency of the study instrument. Descriptive statistics, including mean and standard deviation, were utilized to analyze quantitative data. The study also employed inferential statistics, including multiple regression analysis. Tables and figures were utilized to illustrate the results of the data analysis.

IV. FINDINGS

The descriptive statistics results of information technology application are presented in Table 1

Table 1: Information Technology Application

Indicator	Mean	Std. Deviation
Our project team has fully embraced IT tools for project management.	2.249	1.167
The use of IT in affordable housing projects has improved overall efficiency.	2.257	1.288
There is a positive attitude toward IT adoption among project stakeholders.	2.390	1.157
There is sufficient investment in IT tools to support project execution.	2.307	1.055
IT acceptance and adoption mean score	2.301	1.167
The integration of IT tools into project workflows has improved decision-making.	1.788	1.218
IT solutions are customized to meet the unique needs of affordable housing projects	2.290	1.261
IT implementation has helped reduce project delays and cost overruns	2.079	1.303
IT alignment mean score	2.052	1.261
There is continuous training and development to keep up with IT advancements.	2.353	1.171
Investment in emerging construction technologies has enhanced project efficiency.	2.095	1.315
Automation and data-driven decision-making have significantly impacted project performance.	2.415	0.853
IT advancement mean score	2.288	1.113
Information Technology Application Aggregate Mean Score	2.214	1.180

Table 1 illustrates respondents' views on the integration and performance of IT technologies in affordable housing initiatives. The findings about IT acceptance and adoption indicate a lack of consensus among the respondents. The statement that "there is a positive attitude toward IT adoption among project stakeholders" garnered the highest level of consensus in this category, with a mean of 2.390 (SD = 1.157), suggesting that some respondents either agree or maintain neutrality concerning their openness to IT adoption. However, there is a tendency to challenge the assertion of widespread IT adoption, as indicated by lower ratings such as "Our project team has fully embraced IT tools for project management" at 2.249 (SD = 1.167) and "There is sufficient investment in IT tools to support project execution" at 2.307 (SD = 1.055).

The findings in the IT alignment category reveal a widespread disagreement on the articulated statements. This domain demonstrated the lowest mean score of 2.052 (SD = 1.261). The claim that "the integration of IT tools into project workflows has improved decision-making" received the lowest level of agreement, with a mean score of 1.788 (SD = 1.218), indicating that most respondents dispute the idea that IT substantially helps decision-making. Respondents typically dispute the claim that IT has reduced project delays and cost overruns, as evidenced by a score of 2.079 (SD = 1.303).

The average score for IT advancement and innovation was 2.288 (SD = 1.113). The assertion that "automation and data-driven decision-making have substantially influenced project performance" had a notable agreement score of 2.415 (SD = 0.853). This suggests that numerous individuals either agree or maintain a neutral stance about the influence of automation on performance. The assertion that "continuous training and development is conducted to align with IT advancements" had a score of 2.353 (SD = 1.171), suggesting that although some respondents acknowledge these initiatives, the prevailing viewpoint is one of dissent.

The results indicate that the majority of respondents either dissent or maintain a neutral stance about the effectiveness of IT applications in affordable housing projects. The overall mean score of 2.214 (SD = 1.180) signifies that most respondents conveyed dissent over the favourable claims about the suitability and effectiveness of IT usage. The findings align with the conclusions of Majeed et al. (2023), who observed that IT implementation in underdeveloped countries often fails to meet

expectations due to a lack of skilled labour, high employee turnover, and limited institutional capability. Thus, although information technology is recognized as a crucial enhancer of project efficiency, its strategic application in affordable housing initiatives remains inadequately developed. The results further validate the claims of Nasution, Rangkuty, and Putra (2024), who emphasized that IT frameworks, without comprehensive strategic alignment and efficient decision-making processes, may be insufficient for attaining improved outcomes in intricate project settings.

V. RESULTS OF REGRESSION ANALYSIS

The Moderating of Information Technology Application on The Relationship Between Project Environment Dynamics and Performance of Affordable Housing Projects

The hypothesis asserted that the use of information technology did not influence the relationship between project environment dynamics and the performance of affordable housing projects in the Nairobi Metropolitan Area, Kenya. This hypothesis aimed to clarify the extent to which the utilization of information technology influences the relationship between project environment dynamics and project outcomes in the housing sector. The study employed the moderation approach established by Baron and Kenny (1986) to assess this hypothesis, involving a rigorous three-step regression analysis.

