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PROJECT MANAGEMENT

# PROJECT MANAGEMENT PRACTICES AND SUSTAINABILITY OF BUILDING PROJECTS IN KENYA: A CASE STUDY OF CONSTRUCTION FIRMS IN NAIROBI COUNTY, KENYA

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## ABSTRACT

**Purpose of the study:** The research aimed to evaluate the impact of project management practices on the sustainability of building projects among selected firms in Kenya, with a focus on those situated in Nairobi County. The specific objectives of the study were to find out the effects of technology adoption, capacity planning, resource allocation, and the role of stakeholder involvement in influencing the sustainability of building construction projects among selected construction firms in Kenya.

**Methodology:** The chosen research design was descriptive. The target population was 18 construction companies and the unit of analysis was these companies, while the unit of observation included top-level management, site managers and site foremen. A purposive sampling technique was used to select 216 participants. Data was collected through closed-ended questionnaires. SPSS was used for data analysis, involving descriptive and inferential statistics.
**Findings:** The correlation results showed that technological adoption (r=0.705, p=0.000), capacity planning (r=0.610, p=0.000), resource allocation (r=0.642, p=0.000), and stakeholder involvement (r=0.556, p=0.000) are positively and significantly associated with the sustainability of building construction projects. The regression results showed that technological adoption was positively and significantly related to the sustainability of building construction projects (β=0.289, p=0.000). Additionally, capacity planning exhibited a positive and significant relationship with sustainability (β=0.151, p=0.006). Resource allocation demonstrated a positive and significant relationship with sustainability (β=0.219, p=0.000). Stakeholder involvement was positively and significantly related to sustainability (β=0.142, p=0.001).
**Conclusion:** The study concludes that technological adoption, capacity planning, resource allocation, and stakeholder involvement have a significant positive effect on the sustainability of building construction projects among selected construction firms in Kenya.
**Recommendations:** The study recommends that construction firms in Kenya actively pursue and invest in the adoption of advanced technologies, such as Building Information Modeling (BIM) systems, digital tools for project monitoring, and stakeholder collaboration platforms, to enhance sustainability. The study also recommends implementing robust capacity planning strategies, including the use of appropriate tools and techniques and adjustment of plans, and optimization of resource allocation to streamline operations and enhance resource efficiency.
**Keywords:** *Technological adoption, capacity planning, resource allocation, stakeholder involvement, building construction projects, Nairobi County, Kenya*

## BACKGROUND OF THE STUDY

Sustainability is a critical aspect of any project, and it encompasses various measures to ensure long-term viability and minimal environmental impact. Sustainability is the development that meets the needs of the present generation without compromising the ability of future generations to meet their needs (Taha et al., 2020). Sustainable projects are those that remain suitable/relevant for long, meets priorities to the users and there is high preservation of the environment. One of the key elements is the establishment of sustainability metrics & key performance indicators. These metrics provide a quantifiable means to assess the project's progress towards achieving its sustainability goals (Kamau, 2019; Momanyi & Kamau, 2020). By setting specific targets and regularly monitoring performance, stakeholders can identify areas for improvement and implement necessary adjustments.

Energy efficiency and environmental impact are significant considerations in sustainability. Projects should strive to minimize their energy consumption and reduce their carbon footprint through the adoption of sustainable practices (Ganiyu, 2020). This may involve the implementation of energy-efficient technologies, the utilization of renewable energy sources, and the incorporation of environmentally friendly design principles (Darko et al., 2020). Assessing and mitigating the project's impact on the environment is crucial for long-term sustainability (Venkatesh et al., 2019). In addition, effective material and resource management is another essential aspect of sustainability. This involves the responsible sourcing and utilization of materials, as well as the implementation of waste reduction and recycling strategies (Magassouba et al., 2019).

