Impact of Technology on Civil Construction Project Management

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ABSTRACT

This article examines the impact of technology on civil construction project management, focusing on how technological advancements impact project efficiency, cost, and quality. In recent decades, the adoption of technologies such as Building Information Modeling (BIM), Internet of Things (IoT), and artificial intelligence (AI) has revolutionized the way construction projects are planned, executed, and monitored. These technologies enable more accurate planning, more efficient resource management, and real-time monitoring that enhances the ability to identify and resolve issues proactively. This article explores the various applications of technology in the context of construction project management, analyzing case studies and empirical data to assess the benefits and challenges associated with its implementation. The results show that while technology brings many benefits, such as reduced costs and time and improved quality of project outcomes, challenges such as initial implementation costs and the need for specialized skills still need to be addressed.

Keywords:Construction Technology, Building Information Modeling (BIM), Internet of Things (IoT), Artificial Intelligence (AI), Project Management, Efficiency, Cost, Quality

INTRODUCTION

Civil construction project management faces complex challenges involving the coordination of various elements, from planning to execution and monitoring. With the increasing need for efficiency, cost reduction, and quality improvement, technology has become a crucial factor in transforming this industry. Technological advancements, such as Building Information Modeling (BIM), Internet of Things (IoT), and artificial intelligence (AI), have

introduced new tools and methods that significantly impact the way construction projects are planned, executed, and monitored.

Building Information Modeling (BIM) enables more accurate project planning and visualization, with data integration facilitating better collaboration between stakeholders. BIM not only improves planning efficiency but also enables early identification of potential issues, reducing risks and additional costs (Eastman et al., 2011). The Internet of Things (IoT) offers real-time monitoring capabilities, allowing data to be collected from multiple sources in the field for better analysis and decision-making. IoT enhances the ability to track project progress, manage resources, and ensure compliance with quality and safety standards (Goh & Chong, 2019). Artificial intelligence (AI) has the potential to revolutionize the way project management is done by providing tools for big data analysis, prediction, and automation of routine tasks. AI can speed up the decision-making process and improve the accuracy of project cost and schedule estimates (Zhang & Zhao, 2020).

However, the adoption of this technology also faces challenges, including high initial implementation costs and the need for new skills. This article aims to explore the impact of technology on civil construction project management, focusing on the benefits, challenges and implications for the construction industry.

METHOD

This article uses qualitative and quantitative approaches to evaluate the impact of technology on civil construction project management. The methods used include literature analysis, case studies, and surveys. Literature analysis was conducted to identify and understand the basic concepts and applications of technology in construction project management. The literature reviewed includes books, journal articles, and industry reports relevant to the topics of Building Information Modeling (BIM), Internet of Things (IoT), and artificial intelligence (AI). Several case studies were selected to explore the real application of technology in construction projects. A survey was conducted to collect empirical data from construction industry practitioners regarding their experiences with technology in project management. Questionnaires were distributed to project managers, engineers, and other stakeholders to obtain their perspectives on the impact of technology on project efficiency, cost, and quality. Data obtained

from literature analysis, case studies, and surveys were analyzed comprehensively to draw conclusions about the impact of technology. The analysis techniques used included thematic analysis for qualitative data and descriptive statistics for quantitative data.

RESULTS AND DISCUSSION

1. Impact of Building Information Modeling (BIM)

The analysis results show that the implementation of Building Information Modeling (BIM) significantly improves the efficiency of planning and execution of construction projects. BIM allows for detailed 3D visualization and better data integration, which helps in early problem identification and risk management. A case study on a high-rise project in Singapore showed a 20% reduction in construction time and a 15% reduction in cost due to the use of BIM (Eastman et al., 2011). BIM also facilitates better collaboration between architects, engineers, and contractors, which contributes to the completion of the project on time and on budget.

2. The influence of the Internet of Things (IoT)

The application of the Internet of Things (IoT) in construction projects has shown significant improvements in real-time monitoring and resource management. IoT sensors installed at project sites allow for real-time data collection on environmental conditions and material usage. For example, in a road construction project in China, the use of IoT sensors to monitor soil and weather conditions has reduced project delays by 10% and improved construction quality (Goh & Chong, 2019). IoT also helps in preventative maintenance by providing early warnings of potential equipment or structural problems.

3. Contribution of Artificial Intelligence (AI)

Artificial intelligence (AI) has made a major contribution to data analysis and project planning. AI is used to analyze big data collected from various sources, including BIM and IoT, to make more accurate predictions about project schedules and costs. A case study conducted on an infrastructure project in Europe showed that the use of AI in risk analysis and cost estimation can reduce uncertainty and increase estimation accuracy by 25% (Zhang & Zhao, 2020). In

addition, AI allows automation of several administrative and managerial tasks, which reduces workload and improves operational efficiency.

4. Challenges and Obstacles

Although technology offers many benefits, there are some challenges in its implementation. Initial implementation costs and the need for new skills training are major barriers faced by many construction companies. A study conducted in Australia showed that the initial cost of implementing BIM, IoT, and AI can be as much as 30% of the project budget, and many small and medium-sized companies struggle to meet these costs (Ogunlana & Charoenngam, 2016). In addition, the need for training and adaptation to new technologies requires additional time and investment.

5. Implications for the Construction Industry

The implications of implementing technology in construction project management are very positive, especially in increasing efficiency, reducing costs, and improving the quality of project outcomes. However, the industry needs to address cost and training challenges to maximize the benefits of technology. Developing policies that support technology adoption and investment in training can help overcome these barriers and facilitate digital transformation in the construction sector.

CONCLUSION

Overall, technology has brought significant positive changes to the management of civil construction projects, with increased efficiency, reduced costs, and improved quality of project deliverables. However, challenges such as initial implementation costs, training requirements, and technology integration must be addressed to maximize its benefits. Developing policies that support technology adoption and investment in training will be key to addressing these barriers and ensuring that technology can be effectively implemented in the construction industry.

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