DIGITAL DISRUPTION AND TRANSFORMATION IN PROJECT COST MANAGEMENT IN DEVELOPING COUNTRIES: A SCOPING REVIEW

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There has been an accelerated push within the built environment toward digital transition in recent years. Developing countries stand to benefit significantly from advancing their levels of digital maturity. The rapid adoption of emerging digital technologies, such as Building Information Modelling (BIM), blockchain technology; and Geographic Information Systems (GIS), has profoundly disrupted traditional practices in project cost management, offering both opportunities and challenges. This study examines the interplay between digitalisation, disruption, and development within the context of project cost management. A four-step methodology was employed to investigate advances in digital transformation within project cost management in the built environment. The review evaluates current methodologies, identifies barriers and explores future trajectories in the digital transformation. The findings reveal several key barriers namely a lack of project team experience, the absence of procurement processes integrated with blockchain technology, modelling complexities, and deficiencies in planning, all of which hinder successful digitalisation. Furthermore, the paper identifies gaps in the literature and proposes directions for future research.

Keywords: blockchain technology; cost; digital transition; project cost management; time

INTRODUCTION

Traditionally, infrastructure projects in the built environment are characterised by discrepancies in cost and time performance compared to initial budgets and to similar projects (Gómez-Cabrera *et al.,* 2024; Dahlin and Pesämaa 2021; Durdyev 2021). These manifest in cost and time overruns. The inability to complete projects within an estimated budget has become a significant concern for infrastructure delivery, especially in the public sector. Scholars have outlined this observed phenomenon within and across projects, locations, and delivery systems as a problem if the current status quo continues (Khabisi *et al.,* 2016; Larsen *et al.,* 2016; Mahmud *et al.,* 2021). Furthermore, Martínez-Peláez et l (2023) articulated that without innovative solutions,

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the risk of inefficient and ineffective project delivery was thus likely to increase and further compromise infrastructure development.

As developing countries strive to keep pace with global advancements, digital transitioning emerges as a pivotal force in addressing project cost management challenges. At its core, digital transitioning represents a gradual paradigm shift (Akanmu *et al.,* 2021). Within the context of project cost and time overruns, transformation and innovation become synonymous with adaptation as the construction sector navigates the complexities of integrating digital tools into traditional operational practices (Tereshko and Rudskaya 2021).

It then becomes critical to understand how digital technologies are leveraged to mitigate variations through enhanced project cost management. Notwithstanding, the phenomenon is not limited to projects in developing countries alone. The issue of project cost and time variability in similar projects and overruns is a global phenomenon. For example, Budayan *et al. (*2020) highlighted the need to understand the variability of time and cost between projects. The authors argued that the construction sector faces numerous challenges in managing projects due to locality-specific problems and conditions, which may lead to variations in the management of similar projects conducted in different jurisdictions. One of the reasons for the problem is due to differing regulatory frameworks, availability of skilled labour, material pricing volatility, and inconsistent historical cost data across regions.

Additionally, information management is compromised because some of the data, like project initiation costs, is not collected and stored in a common data environment (Pedral Sampaio *et al.,* 2023). In project management, the availability of historical data is important for analysing trends and behaviour to decipher underlying issues. It assists in establishing, modelling, and predicting future trends to inform, warn, educate, and prepare society and its communities for what to expect in the future. For small companies, that can either be because the said information is not recorded in the system or is not readily available, meaning that a time-consuming search must be made through piles of hard-copy documents stored in a room.

Literature reveals the rapid adoption of emerging digital technologies, such as Building Information Modelling (BIM), blockchain technology, and Geographic Information Systems (GIS), has profoundly disrupted traditional practices in project cost management, offering both opportunities and challenges Raza *et al.,* 2023; Liu *et al.,* 2021; Zhu *et al.,* 2018). The paper builds on existing literature by examining the interplay between digitalisation, disruption, and development within the context of project cost management. This study is guided by the following research questions:

•What are the main barriers to digital transformation in project cost management in developing countries?

•What digital technologies are currently being applied to improve cost and time management?

•How are these technologies disrupting traditional practices?

METHOD

The study employed a four-step review methodology to examine the advancements in project cost management applications within the construction industry as applied in studies such as (Jiang *et al.,* 2021). The study aimed to investigate the significance, applications, current methodologies, challenges, and future trajectories in computer

vision. The initial step involved defining the review's scope, setting the stage for an in-depth exploration of project cost management's role in construction. Our focus was to provide a comprehensive overview of the field's latest developments, barriers, applications, and prospective directions for future studies. The study sourced academic articles from Web of Science and Scopus Search Engine, comprising journal articles, conference papers, and book chapters (see Figure 1).

