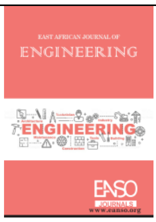

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Original Article

Influence of Technology on Labour Productivity in the Construction Industry in Nairobi City County, Kenya

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ABSTRACT

The construction industry in Nairobi City County, Kenya, significantly contributes to economic growth, infrastructure development, and job creation. However, rapid urbanisation has exposed inefficiencies such as project delays, resource constraints, and low labour productivity. This study aimed to examine the influence of technology adoption, specifically safety technology, Building Information Modelling (BIM), construction automation, and remote monitoring on labour productivity in the construction sector. Guided by the Theory of Constraints, the study sought to identify how technology alleviates productivity limitations in construction processes. The specific objectives were to establish the influence of safety technology and assess the impact of BIM on labour productivity. The research targeted a population of 2,610 construction professionals in Nairobi, including engineers, architects, quantity surveyors, contractors, technicians, and artisans. A sample size of 261 was selected through simple random sampling. Primary data were collected using semi-structured questionnaires and interview guides. The questionnaires featured closed-ended and Likert-scale questions to gather quantitative data, while interviews provided qualitative insights. The study achieved an 88% response rate (230 responses). Data analysis was conducted using SPSS, employing correlation, regression, and ANOVA techniques. The results revealed a significant positive correlation ($r = 0.386$, $p < 0.05$) between technology use and labour productivity. Regression findings showed that technology use accounted for 14.9% of the variance in productivity levels. The study concludes that technology adoption enhances efficiency, safety, and project outcomes in Nairobi's construction industry. It is recommended that construction firms invest in affordable technologies and capacity building. Policymakers should support technological innovation through training and incentives. Further research should explore the impact of artificial intelligence and digital tools in other regions of Kenya and Sub-Saharan Africa.

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INTRODUCTION

The construction industry remains a vital driver of economic growth and national development in Kenya, particularly in urban centres such as Nairobi City County. As one of the fastest-growing cities in Africa, Nairobi is experiencing a surge in demand for housing, transportation infrastructure, and commercial real estate, making construction a key sector for investment and policy focus (KNBS, 2023; World Bank, 2022). The sector significantly contributes to the country's Gross Domestic Product (GDP) and serves as a major source of employment, especially for low- and semi-skilled workers (Republic of Kenya, 2021). In addition to job creation, the industry stimulates other sectors such as manufacturing, mining, and transportation, creating backwards and forward linkages critical to overall national development (African Development Bank [AfDB], 2021; Gachanja & Luketero, 2020).

Despite its considerable economic importance, the construction industry in Nairobi faces systemic challenges that undermine its productivity and efficiency. These include project delays, cost overruns, substandard workmanship, and significant material wastage (Alinaitwe et al., 2017; Kikwasi, 2012). Such inefficiencies are attributed to a variety of factors, including over-reliance on manual processes, limited use of advanced project management tools, lack of skilled labour, and poor coordination among stakeholders (Gwaya et al., 2014; Talukhaba et al., 2019). Additionally, governance issues such as inadequate enforcement of building codes, weak institutional frameworks, and corruption have further compounded project inefficiencies (Transparency International Kenya, 2020; Mwangangi & Kihoro, 2018).

Globally, the construction sector has undergone profound transformation through the adoption of emerging technologies. Building Information Modeling (BIM), drones for site surveying, automated construction machinery, Artificial Intelligence (AI), and Internet of Things (IoT) devices are being used to enhance project planning, resource optimization, and safety on construction sites (Azhar et al., 2012; Eastman et al., 2011). These innovations have improved labour productivity by streamlining workflows, enabling real-time decision-making, and minimising rework (Sacks et al., 2018; Bryde et al., 2013). Technological integration has also been associated with improved project outcomes, greater cost efficiency, and higher client satisfaction in markets where adoption is widespread (Zhou et al., 2012; Hosseini et al., 2016).

However, in the context of developing countries such as Kenya, the adoption of modern construction technologies has been relatively limited. This lag is driven by several constraints, including high initial investment costs, limited access to capital, insufficient awareness among industry stakeholders, and a general lack of technical expertise to manage and maintain new systems (Makori et al., 2020; Muriithi et al., 2017; Maina & Mwaura, 2021). Cultural resistance to change and institutional inertia have also slowed the transition from traditional to digital construction practices (Chege & Rwelamila, 2020; Ofori, 2015). Furthermore, many small and medium-sized construction firms lack the capacity to adopt and scale up new technologies, thereby perpetuating the cycle of low productivity (Karuma & Gwaya, 2020; Nduati & Karanja, 2022).