Step One: Regression of Performance of Affordable Housing projects on Composite Project Environment Dynamics

The first step of the moderation analysis involved assessing the direct effect of the independent variable, project environment dynamics, on the dependent variable, affordable housing project performance. This step aimed to determine whether project environment dynamics independently forecast performance outcomes before the introduction of the moderating variable. The results of this initial regression analysis are presented in Table 2 below.

Table 2: Results of Regression Analysis of the Relationship between project environment dynamics and the performance of affordable housing development

Model Summary

Model	R	R-Squared	Adjusted R-Squared	Standard Error
1	0.1086	0.0118	0.0077	0.55806

ANOVA Analysis

Model	SS	df	MS	F	Sig.
Regression Model	0.88453	1	0.8845	2.84	0.0932
Residual	73.8080	237	0.3114		
Total	74.6926	238	0.3138		

Regression Coefficients

Dependent variable: Affordable Housing Development Performance					
Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. error	Beta		
Project Dynamic	0.1105	0.0655	0.1263	1.69	0.093
Constant Term	2.3125	0.1678		13.78	0.000

Table 2 presents the results of the preliminary phase of the moderation analysis. The R value was 0.1086, indicating a moderately weak positive correlation between project environment dynamics and the success of affordable housing developments in the Nairobi Metropolitan Area, Kenya. The R² result was 0.0118, signifying that only 1.18% of the variation in project performance can be ascribed to project environment dynamics alone. The corrected R² value was somewhat reduced at 0.0077, indicating model complexity and confirming the restricted explanatory power of the predictor variable.

The regression coefficient (β) for project environment dynamics was 0.11055, with a p-value of 0.093. This indicates that although the connection is positive, it does not achieve statistical significance at the 0.05 level, since the p-value surpasses the key barrier. Furthermore, the F-statistic for the overall model was not statistically significant ($p > 0.05$), so corroborating the conclusion that project environment dynamics do not significantly influence the performance of affordable housing projects in the Nairobi Metropolitan Area. The model is so summarized as follows:

$$AH = 2.3125 + 0.11055PED + \varepsilon \dots \dots \dots 3.6$$

Where;

PED - Composite index for project environment dynamics (exogenous variable) which is a multi-dimensional variable

AH – Performance of affordable housing development (dependent variable)

ε : Error term

Step Two: Regression of performance of Affordable Housing Project on Information Technology Application.

The second step of the moderation study involved examining the correlation between the utilization of information technology and the efficacy of affordable housing initiatives in the Nairobi Metropolitan Area, Kenya. This stage aimed to assess the direct influence of the moderating variable on project performance, independent of other factors. The regression results for this correlation are presented in Table 3 below.

Table 3: Results of Regression Analysis of the Relationship between project environment dynamics, information technology application and the performance of affordable housing projects

ANOVA Analysis

Model	SS	df	MS	F	Sig.
Regression Model	29.8660	1	29.8660	156.77	0.0000
Residual	45.1493	237	0.19050		
Total	75.0153	238	0.31519		

Model Summary

Model	R	R-Squared	Adjusted R-Squared	Standard Error
1	0.6310	0.3981	0.3956	0.43647

Regression Coefficients

Dependent variable: Affordable Housing Performance					
Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. error	Beta		
Information technology Application	0.6338	0.0506	0.5885	12.52	0.000
Constant Term	1.1931	0.1148		10.39	0.000

Table 3 displays the results from the second step of the moderation analysis. The correlation coefficient (R) between the application of information technology and the performance of affordable housing projects in the Nairobi Metropolitan Area, Kenya, was 0.631, indicating a strong positive correlation between the two variables. The coefficient of determination (R^2) was 0.3981, signifying that 39.81% of the variance in project performance can be attributed to the use of information technology.

The modified R^2 value was 0.3956, indicating a little reduction of 0.0025 (or 0.25%). This suggests that if the data were derived from the full population rather than the sample, the model would be expected to explain around 0.25% less of the variance in performance. The F-statistic was statistically significant ($p < 0.05$), suggesting that the correlation between the utilization of IT and project performance is improbable to have occurred by chance. The results demonstrate that the utilization of information technology substantially influences the efficacy of affordable housing initiatives.

