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AI AND IOT IN CONSTRUCTION: EFFECTS ON COST AND RESOURCE EFFICIENCY

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ABSTRACT

The construction industry is increasingly integrating Artificial Intelligence (AI) and the Internet of Things (IoT) to improve project performance and operational efficiency. This study presents a narrative review of recent literature to examine how AI and IoT applications influence cost optimization and resource utilization efficiency in construction projects. The findings indicate that AI enhances predictive analytics, enabling more accurate cost estimation and improved decision-making, while IoT supports real-time monitoring of construction activities, leading to better resource allocation and reduced inefficiencies. The integration of these technologies facilitates smart construction practices such as predictive maintenance, automated scheduling, and performance tracking. The results further demonstrate that improvements in cost control contribute directly to better resource utilization, highlighting a strong relationship between financial and operational performance. This study provides practical insights for construction firms seeking to enhance efficiency through digital technologies and identifies areas for future research.

KEYWORDS Artificial Intelligence; Internet of Things; Construction Industry; Cost Optimization; Resource Utilization; Digital Transformation.

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1.0 INTRODUCTION

The construction industry is widely recognized as a critical driver of economic growth, yet it continues to face persistent challenges related to cost overruns, project delays, and inefficient resource utilization. These issues are often attributed to fragmented workflows, limited real-time visibility, and reliance on traditional management practices. As projects become increasingly complex, the need for more efficient, data-driven approaches to construction management has become more urgent.

In recent years, digital transformation has emerged as a key strategy for addressing these challenges. Technologies associated with the Fourth Industrial Revolution, particularly Artificial Intelligence (AI) and the Internet of Things (IoT), have gained significant attention for their potential to improve construction performance. AI enables advanced data analytics, predictive modeling, and intelligent decision-making, while IoT facilitates real-time monitoring of construction activities through interconnected sensors and devices (Li et al., 2020; Sacks et al., 2020). Together, these technologies provide a foundation for more responsive and efficient project management.

The adoption of AI and IoT has been further accelerated by the growing emphasis on productivity and sustainability in the construction sector. Previous studies highlight those digital technologies can reduce waste, improve coordination, and enhance overall project efficiency (Bilal et al., 2020; Alaloul et al., 2021). For example, IoT-based monitoring systems allow for continuous tracking of equipment and materials, while AI-driven models support more accurate forecasting and risk assessment. These capabilities are particularly important in minimizing inefficiencies and improving resource allocation.

Despite these advancements, the implementation of AI and IoT in construction remains uneven. Many firms, particularly in developing regions, face barriers such as high implementation costs, lack of technical expertise, and limited digital infrastructure. Furthermore, while existing research has extensively explored the technical capabilities of these technologies, there is still limited understanding of their direct impact on performance outcomes, especially in terms of cost optimization and resource utilization efficiency.

Another limitation in the current literature is the tendency to examine AI and IoT independently, rather than as integrated systems. This fragmented perspective restricts the understanding of how these technologies interact to deliver value in real-world construction environments. Given that construction projects involve complex and dynamic processes, it is essential to consider how AI and IoT function together to support decision-making and operational efficiency.

In response to these gaps, this study aims to provide a comprehensive review of existing literature on AI and IoT applications in construction, with a specific focus on their effects on cost optimization and resource utilization efficiency. By synthesizing current research, this study seeks to (i) examine the individual and combined roles of AI and IoT in construction, (ii) analyze how these technologies contribute to performance improvements, and (iii) identify key gaps and future research directions.

Overall, this study contributes to the growing body of knowledge on digital transformation in construction by providing a performance-oriented perspective on AI and IoT applications. The findings offer both theoretical insights and practical implications for construction firms seeking to enhance efficiency and competitiveness in an increasingly digital environment. This study contributes to the literature by providing a performance-focused synthesis of AI and IoT applications in construction, emphasizing their integrated role in improving cost optimization and

resource utilization. It further highlights the relationship between financial and operational efficiency and offers practical insights for effective technology implementation.