Labour productivity, defined as the ratio of output to labour input, is a critical metric in construction performance, and its improvement is essential for addressing the challenges facing Nairobi's construction sector (Hwang & Zhao, 2014; Thomas & Horman, 2006). Studies have shown that technological adoption has a direct and positive impact on productivity by reducing human error, enhancing precision, enabling better resource scheduling, and improving communication across project teams (Brynjolfsson & Hitt, 2003; Lee, Yu, & Jeong, 2015). In Kenya, however, the low rate of technology adoption continues to constrain productivity gains, especially in large-scale public projects and low-cost housing developments, where cost-cutting pressures often discourage investment in innovation (Muchangi & Kaluli, 2019; Waswa & Mbote, 2021).

Given these dynamics, this study seeks to explore the relationship between technology adoption and labour productivity in the construction industry in Nairobi City County. The research aims to assess the extent to which construction technologies are currently utilised, evaluate their effectiveness in enhancing workforce efficiency, and identify key challenges and opportunities in their implementation. By analysing both qualitative and quantitative data, the study will provide insights for policymakers, construction managers, developers, and investors on how to better align technological innovation with productivity goals (Ngugi et al., 2020; Kamau & Mohamed, 2019). Ultimately, this research aspires to contribute to the broader agenda of transforming Kenya's construction sector into a more sustainable, efficient, and globally competitive industry.

Research Problem

Despite the construction industry's vital role in driving economic growth, employment, and infrastructural development in Nairobi City County (KNBS, 2023; World Bank, 2022; Republic of Kenya, 2021), the sector continues to face persistent productivity challenges. These inefficiencies evident in project delays, cost overruns, substandard workmanship, and material wastage, stem from factors such as over-reliance on manual processes, poor coordination among stakeholders, and limited adoption of advanced project management tools (Alinaitwe et al., 2017; Gwaya, Wanyona, & Masu, 2014; Talukhaba, 2019). Globally, construction technologies such as Building Information Modeling (BIM), drones, AI, and IoT have been shown to enhance project outcomes and labour productivity by improving planning, reducing errors, and streamlining communication (Azhar, Khalfan, & Maqsood, 2012; Sacks et al., 2018; Bryde, Broquetas, & Volm, 2013). However, in Kenya, adoption remains limited due to high investment costs, lack of technical capacity, institutional resistance to change, and minimal awareness (Makori, Muchelule, & Wamiti, 2020; Chege & Rwelamila, 2020; Muriithi et al., 2017). Consequently, the construction industry in Nairobi continues to underperform, particularly in large-scale public projects and low-cost housing developments where productivity gains are most needed (Muchangi & Kaluli, 2019; Waswa & Mbote, 2021). This situation presents a significant knowledge gap on how technological adoption influences labour productivity, necessitating an in-depth exploration to inform policy, investment, and practice.

Research Purpose

The purpose of the study was to assess the influence of technology on labour productivity in the construction industry in Nairobi City County, Kenya.

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Research Objectives

- To determine the influence of safety technology on labour productivity.
- To assess the extent to which BIM influences labour productivity.
- To identify key barriers and enablers influencing labour productivity

Research Questions:

- How does the adoption of safety technology influence labour productivity in the construction industry in Nairobi City County?
- To what extent does the use of Building Information Modeling (BIM) influence labour productivity in the construction industry?
- What are the key barriers and enablers affecting labour productivity in Nairobi's construction sector?

Hypothesis of the Study

- **H_o:** There is no significant relationship between the adoption of safety technology and labour productivity in the construction industry in Nairobi City County.

H_1: There is a significant relationship between the adoption of safety technology and labour productivity in the construction industry in Nairobi City County.

- **H_o:** The use of Building Information Modeling (BIM) has no significant influence on labour productivity in the construction industry.

H_1: The use of Building Information Modeling (BIM) has a significant influence on labour productivity in the construction industry.

LITERATURE REVIEW

Digital Documentation and Reporting

Digital documentation and reporting technologies have revolutionized construction project management by enhancing the speed, accuracy, and accessibility of information. Traditionally reliant on manual, paper-based processes, construction documentation was often plagued by inefficiencies such as delayed communication, versioning errors, and lost records. The introduction of mobile applications and cloud-based platforms has significantly improved how project data is captured, stored, and shared among stakeholders (Zhou & Wang, 2018; Anastasopoulos, 2012).