Projects should aim to minimize waste generation and promote the reuse or repurposing of materials whenever possible. Additionally, the selection of sustainable and locally sourced materials can contribute to reducing the project's overall environmental footprint (Li et al., 2022). Projects should strive to create positive impacts on the local communities they operate in, by promoting ethical labor practices, supporting local economic development, and fostering community engagement (Ronoh, 2020). Collaboration with stakeholders and the integration of their perspectives can help ensure that the project aligns with the needs and values of the community (Khatatbeh, 2020; Mulei & Gachengo, 2021).

In recent discussions on sustainable project management practices, optimized resource allocation is a crucial element. Contemporary research highlights the importance of selecting environmentally friendly materials, minimizing waste, and promoting circular economy principles (Arashpour et al., 2020). Strategic resource allocation involves judiciously using

materials, energy, and manpower with a focus on environmentally responsible practices (Ding et al., 2021; Giro-Paloma et al., 2020). The literature advocates for sustainable resource allocation to minimize waste, reduce environmental impact, and promote circular economy principles in the construction industry. Adequate resource allocation ensures smooth organizational activities, even during crises (Gunduz & Almuajebh, 2020). Sustainable resource allocation practices contribute to reducing the ecological footprint of building projects.

The involvement of stakeholders in building projects is recognized as a determinant of sustainability. Recent literature emphasizes the role of inclusive stakeholder engagement in addressing diverse environmental, social, and economic considerations (Ofori, 2019; Sánchez, 2020). Stakeholder involvement is viewed as a dynamic and iterative process that ensures the alignment of project objectives with broader sustainability goals and fosters ethical and socially responsible construction practices. In conclusion, latest literature provides a nuanced understanding of how project management practices, specifically focusing on technology adoption, capacity planning, resource allocation, and stakeholder involvement, significantly impact the sustainability outcomes of building projects. As the construction industry continues to evolve, the integration of these practices emerges as a key driver for achieving both project success and broader sustainability objectives.

Continuous improvement and adaptation are essential for maintaining sustainability over the long term. Projects should regularly evaluate their performance, identify areas for enhancement, and implement necessary changes (Osedo, 2021; Ronoh & Kirui, 2020). Thus, achieving sustainability in projects requires a comprehensive and multi-faceted approach. It necessitates the establishment of clear sustainability metrics and key performance indicators to quantify progress and identify areas for improvement. Prioritizing energy efficiency, minimizing environmental impact, and implementing effective material and resource management strategies are crucial. By embracing these measures, projects can not only mitigate their environmental footprint but also create lasting value for society and future generations.

## STATEMENT OF THE PROBLEM

The sustainability of some Kenyan projects has faced challenges, as evidenced by the report from the Kenya National Bureau of Statistics (2020). Despite the construction industry's significant contribution of 5.6% to the country's GDP in 2019 and providing employment to approximately 222,000 people, the sector experienced a decline, with growth dipping from 6.9% in 2018 to 6.4% in 2019. This decline highlights the obstacles that Kenyan projects encounter in achieving long-term sustainability. Furthermore, many construction firms in the Kenya have

prioritized cost-cutting measures over sustainable practices, leading to the widespread use of substandard materials, inadequate waste management systems, and a lack of energy-efficient designs (Gachigwa, 2022). For instance, numerous residential and commercial buildings in Nairobi have been constructed without proper insulation, resulting in excessive energy consumption for heating and cooling (Mwangi, 2019).

The National Construction Authority found that 58 percent of buildings in Nairobi County were unfit for habitation (Oiriga & Ngari, 2019). In addition, Kimeria, Kising'u and Oyoo (2019) showed various unsustainable buildings in Nairobi's Eastlands estates, particularly Umoja, Huruma, Dandora, Kayole. Moreover, the improper disposal of construction waste has contributed to environmental degradation and health hazards within the city (Sila & Gakobo, 2021). The collapse of several buildings in Nairobi, such as the Huruma residential building in 2016 and the Tassia building in 2019, further highlights the consequences of neglecting sustainable construction practices and adherence to safety standards (Bucha, Onyango & Okello, 2020). While initiatives like the Green Building Council of Kenya aim to promote sustainability, their impact has been limited due to insufficient enforcement and a lack of widespread adoption by construction firms in Nairobi City County (Mulei, 2021).