2.0 METHODOLOGY

This study adopts a narrative literature review approach to examine the role of Artificial Intelligence (AI) and the Internet of Things (IoT) in improving cost optimization and resource utilization efficiency in construction projects. A narrative review is appropriate for this study as it allows for a flexible and interpretive synthesis of existing literature, particularly in emerging research areas where concepts and applications are still evolving.

The literature search was conducted using major academic databases, including Scopus, Web of Science, Science Direct, and Google Scholar, to ensure broad coverage of peer-reviewed and high-quality publications. The search focused on recent studies published between 2020 and 2024 to capture current developments in digital technologies within the construction industry.

A combination of keywords was used to identify relevant studies, including “Artificial Intelligence,” “Internet of Things,” “construction,” “AIoT,” “cost optimization,” “resource utilization,” and “digital construction.” These keywords were applied individually and in combination to ensure comprehensive retrieval of relevant literature.

The selection of studies was guided by relevance to the research objective. Articles were included if they (i) discussed applications of AI or IoT in construction, (ii) addressed performance outcomes such as cost efficiency or resource utilization, or (iii) provided insights into smart construction practices. Studies that focused solely on unrelated industries or did not address performance-related outcomes were excluded.

Following the identification of relevant studies, the selected literature was analyzed using a thematic synthesis approach. This involved systematically reviewing and categorizing findings into key themes, including (i) AI applications in construction, (ii) IoT-based monitoring systems, (iii) integration of AI and IoT technologies, and (iv) performance outcomes related to cost optimization and resource efficiency. This approach enabled the identification of consistent patterns, relationships, and insights across different studies.

To ensure analytical rigor, the review emphasizes comparative interpretation rather than descriptive summarization. Findings from multiple studies were compared and synthesized to identify similarities, differences, and emerging trends. Particular attention was given to how AI and IoT contribute individually and collectively to improving construction performance.

While this study does not adopt a strict systematic review protocol, efforts were made to ensure transparency and consistency in the selection and analysis of literature. The focus on recent, peer-reviewed sources enhances the reliability of the findings, while the thematic synthesis approach supports a structured and meaningful interpretation of the existing body of knowledge.

3.0 RESULTS AND SYNTHESIS

The reviewed literature consistently demonstrates that Artificial Intelligence (AI) and the Internet of Things (IoT) play complementary yet distinct roles in improving construction performance. Rather than functioning as isolated technologies, they form an integrated digital ecosystem that enhances data-driven decision-making, operational efficiency, and project control.

IoT technologies primarily serve as the foundation for real-time data acquisition in construction environments. Through the deployment of sensors embedded in equipment, materials, and site infrastructure, IoT systems continuously collect data on construction activities, including equipment utilization, material flow, environmental conditions, and worker movement. This real-time visibility significantly improves situational awareness, enabling project managers to detect inefficiencies, monitor progress, and respond promptly to emerging issues (Li et al., 2020; Wu et al., 2021). As a result, IoT contributes directly to improving operational transparency and reducing uncertainties associated with manual monitoring processes.

In contrast, AI technologies focus on transforming raw data into actionable insights. AI-driven systems utilize machine learning algorithms and predictive models to analyze historical and real-time data, enabling more accurate forecasting, risk identification, and decision support. These capabilities are particularly relevant in cost estimation and project scheduling, where uncertainty and variability often lead to inefficiencies. By improving forecasting accuracy and enabling early intervention, AI reduces the likelihood of cost overruns and project delays (Chen et al., 2021; Kumar et al., 2023; Wang et al., 2022). This highlights the critical role of AI in enhancing strategic planning and financial management within construction projects.

A key trend identified in the literature is the increasing integration of AI and IoT technologies. This integration enables a continuous feedback loop in which data collected by IoT systems is processed and analyzed by AI algorithms in real time. Such an integrated system allows construction firms to move from reactive problem-solving to proactive and predictive management approaches. For example, real-time sensor data can be analyzed to predict equipment failure, optimize resource allocation, and adjust project schedules dynamically. This significantly enhances project control and reduces inefficiencies associated with delayed decision-making (Zhou et al., 2022; Olanrewaju et al., 2022).