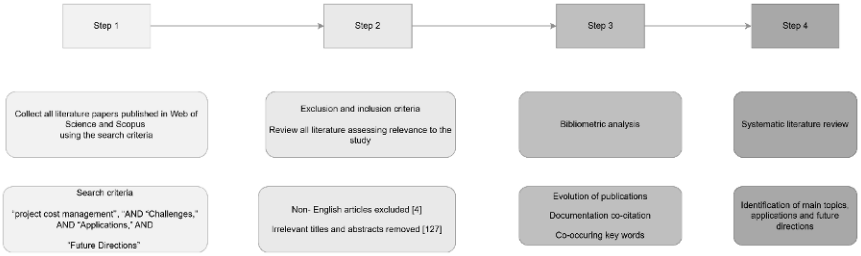

Figure 1: Research approach

Specific keywords such as "project cost management'', "AND "Challenges," AND "Applications," AND "Future Directions" guided our data retrieval process. Following data acquisition, the subsequent steps encompassed data collection and quality assessment, ensuring the inclusion of reliable and pertinent resources. 54 articles were analysed in the bibliometric analysis and 31 in the systematic analysis. Thematic coding was used to identify recurring digital interventions linked to cost/time management strategies. Each identified technology was aligned with a specific project management objective evidenced in the reviewed studies.

FINDINGS AND DISCUSSION

Figure 2 shows the developmental trend in project cost management between 1990 to 2025. In the period from 1990 up to 2002, research was limited and focused on traditional approaches to address project cost and time overruns; the success of the initiatives was inconsistent with limited successful case studies. Post 2002, adopting emerging technologies led to a shift in project management approaches. Between 2002 and 2017, there was a fluctuation due to trial-and-error approaches in technology adoption. Post-2017, there has been a constant increase due to increased digital maturity and improved capacity in organisations. This changed trajectory has led to an increased adoption of BIM and blockchain technology in project management practice.

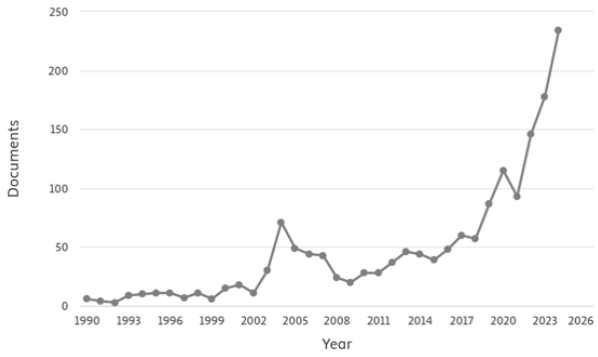

Figure 2: Publication trend on project management

Results showed evidence of emerging key topics and their interconnections in the context of digital technologies, sustainability, and project management over time (see

Figure 3). The colour gradient from blue to yellow indicates the evolution of these topics between 1990 to 2025. The isolated positioning of "business process management" suggests that integrating digital solutions into broader urban and infrastructure projects remains a challenge. While the strong linkage between "construction industry," "project management," and "digital technologies" suggests increasing adoption of BIM, IoT sensors, and AI-driven project planning in construction. Concerning future research direction represented in yellow shows the interconnection between "construction industry," "digitisation," and "design thinking." This alludes to the increasing use of digital technologies for infrastructure planning, predictive maintenance, and sustainability assessments.

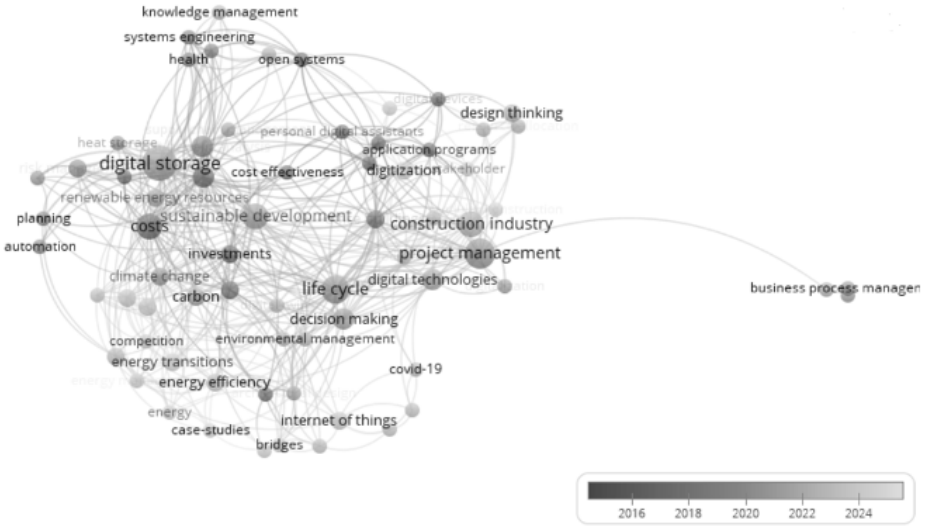

Figure 3: Emerging research trends

Figure 3 highlights how 'project management' increasingly co-occurs with digitisation' and 'BIM', reflecting a growing scholarly interest in digital transformation as a response to cost variability challenges. This trend supports the narrative of evolving digital solutions to cost and time variability by illustrating the growing centrality of digital technology in construction literature.