The literature review revealed a lack of sufficient information to draw a comprehensive conclusion. While numerous empirical research studies have delved into the practices related to project management and project performance, there remains a need for further research and exploration to fill these gaps. For instance, Li et al. (2022) conducted their study in China, Kamau (2019) focused on real estate firms in Nairobi County, and Taha et al. (2020) explored BIM technology in Iraqi construction projects. These contextual differences may limit the direct applicability of their findings to the specific context of building construction projects in Nairobi City County. The conceptual gap is evident in the reviewed literature as none of the studies particularly examined the influence of technology adoption, capacity planning, resource allocation, and stakeholder involvement on the sustainability of building construction projects in Nairobi City County. While some studies looked at related aspects, such as the impact of technology on performance (Khatatbeh, 2020) or the effect of technological innovations on real estate firms (Kamau, 2019), they did not directly address sustainability in the construction context.

The methodological gap in the literature is related to the research design, data, and sampling techniques used in the reviewed studies. Some studies relied on descriptive research designs (Kamau, 2019; Ronoh, 2020; Chepng'eno & Kimutai, 2021), while others used case studies

(Taha et al., 2020; Darko, Chan & Owusu, 2020) or surveys (Mustafa, 2020; Osedo, 2021) as their primary research methods. These variations in research methodologies may impact the generalizability of the findings to building construction projects in Nairobi City County. In light of the identified knowledge gap, this research sought to assess the impact of project management practices on the sustainability of building projects among selected construction firms in Kenya, particularly those located in Nairobi.

## RESEARCH OBJECTIVES

i. To examine the effect of technological adoption on sustainability of building projects among selected construction firms in Nairobi County.
ii. To determine the effect of capacity planning on sustainability of building projects among selected construction firms in Nairobi County.
iii. To access the effect of resource allocation on sustainability of building construction projects among selected construction firms in Nairobi County.
iv. To examine the effect of stakeholder involvement on sustainability of building construction projects among selected construction firms in Nairobi County.

## LITERATURE REVIEW

The literature review included the empirical and conceptual framework.

### Empirical Review

The study done by Li, Sun, Li, Song and Ding (2022) examined the impact of digital technologies like BIM and IoT on sustainability in construction projects. The study highlights the mediating role of stakeholder collaboration in enhancing economic, environmental, and social performance. Data from Chinese construction project managers and members were analyzed using the PLS-SEM method. The findings reveal that digital technology directly improves performance metrics, while stakeholder collaboration notably boosts economic and environmental aspects. This research not only deepens our understanding of digital transformation in project sustainability management but also offers practical insights for the AEC industry to maximize the benefits of digital technology adoption.

Kamau (2019) examined the effect of technological innovations on the performance of real estate firms in Nairobi County, Kenya. The study explored three main components of technological innovations: internet innovation, building technology and operational integration. A descriptive research design was employed, targeting 150 employees from various real estate firms. The sample comprised 109 employees from IT, Finance, and Operations departments. The study used

questionnaires for data collection and applied both quantitative and qualitative research methods for analysis. Findings indicated that operational integration had the most significant impact on firm performance, as evidenced by its high mean and strong positive correlation. Internet innovation also significantly affected performance, ranking second in impact. Building technology had a moderate impact. The study concluded that the effective use of these technological innovations, especially operational integration and internet innovation, could significantly enhance the performance of real estate firms. Recommendations were made for real estate companies to focus on aligning marketing strategies with social media and invest in employee training to keep abreast of technological advances in the industry. The study's insights are also suggested to be potentially beneficial for other industries, inviting further research into the role of technological innovation in competitive advantage within the real estate sector.

Ronoh (2020) conducted a study to examine management practices that influence the performance of residential construction projects in Nairobi City County. Simple random sampling was used. The survey results showed that the performance of the projects is determined by capacity planning, resource scheduling, project communication and monitoring and evaluation and capacity building of the stakeholders. The study noted that capacity building of the employees enhances them to be much innovative to use social media for marketing rental houses or sale of property or even improve search engine rankings and traffic to business websites.