The synthesis of existing studies also reveals that AI and IoT technologies contribute to performance improvements through different but interrelated mechanisms. IoT primarily enhances resource utilization efficiency by providing real-time insights into how resources are deployed and used on-site. This reduces idle time, minimizes material waste, and improves overall operational efficiency. On the other hand, AI contributes more directly to cost optimization by improving financial forecasting, identifying cost drivers, and supporting decision-making processes that reduce unnecessary expenditures.

Importantly, the interaction between AI and IoT creates a synergistic effect that amplifies their individual contributions. While IoT ensures the availability of accurate and timely data, AI ensures that this data is effectively utilized to support decision-making. This synergy enables construction

firms to achieve higher levels of efficiency than would be possible with either technology alone. As such, the integration of AI and IoT represents a critical advancement in construction management, facilitating a shift toward intelligent, data-driven project delivery.

Another significant finding from the literature is that the effectiveness of these technologies depends on the extent to which they are integrated into organizational workflows. Studies indicate that firms that successfully embed AI and IoT into their project management processes experience greater performance improvements compared to those that adopt these technologies in a fragmented manner. This suggests that the benefits of digital technologies are not solely determined by their technical capabilities but also by how effectively they are implemented and utilized within organizational contexts.

Overall, the reviewed studies provide strong evidence that AI and IoT technologies play a crucial role in improving cost optimization and resource utilization efficiency in construction. Their combined use enables enhanced monitoring, predictive decision-making, and efficient resource management, ultimately contributing to improved project performance and organizational outcomes.

4.0 AI AND IOT APPLICATIONS IN CONSTRUCTION

Artificial Intelligence (AI) and the Internet of Things (IoT) are increasingly transforming construction practices by enabling more intelligent, data-driven, and automated project management processes. These technologies are applied across multiple stages of construction, including planning, execution, monitoring, and maintenance, contributing to improved efficiency and reduced operational risks.

AI applications in construction are primarily centered on data analysis, prediction, and decision support. Through machine learning algorithms and advanced analytics, AI systems are capable of processing large volumes of historical and real-time data to generate accurate forecasts and actionable insights. For example, AI is widely used in cost estimation and budgeting, where predictive models analyze past project data to identify cost patterns and potential overruns. This improves financial planning and reduces uncertainty in project delivery (Chen et al., 2021; Kumar et al., 2023). In addition, AI supports project scheduling by optimizing timelines and identifying potential delays, allowing project managers to adjust plans proactively.

Another significant application of AI is in risk management and safety monitoring. AI-based systems can analyze data from multiple sources, including site conditions and worker behavior, to detect potential hazards and predict safety risks. This enables preventive measures to be implemented before incidents occur, thereby improving site safety and reducing project disruptions (Bansal, 2022). Furthermore, AI is increasingly integrated with Building Information Modeling (BIM) systems, enhancing visualization, simulation, and decision-making throughout the project lifecycle (Elghaish et al., 2021).

In contrast, IoT applications in construction focus on real-time data collection and monitoring. IoT devices, such as sensors and wearable technologies, are deployed across construction sites to track

equipment performance, material usage, environmental conditions, and worker activities. This continuous flow of data provides real-time visibility into site operations, enabling project managers to monitor progress and identify inefficiencies more effectively (Li et al., 2020; Cheng et al., 2020).

IoT is particularly valuable in improving resource tracking and utilization. For instance, sensors can monitor the location and usage of machinery, ensuring that equipment is used efficiently and reducing idle time. Similarly, IoT systems can track material consumption, helping to minimize waste and improve inventory management. These capabilities are essential for enhancing operational efficiency and reducing unnecessary costs (Olanrewaju et al., 2022).

The integration of AI and IoT represents a significant advancement in construction technology, often referred to as AIoT. In this integrated framework, IoT devices collect real-time data, which is then processed and analyzed by AI algorithms to generate predictive insights and support decision-making. This creates a continuous feedback loop that enables dynamic and adaptive project management. For example, real-time data on equipment performance can be analyzed to predict maintenance needs, allowing firms to schedule repairs before breakdowns occur. This not only reduces downtime but also extends the lifespan of equipment (Zhou et al., 2022).