Emerging Approaches to Address Project Cost and Time Overruns

Time and cost are among major considerations throughout the project management life cycle and can be regarded as important parameters of project success. Despite its proven importance, it is not uncommon to see a construction project fail to achieve its objectives within the specified time and cost. Bubshait and Al-Juwait (2002) conducted a study in Saudi Arabia. It found that the effects of weather, social and cultural impacts, project location, a lack of productivity standards, supplier manipulation, level of competition, economic stability, the nation's insufficient raw material production, and lack of construction cost data were the main causes of cost overruns. A study in Ghana by Famiyeh *et al. (*2017) highlighted crucial elements contributing to project cost performance. Unfavourable weather, high labour costs, fluctuating material prices, bureaucracy in government agencies, poor financial management, and client financial hardship are some contributing factors. Kaming *et al. (*1997) conducted research in Indonesia. The findings showed that project cost overruns were mostly caused by inaccurate material take-off, rising material costs, and cost increases resulting from environmental limitations.

Similarly, Chimwaso (2001) conducted research in Botswana to evaluate the cost-effectiveness of construction projects. The authors found that measurements of provisional works, contractual claims, variations, and changes in the cost of labour and materials were the main causes of cost overruns. In the Nigerian city of Port Harcourt, Olupitan *et al. (*2021) conducted a study to determine the reasons behind cost overruns on public sector construction projects. The findings from these studies showcase that the most significant contributing factors are variation orders, changes to the project's scope, cash flow, and other financial issues contractors confront, delays in decision-making, and improper preparation.

Several reasons are attributed to projects performing differently across types, locations and management. Notable reasons for the varied performance included the project organisation strategy, procurement method and the monitoring and control regime. To address the above-outlined factors, Table 1 outlines emerging preventative measures implemented to address overruns. Notable examples include BIM replacing traditional estimation spreadsheets (Chahrour *et al.,* 2021); Blockchain enabling transparent subcontractor payment verification (Nanayakkara *et al.,* 2021); and AI-driven cost forecasting surpassing manual historical benchmarking (Liu *et al.,* 2021). These strategies employ emerging technologies as key enablers for ensuring the sustainability of built environment projects. The trend toward digital transformation can be seen through the increased use of many emergent technologies across industries, such as BIM, blockchain technology, and digital twin technology (Musonda *et al.,* 2025).

Table 1: Technology based measures

Approach	Technology used	Source
Actively monitoring and addressing delays during the construction process	BIM; Blockchain technology	Chahrour *et al.,* 2021; Radman *et al.,* 2022; Honnappa and Padala 2022; Alnaser *et al.,* 2024
Collaborating closely with subcontractors to reduce the likelihood of time overruns	Blockchain technology	Mohammed *et al.,* 2021; Lee *et al.,* 2021; Nanayakkara *et al.,* 2021; Khalfan *et al.,* 2022; Sarkar *et al.,* 2023
Implementing time management best practices	Internet of Things (sensors), artificial intelligence	Tereshko and Rudskaya, 2021; Oke *et al.,* 2022; Flyvbjery *et al.,* 2022; Furtado *et al.,* 2023; Patil *et al.,* 2023
Regularly assessing and updating project schedules to minimise time overruns.	BIM	Kavuma *et al.,* 2019; Ratajczak *et al.,* 2019; Rao *et al.,* 2022; Sepasgozar *et al.,* 2022; Chamikara *et al.,* 2024
Allocating sufficient resources to project management and scheduling.	AI and machine learning	Liu *et al.,* 2021; Ashtari *et al.,* 2022; Ali *et al.,* 2022; Rathod and Sonawane 2022; Khodabakhshian *et al.,* 2024
Prioritising continuous improvement in time management to minimise time overruns in future projects.	Digital twin	Farsi *et al.,* 2021; Mahmoodian *et al.,* 2022; Omrany *et al.,* 2023; Esmaeili and Simeone 2023; Weerapura *et al.,* 2023; Moshood *et al.,* 2024

In contrast to traditional approaches, through digitalisation construction progress monitoring is supported by a variety of tools and technologies to alarm delays, such as project management tools to monitor progress, track status and delays throughout the project; 4D-BIM which allows for the integration of scheduling tools to collect data, analysis and present them (Mohammed *et al.,* 2021; Liu *et al.,* 2021). Additionally, IoT technologies are emerging useful for optimising resource tracking (Rao *et al.,* 2021). Concerning promising continued improvements, digital twin technologies are

emerging as a sustainable solution (Omrany *et al.,* 2023). The foregoing observed patterns in relation to technology adoption are interesting. However, it should be noted that these apparent patterns must be interpreted considering the digital maturity of organisations and would, therefore, also affect performance levels. Nevertheless, with increased investment in digital capacity, organisations can derive the full benefits of digital transition leading to reduced project cost and time overruns.

CONCLUSION

This study examines the interplay between digitalisation, disruption, and development within the context of project cost management. The findings outlined a lack of project team experience, the absence of procurement processes integrated with blockchain technology, modelling complexities, and deficiencies in planning, scheduling, and monitoring, all of which hinder successful digitalisation. Despite emerging technologies showing promise, empirical validation in developing countries remains sparse. Most reviewed studies focus on conceptual frameworks or high-income contexts. This paper thus recommends context-specific implementation studies to understand the socio-technical complexities of digital transformation in resource-constrained environments.

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