Gunduz and Almuajebh (2020) sought to determine the critical success factors for sustainable construction project management in Qatar. A comprehensive literature review was carried out. The results of the study showed that sustainable construction project management in Qatar are determined by capacity building, technology adoption and funds allocation. Capacity building includes technological training and promoting the use of mobile technology to give a flexible working environment. The study concluded much considerations in capacity building, technology adoption and funds allocation have the possibility of increasing sustainability. The study was literature-based and thus presents a methodological gap.

Mulei and Gachengo (2021) investigated the influence of community capacity development on the sustainability of government-funded water projects in Kilome Sub-County, Makueni County, Kenya. Their study revealed a significant positive relationship between community capacity development (focusing on investment in community capacity and community organizing) and the sustainability of these projects. Analyzing data from 114 Project Management Committees and five project staff, the study found that these parameters contributed 55.7% to project

sustainability. Venkatesh, Renuka, Malathi and Umarani (2019) sought to identify critical factors that influence the resource allocation in Indian construction projects in private and public sectors. The findings revealed that some of the critical factors: procurement of materials, skill of employees, quality of materials, cost of the raw materials are essential factors that influence the resource allocation. The study concluded effective allocation of resources affects the performance of the projects positively. However, the research was mainly focused on the procurement of materials, the skill of employees, quality of materials, and cost of the raw materials and thus presents a conceptual gap.

Ganiyu (2020) indicated that the sustainability of affordable housing construction projects is influenced by the development of capacity building, advancement in technology and promoting adequate resource allocation. Mambwe, Mwanaumo, Nsefu and Sakala (2020) conducted a study to assess the impact of stakeholder engagement on the performance of road construction projects in Lusaka District, particularly under the L400 roads project. Using a quantitative and descriptive research design, the study focused on how stakeholder engagement affects project cost, schedule, and specifications. The findings indicated a positive correlation between stakeholder engagement and both project schedule and specifications. The study also found a strong negative correlation between stakeholder engagement and project cost.

Ochunga (2020) investigated the impact of stakeholder participation on the sustainability of community development projects implemented by Plan International in Homa Bay Town Sub-County. The study aimed to explore various levels of participation - passive, interactive, functional, and optimum - and their influence on project sustainability. Adopting a descriptive survey design, the research targeted 153 individuals from 51 organizations partnering with Plan International, achieving a response from 103 respondents. Using SPSS for data analysis, the study found a weak and insignificant negative association between passive participation and project sustainability. In contrast, there were moderate significant positive correlations between interactive, functional, and optimum participation and the sustainability of these projects. The research concluded that Plan International should focus less on passive engagement and more on interactive, functional, and optimal stakeholder participation to improve the efficiency, effectiveness, and sustainability of its community development projects.

Maier and Aschilean (2020) explored the critical role of stakeholder management in the sustainability of the construction industry. The paper was presented at the 36th IBIMA Conference, focused on the dynamic and complex nature of the building industry, emphasizing the need to effectively manage the diverse expectations and interests of internal and external

participants, or stakeholders, involved in construction projects. The study proposed an eleven-step process for identifying and managing construction stakeholders, highlighting that proper stakeholder management can better satisfy constituent needs, balance interests, and ultimately enhance the sustainability of the construction industry.

**Conceptual Framework**

The conceptual framework presented in Figure 1 illustrates the relationship between the technology adoption, capacity planning, resource allocation, stakeholder involvement, and sustainability.