The model is consequently summarized as follows:

$$AH = 1.1931 + 0.6338ITA + \varepsilon \dots \dots \dots 3.7$$

Where;

ITA - moderating variable (composite index for information technology application)

AH – Performance of affordable housing development (dependent variable)

ε : Error term

Step 3: Analysis of the Interaction Effect in the Relationship between project environment Dynamics, Information technology Application and performance of affordable housing development

The final part of the moderation analysis was examining the interaction effect of information technology application on the relationship between project environment dynamics and the performance of affordable housing projects in the Nairobi metropolitan area, Kenya. This stage was crucial in evaluating if the implementation of information technology affects the magnitude or orientation of the relationship between the independent and dependent variables. The regression results for this interaction effect are presented in Table 4.

Table 4: Regression analysis for moderated relationship between Project environment dynamics, information technology application and performance of affordable housing development

ANOVA Analysis

Model	SS	df	MS	F	Sig.
Regression Model	30.2053	3	10.0684	52.92	0.0000
Residual	44.3273	233	0.19025		
Total	74.5326	236	0.31582		

Model Summary

Model	R	R-Squared	Adjusted R-Squared	Standard Error
1	0.6366	0.4053	0.3976	0.43617

Regression Coefficients

Dependent variable: Affordable Housing Performance					
Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. error	Beta		
Project environment Dynamics	-0.1795	0.1691	-0.2051	-1.06	0.290
Information techno*Project Dynamic	0.0607	0.0709	0.0521	0.86	0.393
Information technology	0.4860	0.1957	0.4514	2.48	0.014
Constant Term	1.6309	0.4499		3.62	0.000

Table 4 indicates that the coefficient of multiple correlation (R) is 0.6366, signifying a strong association between project environment dynamics, information technology application, and the success of affordable housing projects in the Nairobi Metropolitan Area, Kenya. The coefficient of determination (R^2) for the model was 0.4053, signifying that about 40.53% of the total variation in project performance can be ascribed to the synergistic impacts of project environment dynamics and information technology application.

The adjusted R^2 decreased slightly to 0.3976, indicating a reduction of 0.0077 (or 0.77%). This suggests that using the model on the population, rather than the sample, would result in around 0.77% less variance in performance outcomes. The ANOVA table results demonstrate that the model's F-ratio was statistically significant, $F(3, 236) = 52.92$, $p < 0.05$, indicating that the variance associated with the predictors is unlikely to have occurred by chance. The results confirm that the interaction model provides a statistically significant explanation for performance variations in affordable housing developments within the study area.

The analysis of the regression coefficients in Table 4 indicates that project environment dynamics exhibited a beta coefficient of -0.1795 with a p-value of 0.290, denoting a negative and statistically insignificant relationship with the performance of affordable housing projects in the Nairobi Metropolitan Area, Kenya. The p-value above the 0.05 level, signifying that moderated project environment dynamics do not significantly influence project performance.

The application of information technology had a beta value of 0.4860 and a p-value of 0.014, signifying a positive and statistically significant association with project performance at the 95% confidence level. This discovery underscores the importance of information technology in enhancing the performance outcomes of affordable housing initiatives.

The analysis of the interaction effect (project environment dynamics × information technology application) reveals a beta coefficient of 0.0607 and a p-value of 0.393, indicating that although the interaction is positive, it is not statistically significant. The p-value considerably exceeds the 0.05 level, suggesting that the findings do not endorse the moderating influence of information technology application on the relationship between project environment dynamics and project performance. The model is therefore summarized as follows:

$$AH=1.63093-0.17950PED+0.48608ITA+0.060728ITA*PED+ \varepsilon \quad \dots\dots\dots 3.8$$

Where;

ITA- moderating variable (composite index for information technology application)

PED - Composite index for project environment dynamics (exogenous variable) which is a multi-dimensional variable

AH – Performance of affordable housing development (dependent variable)

ε : Error term

The study sought to examine the moderating effect of information technology utilization on the correlation between project environment dynamics and the effectiveness of affordable housing initiatives in the Nairobi Metropolitan Area, Kenya. A three-step multiple linear regression approach was employed, following the moderation analysis methodology developed by Baron and Kenny (1986).