Platforms such as PlanGrid and Procore exemplify this transformation by enabling real-time access to construction drawings, inspection forms, punch lists, and safety checklists from any internet-enabled device. These tools allow on-site personnel and project managers to update and review documents instantly, ensuring that decisions are based on the most current project information (Bryde et al., 2013). This minimizes the risk of errors due to outdated plans and facilitates quicker responses to site issues, contributing directly to improved labour productivity.

Digital reporting systems also support version control and automated data synchronization, ensuring consistency across teams and reducing rework. For instance, by allowing instant uploads of annotated drawings or field notes, these platforms eliminate redundant administrative tasks and reduce paperwork-related delays (Zhou & Wang, 2018). Furthermore, they promote transparency and accountability by maintaining digital logs of all changes and communications critical for quality assurance and claims management (Anastasopoulos, 2012).

In addition, cloud-based documentation platforms integrate seamlessly with other project management tools such as scheduling software, cost control systems, and Building Information Modeling (BIM), creating a unified digital ecosystem that enhances collaboration and decision-making (Bryde et al., 2013). This holistic integration enables more accurate tracking of labour inputs and outputs, ultimately contributing to more efficient project execution.

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Digital documentation and reporting technologies significantly improve communication, reduce administrative overhead, and enhance workforce efficiency by enabling real-time, data-driven decision-making in construction projects.

Safety Technology

The integration of safety technology in construction projects has become increasingly critical for enhancing both worker well-being and project productivity. Emerging technologies such as wearable devices, smart personal protective equipment (PPE), and Internet of Things (IoT) sensors have transformed traditional approaches to occupational safety by enabling real-time monitoring and proactive risk management on construction sites (Chen et al., 2023; Zhang et al., 2023).

Wearable technologies, including smart helmets, vests with biometric sensors, and GPS-enabled wristbands, allow for continuous tracking of workers' vital signs, location, and environmental exposure. These devices can detect fatigue, excessive noise, heat stress, or toxic gas levels, and automatically trigger alerts to supervisors in the event of a potential safety breach (Zhang et al., 2023). IoT-enabled systems also integrate with central safety dashboards, offering a bird's-eye view of site conditions and worker behaviour, which supports swift intervention and fosters a culture of preventive safety management (Chen et al., 2023).

Research shows a direct positive correlation between safety compliance and labour productivity. Safe working environments reduce the frequency of accidents and injuries, which in turn minimises project interruptions, absenteeism, and compensation claims (Hinze et al., 2013). Furthermore, consistent enforcement of safety protocols improves worker morale, motivation, and efficiency factors that collectively enhance overall performance and output (Abaya & Ondieki, 2021).

In resource-constrained contexts like Kenya, the gradual adoption of affordable smart safety tools can significantly improve site-level productivity. By shifting from reactive to predictive safety approaches, contractors can reduce downtime associated with incidents, improve worksite coordination, and meet project deadlines more reliably. Moreover, data collected through these technologies can inform long-term safety planning and training initiatives, contributing to sustained productivity improvements across the sector. Safety technologies play a dual role in protecting workers and optimising workforce performance. Their integration into construction projects not only reduces occupational hazards but also enhances operational efficiency and accountability.

Building Information Modeling (BIM)

Building Information Modeling (BIM) has emerged as a transformative technology in the construction industry, enabling more efficient planning, design, execution, and maintenance of infrastructure projects. BIM involves the generation and management of digital representations of physical and functional characteristics of construction projects. These models offer a collaborative platform for architects, engineers, contractors, and clients to visualise and coordinate every aspect of a building's lifecycle (Azhar et al., 2012; Eastman et al., 2011).

By integrating 3D modelling with scheduling (4D), cost estimation (5D), and resource management, BIM enhances decision-making and streamlines workflows across project phases. For example, BIM enables clash detection before construction begins, which reduces design errors and rework, thus improving labour efficiency and project timelines (Bryde et al., 2013). Real-time collaboration through BIM platforms allows stakeholders to update project data simultaneously, reducing miscommunication and improving coordination among teams (Sacks et al., 2018).

