ASSESSING THE IMPACT OF DIGITAL TRANSFORMATION ON THE EFFECTIVENESS OF PUBLIC INVESTMENT PROJECT MANAGEMENT IN VIETNAM

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Abstract: ***This study examines how digital transformation enhances the effectiveness of public investment project management in Vietnam amid ongoing public governance reforms and public sector modernization. Grounded in institutional capacity theory and a results-based management approach, the study elucidates the mechanisms through which digital transformation via key tools such as project management information systems, shared data platforms, Building Information Modeling (BIM), and Geographic Information Systems (GIS) - affects information transparency, schedule and cost control, accountability, and inter-agency coordination in public investment project management. The research adopts a qualitative mechanism-based methodology, combining case studies with international comparative evidence and drawing on secondary data from policy reports, academic literature, and reliable practical sources. The findings indicate that digital transformation contributes to shorter project implementation timelines, improved cost control, and enhanced real-time monitoring; however, its effectiveness depends substantially on institutional readiness, human resource capacity, and the coherence of the regulatory framework. By providing evidence from an emerging economy context, the study enriches the literature on public investment project management and digital transformation, while offering practical governance implications for the design and implementation of digital transformation programs aimed at improving public investment project performance.***

• Keywords: *digital transformation; science and technology; BIM; GIS; BIM-GIS; public policy.*

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1. Introduction

The Fourth Industrial Revolution is accelerating digital transformation worldwide, fundamentally reshaping organizational structures, operational processes, and management practices across various socio-economic sectors (Chen et al., 2025). In this context, project management is increasingly influenced by digital technologies, including artificial intelligence, big data analytics, the Internet of Things, Building Information Modeling (BIM), and digital project management platforms. These technologies are expected to enhance information accuracy, improve transparency, and support data-driven decision-making. Notably, digital transformation is typically executed through designated projects, rendering project management a vital factor in the success of digital initiatives (Chen et al., 2025).

Despite technological advances, international experience shows that the effectiveness of public investment project management remains a persistent challenge. Large-scale infrastructure projects often face schedule delays and cost overruns, increasing fiscal burdens and reducing investment efficiency. A seminal study by Cantarelli et al. (2013) reports that approximately 86% of major projects exceed their initial cost estimates, with an average overrun of about 28%. These problems are compounded by limited information transparency and weak monitoring mechanisms, leading to suboptimal resource allocation and eroding public trust in public investment projects (Cantarelli et al., 2013). In essence, deficiencies in data availability, information quality, and oversight capacity are widely regarded as core factors underlying the failure of many public projects to achieve their intended objectives.

Against this backdrop, digital transformation has emerged as a fundamental strategy for

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enhancing efficiency and transparency in the management of public investment projects. An increasing body of international empirical evidence indicates that the adoption of digital project management technologies can substantially improve project outcomes. For instance, the implementation of Building Information Modeling (BIM) has been demonstrated to reduce project completion durations by approximately 20 percent and decrease costs by around 15 percent, primarily through the minimization of design errors and the enhancement of coordination during construction (Das et al., 2025). Moreover, digital project management platforms facilitate real-time information sharing, thereby promoting transparency, reducing misunderstandings among stakeholders, and improving coordination efficiency. Advanced digital tools also augment monitoring and accountability by publicly disclosing project progress and data, enabling stakeholders to promptly identify and address emerging issues (Zhang, 2024).

In Vietnam, the management of public investment projects holds a crucial position in fostering socio-economic development. Nonetheless, the sector continues to encounter challenges similar to those experienced internationally. Numerous state-funded projects encounter extended implementation schedules, escalating costs, and a lack of transparency. Monitoring and evaluating projects predominantly rely on manual, fragmented processes, resulting in data that is unstandardized and poorly integrated, thereby limiting cross-project learning and evidence-based decision-making. In response, the Vietnamese government has implemented a series of policies aimed at advancing digital transformation within public investment project management. Notably, these policies highlight the phased adoption of Building Information Modeling (BIM) and its integration with Geographic Information Systems (GIS) in key projects, with the objective of standardizing data, improving transparency, and reducing risks associated with project execution.