Initially, the project environment dynamics did not significantly predict the performance of affordable housing, indicating a minimal direct effect. The second step revealed that the implementation of information technology positively and statistically significantly influenced performance. In the third step, the interaction term between project environment dynamics and information technology use was introduced. Despite the substantial application of information technology, both the independent variable (project environment dynamics) and the interaction term were statistically insignificant.

Baron and Kenny's (1986) moderation criteria indicate that the absence of a substantial interaction term signifies a lack of moderation. Thus, while the implementation of information technology enhances project performance, it does not influence the relationship between project environmental dynamics and performance results. This conclusion suggests that the benefits of IT application are independent of the project's environmental factors. The moderation effect summary is displayed in Table 5.

Table 5: Summary of the Moderated Relationship

Parameter	Step 1	p-value	Step 2	p-value	Step 3	p-value	Conclusion
R	0.1086	-	0.6351		0.6366	-	Fail to reject the null hypothesis and conclude that information technology application has no significant moderating effect on the relationship between project environment dynamics and the performance of affordable housing development in the Nairobi Metropolitan Area, Kenya
R ²	0.0118	-	0.4034		0.4053	-	
Adjusted R ²	0.077	-	0.3983		0.3976	-	
F-Value	2.84	0.0932	156.77	0.000	52.92	0.000	
β constant	2.3125	0.000	1.1993	0.000	1.6309	0.000	
β PED	0.1105	0.000	-	0.428	-0.1795	0.290	
β ITA	-	-	0.6338	0.000	0.4860	0.014	
β PED*ITA	-	-	-	-	0.0607	0.393	

The analysis of project environment dynamics in relation to project performance produced a coefficient of determination (R²) of 0.0118, signifying a weak correlation. The standardized beta coefficient (β = 0.1105) was statistically significant (p = 0.000), demonstrating that project environment dynamics had a modest but significant positive effect on project performance. The incorporation of information technology application as a moderating variable significantly increased the R² value to 0.4053, indicating an improvement in the model's explanatory capacity with the moderator's addition. The standardized beta coefficient for project environment dynamics decreased to -0.1795, signifying that the direct effect of the independent variable diminished in the presence of the moderator.

The Baron and Kenny (1986) methodology was employed to evaluate the moderating effect. This framework posits that moderation is confirmed if the interaction term (the product of the independent variable and the moderator) has a statistically significant regression coefficient ($\beta_3 \neq 0$, $p < 0.05$). This analysis investigated the coefficient of the interaction term to determine whether the influence of project environment dynamics on project performance significantly differed across various levels of information technology implementation. A significant β_3 would confirm that the implementation of information technology applications moderates the relationship between project environment dynamics and project performance.

The standardized beta coefficient for the interaction term between project environment dynamics and information technology application (β_3) was 0.0607, accompanied by a p-value of 0.393. Baron and Kenny's (1986) moderation testing methodology requires a statistically significant interaction term ($p < 0.05$) to confirm the presence of a moderating effect. As the p-value above the 0.05 threshold, the interaction effect is considered statistically insignificant. The study failed to reject the null hypothesis, concluding that information technology application does not significantly affect the relationship between project environment dynamics and the performance of affordable housing projects in the Nairobi Metropolitan Area, Kenya.

The findings of this study confirmed results of previous research that indicated no significant moderation effect. Hang *et al.* (2022) demonstrated that IT governance did not significantly affect the relationship between board characteristics and business continuity performance during the COVID-19 pandemic. Zardari and Tai (2021) similarly asserted that digital communication tools did not significantly enhance team effectiveness without effective communication and adaptation. Melnick *et al.* (2020) also determined that the usability of electronic health record systems did not affect the relationship between efficiency techniques and physician satisfaction. These studies demonstrate that the mere presence of IT or digital tools does not guarantee improved outcomes, especially when essential factors such as alignment, adoption, or operational readiness are lacking, thereby supporting the current study's conclusion that the implementation of information technology does not substantially affect the relationship between project environment dynamics and performance.