The influence of BIM on labour productivity is particularly evident in its ability to optimise the sequencing of tasks, allocate resources effectively, and provide workers with accurate, up-to-date instructions. Field personnel can access

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digital models via mobile devices, allowing them to better understand complex design elements, which reduces ambiguity and accelerates execution (Zhou et al., 2012). This improved clarity also enhances safety compliance, reduces material waste, and leads to greater overall output per unit of labour input.

Despite its benefits, the adoption of BIM in Kenya remains limited, especially among small and medium-sized firms. Challenges such as high software licensing costs, lack of skilled personnel, and limited awareness among stakeholders continue to impede its widespread use (Makori et al., 2020; Maina & Mwaura, 2021). However, as public infrastructure projects increasingly mandate digital project delivery, BIM adoption is expected to grow, presenting a significant opportunity for productivity gains across the construction sector. BIM is a powerful enabler of labour productivity through improved planning, enhanced collaboration, and more efficient use of resources. Its strategic implementation can contribute to reduced project delays, better cost control, and higher quality outcomes in Nairobi's dynamic construction environment.

Construction Automation

Construction automation involves the use of technologies such as robotics, 3D printing, and automated machinery to execute repetitive, hazardous, or precision-demanding tasks on construction sites. This trend is becoming increasingly prevalent in high-risk and labour-intensive activities such as bricklaying, concrete pouring, steel fabrication, and site surveying (Bock, 2015; Melenbrink et al., 2020). Automation reduces dependency on manual labour, minimises human error, and ensures consistent output, which in turn enhances labour productivity and project timelines.

Robotic construction systems can work continuously without fatigue, improving efficiency and reducing costs associated with delays and rework. Similarly, 3D printing enables rapid prototyping and prefabrication of building components, allowing for greater control over material use and minimizing waste (Wang et al., 2021). These technologies also improve safety by limiting human exposure to dangerous tasks or environments, thus contributing to fewer site incidents and uninterrupted workflows. The integration of automation into the Kenyan construction sector remains limited, largely due to the high costs of acquisition and maintenance. However, as technology becomes more accessible, its application, especially in large-scale projects, is expected to rise, thereby contributing to enhanced productivity, quality, and sustainability in the built environment.

Remote Monitoring and Control

Remote monitoring and control technologies have become vital tools for overseeing construction projects, especially those spread across vast or inaccessible locations. Systems such as GPS tracking, drones, telematics, and remote sensors enable real-time surveillance of project progress, equipment use, and workforce deployment (Fugate & Alzraiee, 2023; Li, Guo et al., 2019).

Drones are used for aerial surveys, volumetric analysis, and progress tracking, providing up-to-date data that helps managers make informed decisions from remote locations. Telematics systems embedded in construction equipment gather data on machine health, fuel usage, and operational efficiency, supporting predictive maintenance and optimal resource scheduling. These technologies not only improve transparency but also reduce supervision costs and downtime associated with manual inspections. In Nairobi's fast-paced urban construction environment, remote monitoring tools offer a strategic advantage by streamlining operations and enabling agile project management. This contributes to improved accountability, resource utilisation, and labour productivity.

Barriers to Technology Adoption

Despite the numerous benefits associated with digital and automated technologies, the construction industry in Kenya continues to face several barriers to adoption. A primary constraint is the high initial investment cost associated with acquiring, implementing, and maintaining

Article DOI: https://doi.org/10.37284/eaje.8.1.2981

advanced systems (Oyewobi et al., 2016). For many small and medium-sized enterprises (SMEs), limited access to credit and capital inhibits their ability to invest in modern tools.

Resistance to change is another significant challenge. Cultural factors, lack of trust in unfamiliar technologies, and a preference for traditional construction methods often slow the adoption process (Ofori, 2000). In many cases, contractors and workers are not fully aware of the benefits of these innovations or fear job displacement, leading to hesitance or outright opposition.

Additionally, lack of technical training and inadequate infrastructure, including poor internet connectivity, outdated equipment, and insufficient regulatory frameworks, further hinder technology integration (Olugboyega & Windapo, 2019). These barriers underscore the need for targeted policy interventions, industry sensitisation, and capacity-building programs to facilitate a smoother digital transition in the construction sector.

Theoretical Scope

This study is grounded in the Theory of Constraints (ToC), developed by Goldratt (1984), which serves as the principal theoretical lens for analysing the relationship between technology adoption and labour productivity in the construction industry. ToC posits that every system has at least one constraint that limits its performance, and that identifying and addressing this constraint is essential for improving overall system effectiveness (Goldratt, 2009). In construction, these constraints may include inadequate planning, limited technical expertise, insufficient resource allocation, or the underutilization of digital technologies.