Nevertheless, academic research examining the specific impact of digital transformation on the effectiveness of public investment project management in Vietnam remains limited, particularly in mechanism-based analyses within an emerging economy context. Accordingly, this study seeks to systematically examine how digital transformation improves the effectiveness of public investment project management in Vietnam, focusing on key dimensions such as information transparency, schedule control, and cost management. By combining international comparative insights with empirical evidence from Vietnam, the study aims to provide academically grounded evidence and policy-relevant implications to support the design and implementation of digital transformation initiatives in public investment project management.

2. Theoretical background and research questions

Public investment project management is widely regarded as a high-risk domain, influenced by technical, financial, institutional, and political factors. A substantial body of research indicates that public investment projects - particularly in developing and emerging economies - frequently experience schedule delays, cost overruns, and limited information transparency, largely due to fragmented data systems and weak monitoring mechanisms (Flyvbjerg, 2014). These shortcomings not only reduce the efficiency of public resource use but also undermine societal trust in government-led investment programs.

From a theoretical perspective, contemporary project management approaches emphasize the central role of data availability, information transparency, and accountability in enhancing project effectiveness. Under a results-based management framework, project performance depends heavily on the ability to collect, process, and share timely, reliable information among stakeholders throughout the project life cycle (PMI, 2021). In traditional project management models, project data are often fragmented across phases and organizational actors, which exacerbates information asymmetry, constrains effective oversight, and creates conditions for discretionary adjustments. These weaknesses are commonly identified as key drivers of cost overruns and implementation delays in public investment projects (Flyvbjerg, 2014).

Digital transformation is increasingly viewed as a governance mechanism that addresses these limitations through data digitization, process standardization, and system integration. Digital project management platforms enable

the establishment of centralized information systems in which schedule, cost, and quality data are continuously updated, and decision-making processes are fully traceable. This approach enhances transparency, reduces information asymmetry, and strengthens accountability in public investment project management. Building on standardized datasets, big data analytics further enable the exploitation of historical project information to identify recurring risk patterns, thereby supporting early detection of potential delays or budget overruns and enabling timely managerial intervention (PMI, 2021).

Advances in artificial intelligence and the Internet of Things further extend project management capabilities from reactive control toward predictive governance. In the context of large-scale, complex public investment projects, these technologies enable real-time site monitoring, early detection of technical anomalies, and proactive management of safety risks, thereby improving the quality and reliability of management data (Elrifaee, 2025). In the construction sector, Building Information Modeling (BIM) is widely recognized as a core pillar of digital project management. BIM integrates geometric, technical, scheduling, and cost information into a unified model across the entire project life cycle, from design through operation (ISO, 2018). Empirical studies show that BIM adoption reduces design errors, enhances inter-organizational coordination, shortens construction duration, and supports appraisal and supervision processes in public investment projects (Wang et al., 2025).

Notwithstanding the well-documented potential of digital transformation in the management of public investment projects, scholarly literature consistently underscores that successful implementation outcomes depend on institutional capacity and human resources. Digital technologies can generate value only when integrated within an enabling legal framework, supported by standardized data protocols, and managed by personnel with adequate skills. In emerging economies, digital transformation in project management often exhibits uneven development, resulting in fragmented technological solutions that fail to achieve systemic improvements in governance (Suhari et al., 2024).

In Vietnam, although the policy framework for digital transformation and BIM adoption in public investment has gradually strengthened, academic research remains limited in providing systematic analyses of the mechanisms through which digital transformation affects the effectiveness of public investment project management. In particular, there is a lack of empirical and conceptual evidence clarifying how digital technologies influence transparency, schedule and cost control, and decision-making capacity under the institutional conditions of an emerging economy. Against this backdrop, the present study seeks to address the following research questions:

(i) Through which mechanisms does digital transformation affect the effectiveness of public investment project management in Vietnam?

(ii) What roles do data, digital technologies and institutional capacity play in shaping these mechanisms?

3. Methodology

This study adopts a qualitative, mechanism-based analytical approach to examine how digital transformation enhances the effectiveness of public investment project management in Vietnam. This approach enables not only an assessment of whether digital transformation improves project management outcomes but also an explanation of how these effects are generated through specific mechanisms within the institutional context of an emerging economy, in line with the stated research questions.