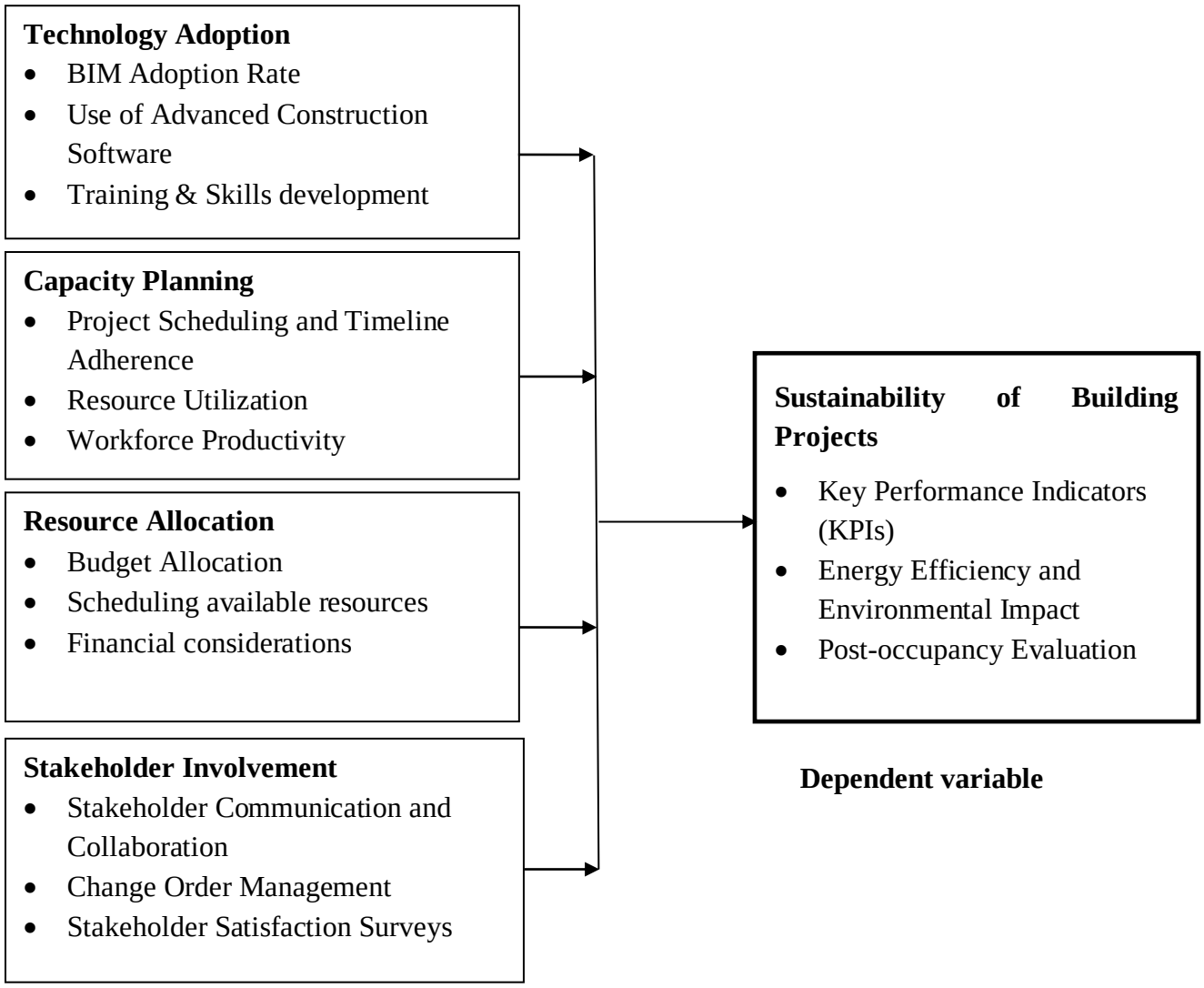


**Figure 1: Conceptual Framework**

## RESEARCH METHODOLOGY

The study employed a descriptive research design to investigate the attributes of various phenomena without manipulating any variables, specifically focusing on the attitudes, opinions, and habits of individuals associated with 18 construction companies in Nairobi County. The population included top-level managers, site managers, and site foremen from these companies, and the data were compiled based on a purposive sampling technique, allowing the researcher to use their judgment to select a technically suitable sample for the study. For data collection, the researcher administered questionnaires directly to the different management levels of the sampled construction companies, obtaining responses through a drop-and-pick technique to ensure confidentiality and reliability of the data collected. The analysis of the collected data was performed using SPSS, employing descriptive and inferential statistics to draw conclusions. The study maintained high ethical standards, securing approvals from relevant authorities and ensuring respondent anonymity and data confidentiality, with data processed and analyzed using SPSS to draw conclusions on the effectiveness of current management practices.