The theory offers a structured five-step improvement process: identifying the constraint, exploiting it, subordinating all other processes to it, elevating it through strategic investment, and repeating the cycle as new constraints emerge. This approach aligns well with the objectives of the study, which seeks to explore how the adoption of construction technologies such as Building Information Modeling (BIM), wearable safety devices, and automation tools can address the industry's core productivity challenges.

The application of ToC within this study enables a focused examination of technological gaps as the potential constraints affecting labour productivity. For example, in Nairobi's construction sector, limited use of digital tools and resistance to innovation may represent primary bottlenecks. By identifying these limitations, the study aims to reveal how targeted technological interventions can enhance project performance and workforce efficiency. Furthermore, ToC supports the study's emphasis on continuous improvement by offering a dynamic framework that goes beyond one-time solutions and encourages adaptive change and resource optimisation.

Thus, the theoretical scope defined by the Theory of Constraints provides a comprehensive foundation for exploring not only the nature and impact of existing barriers in the construction sector but also the mechanisms through which technology can serve as a strategic enabler of productivity. It informs both the research design and the interpretation of findings by framing the construction industry as a complex system that can be incrementally optimised through strategic innovation and constraint management.

The Theory of Constraints (ToC), introduced by Eliyahu M. Goldratt in 1984, provides a valuable framework for analysing and addressing productivity challenges in the construction industry. According to Goldratt, every system has at least one constraint that limits its performance. By identifying and managing this constraint, organisations can significantly enhance their efficiency and outcomes (Goldratt, 1984; Goldratt, 2009).

In the context of construction, constraints often manifest as poor planning, inadequate technology, lack of skilled labour, or inefficient communication and stakeholder coordination. These factors tend to slow down project

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execution, increase costs, and reduce the overall quality of outputs. Rothwell et al. (2018) observe that such constraints are particularly acute in developing countries, where institutional and infrastructural limitations are common.

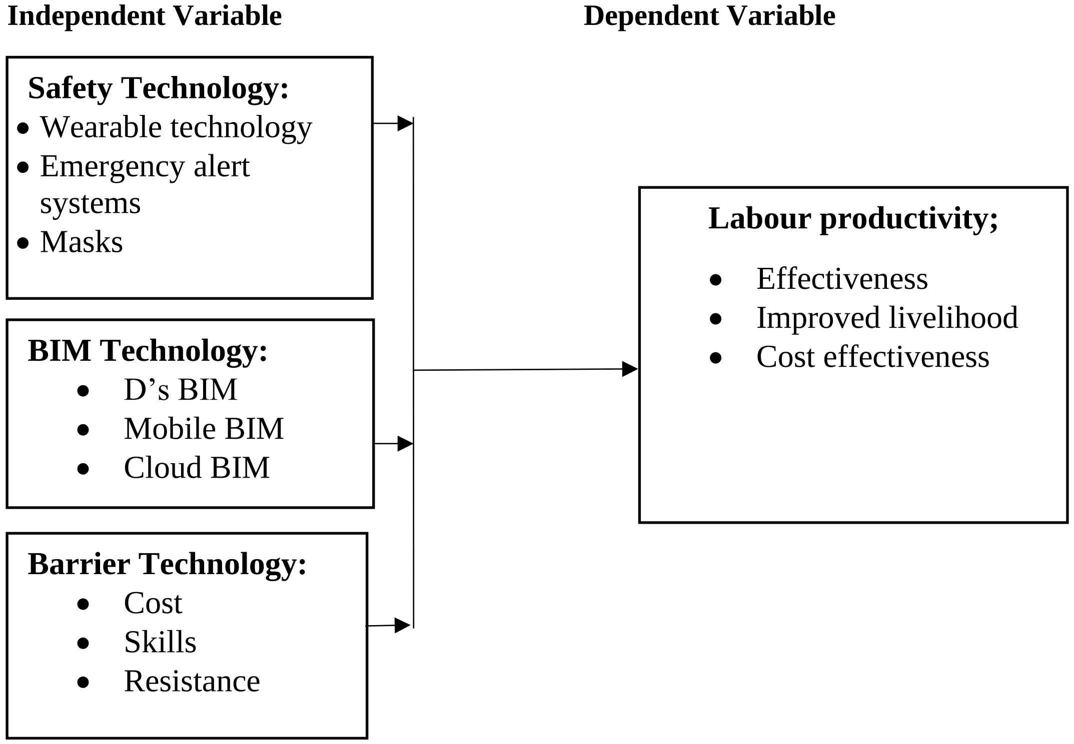
ToC outlines a five-step process for continuous improvement: identify the constraint, exploit it by maximising its current output, subordinate all other activities to support the constraint, elevate the constraint through strategic investment, and repeat the process to identify new constraints once the current one is resolved. This cyclical method aligns well with contemporary performance enhancement strategies in construction, such as Lean Construction, which also emphasises waste reduction and process optimisation (Goldratt, 2009).