Moreover, AIoT systems enhance project coordination and communication by providing centralized platforms where data from multiple sources can be integrated and visualized. This improves collaboration among project stakeholders and supports more informed decision-making. As a result, construction firms can achieve higher levels of efficiency, accuracy, and control over project execution.

Despite these advantages, the implementation of AI and IoT technologies is not without challenges. High initial investment costs, lack of technical expertise, and issues related to data integration and system interoperability remain significant barriers. These challenges highlight the importance of organizational readiness and strategic planning in ensuring the successful adoption and utilization of digital technologies.

Overall, AI and IoT applications play a crucial role in enhancing construction performance by improving data visibility, enabling predictive analytics, and supporting smarter decision-making. Their integration provides a powerful framework for achieving cost optimization and resource utilization efficiency in modern construction projects.

5.0 SMART PRACTICES FOR COST AND RESOURCE EFFICIENCY

Smart construction practices enabled by Artificial Intelligence (AI) and the Internet of Things (IoT) represent a shift from conventional, reactive management approaches toward proactive and data-driven operational strategies. These practices focus on improving efficiency through automation, real-time monitoring, and predictive decision-making, ultimately contributing to better cost control and optimized resource utilization.

One of the most significant smart practices is predictive maintenance, which leverages IoT sensors and AI algorithms to monitor equipment performance and predict potential failures before they occur. By analyzing real-time operational data, AI models can identify patterns indicating wear and

tear, allowing maintenance activities to be scheduled proactively. This reduces unexpected downtime, minimizes repair costs, and extends equipment lifespan, thereby improving both cost efficiency and operational continuity (Zhou et al., 2022; Kumar et al., 2023).

Another key practice is automated scheduling and workflow optimization. AI-driven systems analyze project data, including timelines, resource availability, and task dependencies, to generate optimized construction schedules. These systems can dynamically adjust schedules in response to real-time changes, such as delays or resource shortages. This level of adaptability enhances coordination among project activities, reduces bottlenecks, and improves overall project efficiency.

In addition, real-time performance monitoring plays a crucial role in smart construction practices. IoT devices continuously collect data on site activities, enabling project managers to track progress, monitor productivity, and identify inefficiencies as they occur. This real-time visibility allows for immediate corrective actions, preventing minor issues from escalating into major problems. As a result, projects can be managed more efficiently, with improved control over both time and cost.

Smart practices also extend to resource planning and allocation, where AI and IoT technologies support more accurate and efficient decision-making. Real-time data on resource usage allows firms to optimize the allocation of labor, materials, and equipment, ensuring that resources are used effectively and minimizing waste. This is particularly important in large-scale projects where inefficient resource management can lead to significant cost increases.

Furthermore, the integration of digital technologies facilitates data-driven decision-making at both operational and strategic levels. By combining real-time monitoring with predictive analytics, construction firms can make informed decisions that improve project outcomes. This approach enhances not only efficiency but also transparency and accountability within project management processes.

Despite these benefits, the successful implementation of smart construction practices depends on several factors, including organizational readiness, technological infrastructure, and workforce capabilities. Firms must invest in training, system integration, and process redesign to fully realize the potential of AI and IoT technologies.

Overall, smart construction practices enabled by AI and IoT provide a comprehensive framework for improving efficiency in construction projects. By enhancing monitoring, automation, and decision-making, these practices contribute significantly to achieving cost optimization and resource utilization efficiency.

6.0 COST AND RESOURCE EFFICIENCY

The integration of Artificial Intelligence (AI) and the Internet of Things (IoT) in construction projects has a direct and measurable impact on two critical performance outcomes: cost optimization and resource utilization efficiency. These outcomes are closely interconnected, with improvements in one often leading to gains in the other.

6.1 Cost Optimization

Cost optimization in construction refers to the ability to minimize unnecessary expenditures while maintaining project quality and performance standards. AI technologies play a central role in achieving this objective by enhancing predictive analytics, cost estimation, and financial decision-making.

AI-driven models analyze large datasets, including historical project data and real-time site information, to identify cost patterns and potential risks. This enables more accurate forecasting and budgeting, reducing uncertainty in financial planning. By detecting early signs of cost overruns, AI systems allow project managers to implement corrective actions before costs escalate (Kumar et al., 2023; Wang et al., 2022).