## RESEARCH FINDINGS AND DISCUSSIONS

### Response Rate

The sample size for this study consisted of 192 respondents. The respondents included top-level management, site management, and site foremen. Out of the total sample size of 192, the study received 178 questionnaires that were completed properly. The analysis and inferences were based on these 178 responses. Thus, average response rate was 92.71% (178/192), which was significantly higher than the 60% threshold recommended by Zhao, Wang, Hemani, and Bowden (2020) and Hemani, Tilling, and Smith (2021) for ensuring adequate representation in analyses. Such a high response rate enhances the reliability of the survey's outcomes, instilling greater confidence in the findings. Consequently, this boosts the study's influence, as stakeholders may regard its conclusions with higher credibility. The robust response rate underscores the participants' engagement and interest in the study, potentially leading to a more insightful and comprehensive understanding of the subject matter.

### Correlation Analysis

Correlation analysis examines the association between independent and dependent variables. The correlation results are summarized in Table 1.

**Table 1: Correlation Results**

| | | Sustainability of Building Projects | Technology adoption | Capacity Planning | Resource Allocation | Stakeholder Involvement |
|---|---|---|---|---|---|---|
| Sustainability of Building Projects | Pearson Correlation | 1.000 | | | | |
| | Sig. (2-tailed) | | | | | |
| Technology adoption | Pearson Correlation | .705** | 1.000 | | | |
| | Sig. (2-tailed) | 0.000 | | | | |
| Capacity Planning | Pearson Correlation | .610** | .559** | 1.000 | | |
| | Sig. (2-tailed) | 0.000 | 0.000 | | | |
| Resource Allocation | Pearson Correlation | .642** | .525** | .468** | 1.000 | |
| | Sig. (2-tailed) | 0.000 | 0.000 | 0.000 | | |
| Stakeholder Involvement | Pearson Correlation | .556** | .449** | .527** | .384** | 1.000 |
| | Sig. (2-tailed) | 0.000 | 0.000 | 0.000 | 0.000 | |

The study results as shown in Table 1 found that the technology adoption is positively and significantly associated with the sustainability of building projects (r=0.705, p=0.000). This positive correlation implies that higher levels of technological adoption are linked to improved sustainability outcomes in construction projects. Moreover, the study found that capacity planning is positively and significantly associated with the sustainability of building projects (r=0.610, p=0.000). This positive relationship suggests that effective capacity planning practices contribute to enhancing the sustainability of construction projects. Additionally, the study found that resource allocation is positively and significantly associated with the sustainability of building projects (r=0.642, p=0.000). This positive correlation indicates that proper resource allocation strategies play a vital role in achieving sustainable construction practices. Finally, the study found that stakeholder involvement is positively and significantly associated with the sustainability of building projects (r=0.556, p=0.000). This positive association highlights the importance of engaging stakeholders in the construction process to promote sustainable practices and outcomes.

The study results concur with the findings of Gunduz and Almuajebh (2020) who indicated that capacity building, technology adoption, and funds allocation are critical for sustainable construction project management in Qatar. Taha, Hatem, and Jasim (2020) demonstrated that BIM technology, particularly through design parameter alternatives like window-to-wall ratio, significantly optimizes energy use and costs, contributing to sustainability in Iraqi construction projects. Mulei and Gachengo (2021) found a significant positive relationship between

community capacity development and the sustainability of government-funded water projects in Kenya. Mustafa (2020) indicated that capacity planning is a key factor in enhancing project sustainability in Laikipia County, Kenya.