Applying ToC in the Nairobi construction sector, for example, could involve identifying low technology adoption as a major constraint to labour productivity. By addressing this through the implementation of tools like Building Information Modeling (BIM), real-time reporting platforms, or automated scheduling systems, firms could significantly reduce delays and improve coordination. In this way, ToC not only promotes the adoption of innovation but also fosters a culture of continuous evaluation and improvement.

Therefore, the Theory of Constraints serves not only as a practical tool for project-level interventions but also as a strategic model that construction managers, developers, and policymakers can use to focus resources where they are most impactful, contributing to a more efficient and productive industry.

Conceptual Framework

Figure 1: Conceptual Framework Showing the Inter-relationship between the Variables



Source: Researcher (2025)

Safety technology encompasses various tools and systems designed to enhance workplace safety and mitigate risks in various industries. These technologies aim to protect workers from accidents, injuries, and occupational hazards by implementing preventive measures and providing real-time monitoring and alerts. Examples of safety technology include personal protective equipment (PPE) such as helmets, gloves, and goggles, as well as more advanced solutions like

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fall detection systems, gas detectors, and machine guarding systems. Additionally, wearable devices equipped with sensors can track vital signs and movement patterns, providing early warnings of potential dangers (Abaya et al., 2021). Safety technology also encompasses digital platforms and software applications for safety training, incident reporting, and emergency response coordination. By leveraging safety technology, organisations can create safer work environments, reduce workplace accidents, and safeguard the well-being of their employees.

Building Information Modeling (BIM) technology encompasses various dimensions and applications tailored to different stages and aspects of the construction process (Karatas & Budak, 2023). 3D BIM represents the physical and spatial aspects of a building, aiding stakeholders in visualising design and layout effectively. 4D BIM adds the time dimension, facilitating visualisation of construction sequences and schedules for improved planning and coordination. 5D BIM integrates cost data, enabling cost estimation and budget management throughout the construction lifecycle. 6D BIM expands to include facility management data, offering insights into ongoing operations and maintenance. 7D BIM incorporates sustainability metrics, allowing stakeholders to assess environmental performance over the building's lifecycle. Mobile BIM enables on-site personnel to access BIM data in real-time, enhancing communication and decision-making. Cloud-based BIM platforms facilitate collaboration and data sharing among project stakeholders from anywhere with an internet connection. Interoperable BIM solutions ensure seamless integration between different BIM software, enhancing collaboration and coordination across disciplines.

High initial costs, limited technical expertise, and strong resistance to change hinder technology adoption in construction. Many firms lack capital to invest in advanced tools, face skill shortages for effective implementation, and encounter cultural inertia as stakeholders prefer traditional methods.

RESEARCH METHODOLOGY

The overall strategy integrated the different components of the study in a coherent and logical way; it constitutes the blueprint for the collection, measurement, and analysis of data. The study adopted a survey design that involved data collection, data analysis and determination of the relationship between the variables. This research used a descriptive survey design that incorporated both the qualitative and quantitative approaches to gather the research data. The research design gave the advantage of collecting information from a dispersed population easily using questionnaires.

The Study Area, Population and Sample Size

A simple random sampling was used to select a non-biased sample size of 261 respondents from the entire population of 2610. According to Mugenda and Mugenda (2013), a target population of 10-20% was useful when the population is high. The sample for the study consisted of 261 construction personnel from the area of study, which took a 10% proportion of the target population (Mugenda & Mugenda, 2013). Therefore, the following respondents were targeted for the study: Quantity Surveyors (40), Architects (39), Engineers (43), Technicians (67), Artisans (42), and Contractors (30), giving a total of 261 respondents.