In addition, AI supports risk management and scenario analysis, allowing firms to evaluate different project strategies and select the most cost-effective options. This proactive approach reduces financial risks and improves overall project profitability. The ability to simulate various outcomes also enhances decision-making under uncertainty, which is a common challenge in construction projects.

Another important contribution of AI to cost optimization is the reduction of waste. Through improved planning and monitoring, AI systems help identify inefficiencies in material usage and workflow processes. This minimizes unnecessary expenditures and contributes to more sustainable construction practices.

6.2 Resource Utilization Efficiency

Resource utilization efficiency refers to the effective use of labor, materials, and equipment to maximize productivity and minimize waste. IoT technologies play a critical role in enhancing this aspect of construction performance by providing real-time visibility into resource deployment and usage.

IoT systems enable continuous monitoring of equipment and workforce activities, allowing project managers to track resource utilization accurately. This reduces idle time, improves equipment usage rates, and ensures that resources are allocated where they are most needed (Li et al., 2020; Olanrewaju et al., 2022).

In terms of labor management, IoT devices such as wearable sensors can monitor worker movement and productivity, providing insights into workflow efficiency. This information can be used to optimize task allocation and improve coordination among workers, leading to higher productivity levels.

Material management is also enhanced through IoT-enabled tracking systems, which monitor inventory levels and material usage in real time. This reduces material wastage and ensures timely replenishment, preventing delays caused by shortages or mismanagement.

6.3 Interrelationship between Cost and Resource Efficiency

A critical insight from the literature is the strong interrelationship between cost optimization and resource utilization efficiency. Efficient resource management reduces unnecessary costs, while effective cost control enables better allocation of resources. This indicates that cost and resource efficiency should not be viewed as separate outcomes but as mutually reinforcing components of overall project performance.

The integration of AI and IoT technologies strengthens this relationship by enabling both predictive and real-time management capabilities. AI improves financial planning and cost control, while IoT enhances operational visibility and resource tracking. Together, these technologies create a comprehensive system that supports both financial and operational efficiency.

7.0 DISCUSSION

This study provides a comprehensive understanding of how Artificial Intelligence (AI) and the Internet of Things (IoT) influence construction performance, particularly in relation to cost optimization and resource utilization efficiency. The findings indicate that these technologies do not operate in isolation but function as an integrated system that reshapes how construction projects are planned, monitored, and controlled.

A key insight from the reviewed literature is the functional distinction and interdependence between AI and IoT. IoT technologies primarily serve as the data acquisition layer, capturing real-time information on equipment performance, material usage, and site conditions. However, the value of this data remains limited without advanced analytical capabilities. AI complements IoT by processing and analyzing large volumes of data to generate predictive insights, enabling project managers to anticipate risks, optimize scheduling, and improve financial planning. This interaction demonstrates that the effectiveness of digital transformation lies in the integration of technologies rather than their isolated use.

From a performance perspective, the findings suggest that AI contributes most significantly to cost optimization, while IoT has a more direct impact on resource utilization efficiency. AI-driven predictive models enhance budgeting accuracy by identifying potential cost overruns at an early stage, allowing firms to implement corrective measures proactively. In contrast, IoT systems improve operational efficiency by providing real-time visibility into resource deployment, thereby reducing idle time and minimizing waste.

Importantly, the analysis highlights a sequential relationship between cost optimization and resource utilization. Effective cost control enables more efficient allocation of resources, as financial planning guides decisions related to labor, materials, and equipment usage. This suggests that cost efficiency is not merely an outcome but also a driver of broader operational performance.

These findings can be interpreted through established technology adoption perspectives. From a Diffusion of Innovation viewpoint, the effectiveness of AI and IoT is closely linked to their perceived usefulness in delivering measurable performance improvements. From a Technology–Organization–Environment perspective, the realization of these benefits depends on organizational

readiness and external conditions that support technology use (Alaloul et al., 2021; Hamid et al., 2022).