Osedo (2021) identified staff competency, management support, and project planning tools as significant factors for effective construction project implementation in Nairobi. Ronoh and Kirui (2020) observed a positive relationship between resource scheduling and the performance of residential construction projects in Nairobi. Chepng'eno and Kimutai (2021) demonstrated that project planning and resource allocation significantly impact the sustainability of road projects in Kericho County, Kenya. Ganiyu (2020) found that capacity building, technology advancement, and resource allocation enhance the sustainability of affordable housing projects in Cape Town, South Africa. Momanyi and Kamau (2020) highlighted efficient resource allocation as critical for the performance of housing construction projects in Kisii County, Kenya.

**Regression Analysis**

Regression analysis is a statistical method used to understand the relationship between variables. The goal of regression analysis is to find the best linear combination of the independent variables that can predict the dependent variable. The regression analysis includes the analysis of model fitness, analysis of variance and regression of coefficient. The study results of the model fitness are presented in Table 2

**Table 2: Model Fitness**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .811a | 0.658 | 0.65 | 0.200373 |

The study results in Table 2 show that the R Square value is 0.658, indicating that approximately 65.8% of the variance in the dependent variable, which is the sustainability of building construction projects among selected construction firms in Kenya can be explained by technological adoption, capacity planning, resource allocation and stakeholder involvement. This high R Square value suggests that the regression model with these predictors has good explanatory power and captures a significant amount of the variation in construction project sustainability practices within the studied sample of Kenyan construction firms. The analysis of variance results in the analysis are presented in Table 3.

**Table 3: Analysis of Variance (ANOVA)**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 13.368 | 4 | 3.342 | 83.24 | .000b |
| | Residual | 6.946 | 173 | 0.04 | | |
| | Total | 20.314 | 177 | | | |

The study results presented in Table 3 show that the p-value associated with the Analysis of Variance (ANOVA) for the regression model is 0.000. This indicates that the overall regression model is statistically significant, as the p-value is less than the conventional significance level of 0.05. In other words, the combination of the predictor variables (technological adoption, capacity planning, resource allocation, and stakeholder involvement) significantly explains the variation in the dependent variable (sustainability of building construction projects). This result implies that the regression model, with these four predictors, is a good fit for the data and can be reliably used to make inferences about the relationships between the independent variables and the sustainability of construction projects. The regression of coefficient results is presented in Table 4.

**Table 4: Regressions of Coefficients**

| | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|
| | Beta | Std. Error | Beta | | |
| (Constant) | 0.217 | 0.110 | | 1.979 | 0.049 |
| Technological adoption | 0.289 | 0.045 | 0.374 | 6.412 | 0.000 |
| Capacity planning | 0.151 | 0.054 | 0.164 | 2.780 | 0.006 |
| Resource allocation | 0.219 | 0.040 | 0.296 | 5.462 | 0.000 |
| Stakeholder involvement | 0.142 | 0.041 | 0.188 | 3.486 | 0.001 |

The regression model thus becomes;

$$Y = 0.217 + 0.289X_1 + 0.151X_2 + 0.219X_3 + 0.142X_4$$

Where: Y = Sustainability; $X_1$= Technology adoption; $X_2$ = Capacity planning; $X_3$ = Resource allocation; $X_4$ = Stakeholder involvement

The study results in Table 4 found that technological adoption is positively and significantly related to the sustainability of building construction projects among selected construction firms in Kenya (β=0.289, p=0.000). This indicated that construction firms adopting new technologies tend to achieve better sustainability outcomes in their building projects. In addition, it was found that capacity planning is positively and significantly related to sustainability (β=0.151, p=0.006).

This indicates that effective capacity planning practices contribute to enhancing the sustainability performance of construction projects. Moreover, the study found that resource allocation is positively and significantly associated with sustainability (β=0.219, p=0.000). This implies that proper allocation and management of resources play a crucial role in enabling sustainable construction practices.