The study utilised semi-structured questionnaires as the primary instrument for data collection, targeting a large and geographically diverse sample. Questionnaires were chosen for their cost-effectiveness, ease of administration, and ability to generate a substantial amount of data efficiently, particularly when administered electronically to respondents across different locations. The questionnaires comprised close-ended questions, including Likert scale items and rating questions, to gather quantitative data on the use of technology and labour productivity in the construction industry of Nairobi City County, Kenya. Additionally, an interview guide was employed to collect qualitative data from contractors, senior engineers, architects, and quantity surveyors. The semi-structured nature of the interviews allowed for flexibility and depth in

Article DOI: https://doi.org/10.37284/eaje.8.1.2981

data collection, with open-ended questions enabling the researcher to gather comprehensive insights. Face-to-face interviews further facilitated the observation of nonverbal cues, enriching the qualitative findings through triangulation with the questionnaire data.

RESULTS AND DISCUSSIONS

Demographic Information

A total of 261 questionnaires were distributed electronically through Google Forms to the sampled respondents. Out of these, 230 were successfully completed and returned, while 31 were not. This represents an 88% response rate, which, according to Mugenda and Mugenda (1999), is considered excellent. Such a high return rate was attributed to the clarity and logical flow of the questions, which made it easy for respondents to complete them quickly. Additionally, the use of online forms allowed respondents to participate regardless of their geographical location. This high response rate provided a reliable representation of the target population and strengthened the validity of the study findings.

The demographic profile of the respondents was analysed to ensure their relevance to the study. In terms of gender distribution, 69.1% of the respondents were male, while 30.9% were female. This suggests a greater participation of males, which may reflect the gender dynamics in the construction industry.

Regarding age, the majority of respondents fell within the active working-age groups. Specifically, 5.7% were below 25 years, 28.7% were between 25 and 29 years, 24.3% were between 30 and 34 years, 12.6% between 35 and 39 years, 19.1% between 40 and 44 years, 4.3% between 45 and 49 years, and 5.2% were over 50 years old. The age distribution confirmed that all respondents were mature enough to provide informed and independent responses, and there was no need for parental or guardian consent.

In terms of academic qualifications, the study found that all respondents had attained some level of formal education. Specifically, 2.2% had completed KCSE, 3.5% held certificates, 41.3% had diplomas, 36.5% had degrees, 11.7% had master's degrees, and 4.8% held PhDs. This educational background was significant as it indicated the respondents' ability to understand the questionnaire content, particularly on matters related to labour productivity in the construction sector. The use of English as the language of the questionnaire posed no barrier, given the respondents' level of education.

Correlation Analysis of the Use of Technology and Labour Productivity in the Construction Industry in Kenya

Pearson's correlation analysis was used to determine the strength as well as direction of the correlation between the independent variable (Use of Technology) and the dependent variable (Labour Productivity in the Construction industry in Kenya). The following are correlation analysis results, as shown in Table 1.

Table 1: Correlation Analysis of the Use of Technology and Labour Productivity in the Construction Industry in Kenya

Variable		Use of Technology	Labour Productivity in the Construction Industry in Kenya
Use of Technology	Pearson Correlation	1	0.386
	Sig. (2-tailed)		0.000
	N	230	230
Labour Productivity	Pearson Correlation	0.386	1
	Sig. (2-tailed)	0.000	
	N	230	230

Correlation is significant at the 0.05 level (2 - tailed)

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The findings of this study reveal a statistically significant and positive relationship between the use of technology and labour productivity in the construction industry in Kenya, particularly in Nairobi City County. The correlation coefficient (r = 0.386, $p < 0.05$) indicates a moderate but meaningful positive association, suggesting that increased technology adoption leads to improved labour efficiency. This supports previous studies such as those by Brynjolfsson and Hitt (2003) and Sacks et al. (2018), which demonstrated that digital transformation in construction positively impacts labour productivity.

Model Summary of Use of Technology and Labour Productivity in the Construction Industry in Kenya

Model Summary Regression Analysis was run using SPSS Version 26 to examine the associations between independent variable (Use of Technology) and dependent variable (Labour Productivity in the Construction industry in Kenya), and results were presented in Table 2.