Although the study's results indicated that the use of information technology does not significantly influence the relationship between project environment dynamics and the performance of affordable housing projects in the Nairobi Metropolitan Area, numerous previous studies contradict this conclusion. Kabiru *et al.* (2022) emphasized that IT skills significantly impacted the relationship between business process reengineering (BPR) elements and organizational performance in Nigerian banks. Zhao *et al.* (2019) established the significance of information technology capabilities in influencing the relationship between organizational responsiveness and supply chain collaboration in Chinese enterprises, highlighting its role as a strategic facilitator in complex projects. Ilmudeen and Bao (2017) emphasized the importance of IT competency in enabling organizations to achieve improved performance.

The variation between these findings and the results of the current study may be ascribed to sectoral differences, varying levels of IT maturity, or context-specific challenges within Kenya's affordable housing and construction sector. Unlike the banking and industrial sectors, which have fully integrated IT systems into their operational processes, the construction industry seems to be in the nascent stages of IT adoption, demonstrating limited alignment between technological use and strategic project goals (Bello, Olanrewaju, Gbenga, Khan & Isa, 2024). Therefore, while the potential for IT to act as a significant moderator exists, the current level of adoption and alignment in the Nairobi Metropolitan Area may be insufficient to yield a measurable impact.

VI. CONCLUSIONS

The study concludes that information technology applications do not significantly influence the relationship between project environment dynamics and the performance of affordable housing projects in the Nairobi Metropolitan Area. This finding corresponds with previous studies indicating the restricted influence of IT in environments characterized by inadequate alignment, adoption, and operational preparedness, while differing from research in industries like banking and manufacturing where IT integration is more sophisticated and strategically ingrained. The disparity highlights that while IT can improve project outcomes, its current adoption and maturity in the Nairobi construction sector are inadequate to produce a significant impact, indicating that enhanced technological readiness, user training, and strategic alignment are essential before IT can effectively moderate performance in affordable housing projects.

VII. RECOMMENDATIONS

To augment the impact of information technology (IT) on the performance of affordable housing projects in the Nairobi Metropolitan Area, many strategies are essential. The government should establish frameworks at the policy level that encourage IT integration in housing projects, bolstered by incentives such as tax reliefs or subsidies, while concurrently enhancing digital infrastructure, including affordable internet and centralized data platforms. From a managerial standpoint, project managers and developers must prioritize capacity building via staff training, ensure alignment of IT investments with strategic project goals, and use change management tactics to mitigate opposition and cultivate a culture of innovation. Housing developers ought to initiate a gradual implementation of fundamental digital tools, including scheduling and cost-tracking systems, prior to advancing to sophisticated applications such as Building Information Modelling (BIM). Concurrently, stakeholders within the sector should adopt integrated platforms for real-time collaboration. Continuous monitoring and assessment of IT utilization in projects is crucial for capturing best practices, identifying deficiencies, and directing enhancements that can increase both adoption and project results.