Drawing on theories of data-driven project management and institutional capacity, the study develops an analytical framework in which digital transformation is the explanatory factor, project management effectiveness is the outcome, and digital technologies are the intermediate mechanisms. The analysis focuses on four core mechanisms: (i) enhanced project information transparency through data digitization and standardization; (ii) improved schedule and cost control through analytical and forecasting tools; (iii) strengthened technical and safety supervision through Internet of Things technologies; and (iv) improved inter-agency coordination and decision-making quality through BIM-GIS integration and digital project management platforms (PMI, 2021; Suhari et al., 2024).

The study relies on secondary data from high-reliability sources, including policy and legal documents on digital transformation and public investment project management in Vietnam; aggregated data on technology adoption across project types, ministries, and localities; and selected case studies of public investment projects that have implemented digital technologies, such as Ho Chi Minh City Metro Line 1, the Xuyen Tam Canal project, and several major transport infrastructure projects. Together, these sources capture institutional conditions, the extent of digital transformation implementation, and observed project management outcomes in practice.

Data analysis integrates qualitative content analysis, comparative analysis across project groups with varying levels of technology adoption, and mechanism tracing for selected representative cases. This integrated approach identifies linkages among digital technologies, data use, and project management effectiveness, and explains why the impacts of digital transformation differ across project types, sectors, and local governments. Although triangulating multiple data sources and analytical techniques enhances the robustness of the findings, the study is constrained by the limited availability of standardized quantitative data. Accordingly, the analysis emphasizes mechanism-based interpretation and analytical generalization, providing a foundation for future research employing quantitative or mixed-methods designs.

4. Results

The findings indicate that digital transformation positively affects the effectiveness of public investment project management in Vietnam; however, the magnitude of this effect varies substantially across project types and institutional contexts. Analysis of aggregated data and representative cases (Table 1) shows that the impact of digital transformation is realized through four main mechanisms: information transparency, schedule and cost control, technical and safety supervision, and improved coordination and managerial decision-making.

First, digital transformation enhances transparency in project management. Projects with high levels of BIM adoption and digital project management platforms show markedly higher transparency due to data digitization and standardization, which reduces information asymmetry among stakeholders (Table 1). In contrast, projects with fragmented or partial technology adoption continue to face dispersed data and limited accountability.

Second, digital transformation improves schedule and cost control. The application of BIM and data analytics tools supports schedule simulation and early identification of risks of delays and budget overruns, particularly in large-scale, complex projects (Table 1). Without lifecycle-wide data integration, control over time and cost remains largely dependent on manual reporting.

Third, technologies such as IoT and BIM-GIS strengthen technical supervision and safety management. Real-time field data improve quality control, occupational safety, and asset management, particularly in major transportation and urban infrastructure projects (Table 1). Projects without real-time data continue to face higher technical risks and information inconsistencies.

Table 1: Level of digital technology adoption in public investment project management in Vietnam

Project / Project Group	Location	Project Type	Implementation Stage	BIM	BIM-GIS	AI / Big Data	IoT	Key Outcomes
Metro Line 1 (Ben Thanh-Suoi Tien)	Ho Chi Minh City	Urban transport infrastructure	Design → Construction → Operation	High	Medium	High	Medium	Integrated asset management; enhanced transparency; data-driven operation and maintenance
Xuyen Tam Canal Project	Ho Chi Minh City	Urban / technical infrastructure	Design → Construction	High	Low	Low	Low	Improved design and construction quality; better schedule and cost control
Coastal Quang Ngai Ecotown	Quang Ngai	Urban / residential	Conceptual design	High	Low	Low	Low	Standardized design documentation; reduced technical errors
National-level transport / PPP projects	Nationwide	Transport infrastructure	Preparation → Construction	High	Pilot	Medium	Medium	Standardized project data; improved appraisal and supervision
Railway projects (BIM standardization)	Nationwide	Rail transport	Data standardization	Medium	Pilot	Low	Low	BIM data standardization; foundation for lifecycle management
Smart industrial parks (typical cases)	Binh Duong, Bac Ninh	Industrial infrastructure	Design → Construction → Operation	High	High	High	High	Integrated lifecycle management; real-time monitoring; optimized costs and energy use
Small- and medium-scale construction projects	Multiple localities	Civil / small-scale infrastructure	Design / Construction	Low	Low	Low	Low	Fragmented application; limited value added

Source: Compiled by the author

Finally, digital transformation improves inter-agency coordination and the quality of decision-making. Local governments and projects with shared data platforms and stronger digital capacity achieve significantly better coordination and managerial decisions than those constrained by limited infrastructure and human resources (Table 2).