Despite the benefits, several challenges remain, including high implementation costs, lack of technical expertise, and data integration issues. These barriers limit the effectiveness of AI and IoT, particularly in resource-constrained environments.

8.0 RESEARCH GAP

Despite the growing body of literature on Artificial Intelligence (AI) and the Internet of Things (IoT) in construction, several critical gaps remain that limit a comprehensive understanding of their impact on project performance.

First, a significant portion of existing research examines AI and IoT as separate technologies, with limited focus on their integrated application. While individual studies highlight the benefits of AI in predictive analytics and IoT in real-time monitoring, there is insufficient exploration of how these technologies interact to produce synergistic performance outcomes. Given the increasing convergence of digital technologies, understanding their combined impact is essential for advancing construction management practices.

Second, many studies emphasize the technical capabilities and applications of AI and IoT rather than their direct influence on organizational performance outcomes. Although concepts such as predictive maintenance, automation, and real-time monitoring are widely discussed, there is limited empirical and analytical evidence linking these applications to measurable improvements in cost optimization and resource utilization efficiency. This creates a gap between technological potential and demonstrated performance impact.

Third, the existing literature is largely conceptual or descriptive, with relatively few studies employing empirical data to validate the effectiveness of AI and IoT in real-world construction projects. The lack of quantitative analysis limits the ability to generalize findings and assess the true magnitude of performance improvements associated with digital technology adoption.

Furthermore, contextual factors such as organizational readiness, project complexity, and digital maturity are often underexplored. These factors play a critical role in determining how effectively AI and IoT technologies are implemented and utilized. Without considering these contextual variables, it is difficult to fully understand the conditions under which digital transformation leads to improved outcomes.

Finally, there is limited research focusing on developing regions, where challenges such as infrastructure limitations, financial constraints, and skill shortages may significantly affect technology implementation.

This highlights the need for more context-specific studies that examine how AI and IoT can be effectively deployed in different environments.

Addressing these gaps is essential for bridging the disconnect between technological innovation and practical implementation. This study contributes to the literature by providing a performance-oriented synthesis that emphasizes the integrated role of AI and IoT in improving cost efficiency and resource utilization in construction.

9.0 MANAGERIAL IMPLICATIONS

The findings of this study provide several important implications for construction firms seeking to improve performance through the adoption of Artificial Intelligence (AI) and the Internet of Things (IoT). These implications are particularly relevant for project managers, decision-makers, and organizational leaders involved in digital transformation initiatives.

First, construction firms should prioritize the adoption of technologies that deliver measurable performance outcomes, particularly in terms of cost optimization and resource utilization efficiency. Rather than adopting digital tools for their novelty, firms should focus on solutions that directly address operational inefficiencies and contribute to improved project performance.

Second, organizations should adopt an integrated approach to technology implementation. The findings highlight that the combined use of AI and IoT provides greater benefits than the use of individual technologies. Firms should therefore invest in systems that enable seamless data integration and real-time analytics, ensuring that data collected through IoT devices can be effectively processed and utilized by AI systems.

Third, organizational readiness is a critical factor in the successful implementation of digital technologies. Firms must invest in developing technical capabilities, including workforce training and digital skills, as well as establishing the necessary infrastructure to support AI and IoT systems. Without these capabilities, the potential benefits of technology adoption may not be fully realized.

Fourth, construction firms should leverage real-time monitoring and predictive analytics to improve decision-making. The use of IoT-based monitoring systems allows for continuous tracking of project activities, while AI-driven analytics supports proactive planning and risk management. Together, these capabilities enable more efficient resource allocation and improved cost control.

Fifth, firms should adopt a data-driven management culture that emphasizes continuous improvement and performance monitoring. The integration of AI and IoT provides access to large volumes of data, which can be used to evaluate performance, identify inefficiencies, and optimize processes over time. This shift toward data-driven decision-making is essential for achieving long-term efficiency gains.

Finally, managers should recognize that digital transformation is not solely a technological change but also an organizational and strategic transformation. Successful implementation requires alignment between technology adoption and organizational goals, as well as a willingness to adapt existing workflows and management practices.