REFERENCES

- [1] Ahiaga-Dagbui, D. D., Love, P. E. D., Smith, S. D., & Ackermann, F. (2017). Toward a Systemic View to Cost Overrun Causation in Infrastructure Projects: A Review and implications for Research. *Project Management Journal*, 2(48), 88–284.
- [2] Chakravarty, A., Grewal, R., & Sambamurthy, V. (2018). Information technology competencies, organizational agility, and firm performance: Enabling and facilitating roles. *Information Systems Research*, 24(4), 976–997. <https://doi.org/10.1287/isre.2013.0500>
- [3] Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information. In *Source: MIS Quarterly* (Vol. 13, Issue 3).
- [4] Government of Kenya. (2020). Republic Of Kenya State Department for Planning Third Progress Report on Implementation of The Big Four Agenda 2020/2021 FY.
- [5] Hang, Y., Hussain, G., Amin, A., & Abdullah, M. I. (2022). The Moderating Effects of Technostress Inhibitors on Techno-Stressors and Employee's Well-Being. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.821446>
- [6] Huemann, M., & Turner, R. (n.d.). *The Handbook of Project Management*.
- [7] Ilmudeen, A., & Bao, Y. (2017). Mediating role of managing information technology and its impact on firm performance: insight from China. *Industrial Management & Data Systems*, 118(4), 912–929.
- [8] Kabiru, J. R., Mohd, R. R., & Norlena, H. (2022). Moderating effect of Information technology (IT) capability on the relationship between business process reengineering factors and organizational performance of Bank. *AFRICAN JOURNAL OF BUSINESS MANAGEMENT*, 6(16). <https://doi.org/10.5897/AJBM11.2792>
- [9] Kenya National Bureau of Statistics. (2022). *Kenya Economic Survey 2022*.
- [10] Kerzner, H. (2019). *Project management: A systems approach to planning, scheduling, and controlling* (12th ed.). John Wiley & Sons.
- [11] Khamaksorn, A. (2016, December 1). *Project Management Knowledge and Skills for the Construction Industry*. <https://doi.org/10.15242/iicbe.dir1216416>
- [12] King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information and Management*, 43(6), 740–755. <https://doi.org/10.1016/j.im.2006.05.003>
- [13] Marzouk, M., & Othman, A. (2020). Planning utility infrastructure requirements for smart cities using the integration between BIM and GIS. *Sustainable Cities and Society*, 57. <https://doi.org/10.1016/j.scs.2020.102120>
- [14] Md Ab Malik, A., Kassim, E. S., & Hairuddin, H. (2019). Project strategy and performance: Moderating effects of information technology use and position. *Academy of Strategic Management Journal*, 18(6), 1–6.

- [15] Melnick, E. R., Harry, E., Sinsky, C. A., Dyrbye, L. N., Wang, H., Trockel, M. T., West, C. P., & Shanafelt, T. (2020). Perceived electronic health record usability as a predictor of task load and burnout among US physicians: Mediation analysis. *Journal of Medical Internet Research*, 22(12). <https://doi.org/10.2196/23382>
- [16] Nasution, L. N., Rangkuty, D. M., & Putra, S. M. (2024). The Digital Payment System: How Does it Impact Indonesia's Poverty? *ABAC Journal*, 44(3), 228–242. <https://doi.org/10.59865/ABACJ.2024.37>
- [17] Oladapo, A. A. (2006). The Impact of ICT on Professional Practice in the Nigerian Construction Industry. *Electronic Journal of Information Systems in Developing Countries*, 24(1), 1–19. <https://doi.org/10.1002/j.1681-4835.2006.tb00157.x>
- [18] Rani, H.A; Abdullah, C.S; Mohtar, S. (2018). The Moderating Effect of Technology on the Utilization on Project Management Function and Project Performance. *Malaysian Management Journal*, 17(4), 77–113. <http://www.mmj.uum.edu.my/index.php/previous-issues/140-malaysian-management-journal-mmj-vol-17-2013?fontstyle=f-larger>
- [19] Seun, E., Babajide, G., Taye, F., Aderonke, A., & Olabode, B. (2023). Impact of Information Systems on Operational Efficiency: A Comprehensive Analysis. *Indian Journal of Computer Science and Engineering*, 14(4), 661–673. <https://doi.org/10.21817/indjcse/2023/v14i4/231404013>
- [20] Succar, B. (2015). Building Information Modelling Maturity Matrix. In *Handbook of Research on Building Information Modelling and Construction Informatics: Concepts and Technologies* (pp. 65–103). <https://doi.org/10.4018/978-1-60566-928-1.ch004>
- [21] UN-Habitat. (2020). *World cities report 2020: The value of sustainable urbanization*.
- [22] Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, 39(2), 273–315. <https://doi.org/10.1111/j.1540-5915.2008.00192.x>
- [23] Venkatesh, V., & Davis, F. D. (2000). Theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. *Management Science*, 46(2), 186–204. <https://doi.org/10.1287/mnsc.46.2.186.11926>
- [24] Zardari, S., & Tai, J. (2021). Moderating Effect of Digital Communication Systems, Including Slack and Jira, on the Correlation Between Team Agility and Project Delivery Success. <https://www.researchgate.net/publication/339077481>
- [25] Zhao, Cai ;Qian, Huang; Hefu, L. L. (2016). The Moderating Role of Information Technology Capability in the Relationship between Supply Chain Collaboration and Organizational Responsiveness: Evidence from China. *International Journal of Operations & Production Management*, 36(10), 91–100.