Table 2: Model Summary of Use of Technology and Labour Productivity Construction Industry in Kenya

Model	R	R - Square	Adjusted R - Square	Standard Error of Estimate
1	0.386a	0.149	0.145	0.72987

a. Predictor: (Constant) Use of Technology

Analysis from Table 2 shows that the Use of Technology has a significant effect on Labour Productivity in the Construction Industry in Kenya, as confirmed that technology usage accounts for 14.9% of the variation in labour productivity ($R^2 = 0.149$). While this figure may appear modest, it is significant in the context of a complex sector influenced by multiple variables such as skill levels, project financing, regulatory frameworks, and material availability.

Regression ANOVA Analysis of Use of Technology and Labour Productivity Construction Industry in Kenya

ANOVA regression analysis was used to examine the degree of association between the independent variable (Labour Productivity in Construction in Kenya) and the dependent variable (Use of Technology). Results were presented in Table 3.

Table 3: ANOVA Analysis between Use of Technology and Labour Productivity in the Construction Industry in Kenya

Model		Sum of Squares	Df	Mean Squares	F	Sig.
1	Regression	21.302	1	21.302	39.989	0.000b
	Residuals	121.458	228	0.533		
	Total1	142.760	229			

a. Dependent Variable: Labour Productivity in the Construction Industry in Kenya
b. Predictors:(Constant); Use of Technology

ANOVA analysis from Table 3 shows that p=0.000 is below 0.05, the alpha level is hence significant. As a result, we conclude that the Use of Technology is important in Labour Productivity in the Construction industry in Kenya. Moreover, the ANOVA results (F = 39.989, p = 0.000) provide strong evidence that the use of technology has a statistically significant effect on productivity outcomes. These findings align with the theoretical underpinning of the Theory of Constraints, which emphasizes identifying and addressing critical limiting factors in this case, the lack of technological adoption as a strategy to enhance output and efficiency (Goldratt, 1984; Rothwell et al., 2018).

Regression Coefficients of Use of Technology and Labour Productivity Construction Industry in Kenya

Regression Coefficient analysis was deployed to evaluate the degree of association between Level of expertise and the Construction industry in Kenya, and results were presented in Table 4.

Table 4: Regression Coefficients Analysis between Use of Technology and Labour Productivity in the Construction Industry in Kenya

Model	Unstandardized coefficient		standardized coefficient	T	Sig.
	B	Std. Err	Beta		
1(Constant)	0.679	0.219		3.095	0.003
Use of Technology	0.785	0.061	0.844	12.957	0.000

Dependent 1 variable: Labour Productivity in the Construction industry in Kenya
Predictors: (Constant) Use of Technology

Regression coefficients analysis results between Use of Technology and Labour Productivity in the Construction industry in Kenya show that p=0.003 is below 0.05, the alpha level is hence significant. The standardized coefficient (β = 0.844, p = 0.000) reinforces the conclusion that technology serves as a major productivity driver in Kenya's construction industry. As a result, we concluded that the Use of Technology has a significant impact on Labour Productivity in the Construction industry in Kenya. Despite this positive association, adoption remains relatively low due to barriers such as high initial costs, lack of training, and resistance to change, as highlighted in both literature and respondent feedback. These challenges may partially explain why only a portion of the productivity variance is explained by technology in this study.

Beyond the statistical results, qualitative responses revealed recurring themes that help explain the moderate correlation between technology and productivity. As one senior project engineer remarked, *"When we introduced wearable safety tech and remote monitoring tools, our teams completed tasks more confidently and with fewer delays.*" This qualitative insight illustrates how technology not only streamlines workflow but also fosters a safer and more motivated workforce."

Complementary to statistical results of this study, qualitative responses from one quantity surveyor interviewed alluded that: *"We have the software such as BIM; PlanSwift Cost estimators and Microsoft Project, but very few staff know how to use it to its full potential."* These sentiments align with the Theory of Constraints by highlighting underutilized technological capacity as a bottleneck in labour productivity. Addressing this gap through strategic investment in human capital and operational support is essential for unlocking the productivity gains that digital tools promise in Nairobi's construction sector.

CONCLUSIONS

In summary, the study established a significant positive relationship between the use of technology and labour productivity in the construction industry in Nairobi City County, Kenya. Technological tools such as BIM, safety systems, automation, and remote monitoring were shown to enhance efficiency, reduce errors, and improve project outcomes. Although technology only explains a portion of productivity variation, its impact is substantial and cannot be overlooked. However, barriers such as high costs, limited expertise, and resistance to change hinder widespread adoption. Therefore, the integration of technology, supported by training, policy reforms, and investment incentives, is essential for driving sustainable productivity improvements in Kenya's construction sector.

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