The study also found that stakeholder involvement is positively and significantly related to sustainability (β=0.142, p=0.001). This indicates that active engagement and involvement of stakeholders throughout the construction process is linked to improved sustainability outcomes in building projects. The study results are consistent with the findings of Li, Sun, Li, Song, and Ding (2022) who found that digital technologies like BIM and IoT directly enhance construction project sustainability. Kamau (2019) discovered that in Nairobi's real estate firms, operational integration significantly impacts firm performance, followed by internet innovation, with building technology having a moderate effect. Magassouba, Tambi, Alkhlaifat, and Abdullah (2019) emphasized the significant role of stakeholder involvement in the sustainability of development projects in Guinea.

Mambwe, Mwanaumo, Nsefu, and Sakala (2020) found a positive correlation between stakeholder engagement and the performance of road construction projects in Lusaka, Zambia. Ochunga (2020) discovered that higher levels of stakeholder participation correlate positively with the sustainability of community development projects in Homa Bay, Kenya. Maier and Aschilean (2020) proposed an eleven-step process for managing stakeholders to enhance the sustainability of the construction industry. Ebekozien, Aigbavboa, and Ramotshela (2023) emphasized the crucial role of effective stakeholder engagement in South African construction projects for enhanced collaboration and delivery. Adhi and Muslim (2023) identified the importance of cohesive collaboration and lean construction principles in stakeholder engagement for sustainable construction in Indonesia.

Khatatbeh (2020) revealed a significant positive impact of technology on project management and performance in Jordan's construction sector. Magaba and Cowden (2020) found that technological changes lead to effective project management and timely completion in Kuwait's construction industry. Saleh and Al-Swidi (2019) highlighted that environmental and TPB variables strongly influence the adoption of green building practices in Qatar's construction projects. Ronoh (2020) showed that capacity planning, including training and resource scheduling, positively influences the performance of residential construction projects in Nairobi.

## CONCLUSIONS

The study concludes that technological adoption, capacity planning, resource allocation, and stakeholder involvement significantly influence the sustainability of building construction projects among selected construction firms in Kenya. The adoption of advanced technologies like Building Information Modeling (BIM), construction management software, and digital monitoring tools facilitates efficient resource utilization, reduces waste, improves decision-making, and enables more sustainable practices throughout project lifecycles. Effective capacity planning through optimal allocation and management of resources, personnel, equipment, and schedules contributes to minimizing waste and achieving sustainability goals.

Furthermore, the study concludes that proper resource allocation involving responsible financial management, material sourcing, equipment allocation, and personnel management is essential for achieving sustainable construction outcomes. Effective strategies for budgeting, waste reduction, and resource monitoring can minimize environmental impact and enhance economic and social sustainability aspects. Additionally, active stakeholder involvement through open communication and collaboration with clients, suppliers, communities, and regulators is crucial for identifying sustainability concerns, incorporating sustainable practices, and ensuring alignment with sustainability requirements. Overall, these factors significantly influence the ability of construction firms in Kenya to deliver sustainable building projects.

## RECOMMENDATIONS

The study recommends that construction firms in Kenya actively pursue and invest in the adoption of advanced technologies to enhance the sustainability of their building projects. Specifically, firms should prioritize the implementation of Building Information Modeling (BIM) systems, digital tools for project monitoring, progress tracking, and stakeholder collaboration. These technologies can facilitate efficient design, coordination, management while minimizing waste, optimizing resource utilization, and enabling more sustainable practices. To support successful adoption, firms should develop comprehensive training programs to ensure their workforce has the necessary skills to leverage these technologies effectively.

Additionally, the study recommends that firms implement robust capacity planning strategies, develop comprehensive resource allocation plans, and prioritize stakeholder engagement throughout project lifecycles. Effective capacity planning using tools like resource leveling and critical path analysis can optimize resource allocation and streamline operations. Establishing

clear procedures for budgeting, material sourcing, and equipment allocation aligned with sustainability goals is crucial. Leveraging financial experts and sustainability specialists can guide responsible resource utilization. Actively engaging stakeholders like clients, suppliers, communities, and regulators through open communication and collaboration platforms allows firms to incorporate sustainable practices, gather feedback, and ultimately contribute to the long-term sustainability of the built environment.

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