Overall, these implications highlight the importance of a strategic, integrated, and performance-focused approach to AI and IoT adoption in construction. By aligning technology use with organizational objectives, firms can achieve significant improvements in cost efficiency and resource utilization.

10. CONCLUSION

This study examines the role of Artificial Intelligence (AI) and the Internet of Things (IoT) in improving construction performance, with a specific focus on cost optimization and resource utilization efficiency. Through a narrative synthesis of recent literature, the findings demonstrate that these technologies play complementary roles in enhancing project outcomes. IoT provides real-time visibility into construction activities, while AI enables predictive analytics and data-driven decision-making. Their integration supports a shift toward proactive and intelligent project management.

A key contribution of this study is the identification of a strong relationship between cost optimization and resource utilization efficiency. The findings suggest that effective cost control not only reduces unnecessary expenditures but also enables more efficient allocation of resources, thereby improving overall project productivity. In addition, the study highlights the importance of integrating AI and IoT technologies rather than adopting them in isolation, as their combined use generates greater performance benefits.

From a practical perspective, the study provides insights for construction firms seeking to enhance efficiency through digital transformation. The findings emphasize the need for an integrated, performance-focused approach to technology implementation, supported by organizational readiness, technical capability, and strategic alignment. Firms that successfully adopt such approaches are more likely to achieve sustainable improvements in both financial and operational performance.

Despite its contributions, this study is limited by its reliance on existing literature and the absence of empirical validation. Future research should focus on quantitative analysis to examine the direct impact of AI and IoT on construction performance across different project contexts. In addition, further studies are needed to explore how organizational and environmental factors influence the effectiveness of digital technology adoption.

In conclusion, AI and IoT technologies offer significant potential to transform construction management by improving cost efficiency and resource utilization. By emphasizing their integrated application and performance outcomes, this study contributes to advancing both academic understanding and practical implementation of digital technologies in the construction industry.

REFERENCES (APA 7)

- [1] Alaloul, W. S., Liew, M. S., Zawawi, N. A. W. A., & Kennedy, I. B. (2021). Industrial Revolution 4.0 in construction. *Buildings*, *11*(8), 349.
- [2] Bilal, M., Oyedele, L. O., Qadir, J., et al. (2020). Big data in construction. *Advanced Engineering Informatics*, *43*, 101047.

- [3] Bansal, V. K. (2022). AI in construction safety. *Automation in Construction*, 135, 104119.
- [4] Chen, J., Zhang, X., & Zhang, S. (2021). Data-driven construction management. *Automation in Construction*, 125, 103578.
- [5] Cheng, T., Migliaccio, G., Teizer, J., & Gatti, U. (2020). Construction safety monitoring. *Automation in Construction*, 112, 103087.
- [6] Elghaish, F., Abrishami, S., & Hosseini, M. (2021). BIM integration. *Engineering, Construction and Architectural Management*, 28(5), 1335–1357.
- [7] Gamil, Y., & Rahman, I. (2021). Resource optimization. *Sustainability*, 13(4), 2071.
- [8] Hamid, A. R. A., et al. (2022). Digital adoption barriers. *Journal of Engineering Science and Technology*, 17(2).
- [9] Kumar, A., Singh, R., & Gupta, S. (2023). AI in construction management. *Automation in Construction*, 145, 104538.
- [9] Li, H., Lu, M., & Wong, C. T. (2020). Real-time monitoring. *Automation in Construction*, 114, 103155.
- [10] Olanrewaju, O. I., et al. (2022). IoT in construction. *Journal of Building Engineering*, 45, 103517.
- [11] Sacks, R., Brilakis, I., Pikas, E., Xie, H., & Girolami, M. (2020). Digital twin systems. *Automation in Construction*, 114, 103163.
- [12] Wang, J., Wang, X., Shou, W., et al. (2022). AI risk prediction. *Automation in Construction*, 134, 104050.
- [13] Wu, X., Luo, H., & Yang, X. (2021). Smart monitoring using IoT. *Automation in Construction*, 127, 103689.
- [14] Zhou, Y., Zhang, J., & Li, X. (2022). Construction automation review. *Automation in Construction*, 136, 104202.