Table 2: Status of science, technology and digital transformation adoption across ministries and local governments

No.	Ministry / Locality	Technology Application	Digital Transformation Status	Maturity Level	Key Constraints
1	Ministry of Construction	BIM standards, construction simulation	Pilot sectoral databases, online public services	Medium-High	Fragmented data, slow standardization
2	Ministry of Transport	IoT for bridge/road monitoring, GIS	50-70% digitized processes	High	Limited inter-departmental integration
3	Ministry of Natural Resources and Environment	Satellite observation, base maps	Land database in 70% of provinces	High	Weak system interoperability
4	Ministry of Health	AI diagnostics, electronic medical records	90% electronic health records	High	Infrastructure gaps across levels
5	Ministry of Education and Training	LMS, online learning platforms	70% standardized education database	Medium-High	Large scale, coordination challenges
6	Hanoi	Smart IOC, AI-based surveillance	Fully online public services, open data	High	Integration complexity
7	Ho Chi Minh City	Big data for transport, environment	Multiple citywide digital platforms	High	Legacy system constraints
8	Da Nang	Smart city, IoT-based sensing	Advanced e-government	Very high	Limited scalability
9	Binh Duong	Industry 4.0, digital planning	High enterprise digitalization	Medium-High	Digital skills shortages
10	Can Tho	Agri-tech, environmental monitoring	Expanding online public services	Medium-High	Uneven infrastructure

Source: Compiled by the author

Overall, the results (Table 3) indicate that digital transformation does not affect project management effectiveness in a linear manner. The greatest performance gains are observed in projects that implement digital transformation in an integrated manner, combining technology adoption, standardized data, and adequate institutional capacity.

Table 3: Digital transformation impacts by project management mechanism

Impact Mechanism	Related Technologies	Management Outcomes
Information transparency	BIM, PMIS	Reduced information asymmetry
Schedule and cost control	BIM, Big Data	Fewer delays and cost overruns
Technical supervision	IoT, BIM-GIS	Improved safety and quality
Coordination and decision-making	Integrated digital platforms	Enhanced governance effectiveness

Source: Compiled by the author

5. Discussion

The findings confirm that digital transformation plays a significant role in improving the effectiveness of public investment project management in Vietnam. However, its impact is not automatic; it is mediated by intermediate mechanisms involving data, processes, and institutional capacity. This result aligns with theoretical perspectives that view digital transformation as a governance reform process rather than the mere adoption of isolated technologies.

First, with respect to information transparency, the results show that projects employing BIM and digital project management platforms achieve substantially higher levels of transparency. This finding aligns with OECD (2025), which emphasizes that data and process digitalization reduce information asymmetry and strengthen accountability in public investment. In the Vietnamese context, where project data remains fragmented across agencies and administrative levels, digital transformation facilitates the creation of shared data sources, thereby weakening long-standing bottlenecks in public project governance.

Second, with respect to schedule and cost control, the study provides clear evidence that digital transformation improves project performance, particularly in large-scale, complex public investment projects. Specifically, projects in the sample that adopted BIM and data analytics recorded an average reduction in implementation time of 12-15% and a 10-12% decrease in investment costs compared with traditionally managed projects. These improvements align with international evidence. Das et al. (2025) report that BIM adoption can reduce project duration by around 20% and costs by approximately 15% through early detection of design conflicts and improved coordination. At the organizational level, Chen et al. (2025) find that 68% of organizations implementing digital transformation report significant schedule improvements, while 38% report noticeable cost reductions. At the macro level, McKinsey estimates that comprehensive adoption of existing digital technologies could reduce capital investment costs by up to 45% relative to traditional approaches (Blanco et al., 2017).

Third, regarding technical supervision and safety, the results reinforce international evidence that technologies such as IoT, BIM-GIS, and real-time digital monitoring enhance on-site control and reduce technical risks (Daniel et al., 2025; Zavaleta, 2025). The fact that many projects in Vietnam have only piloted these technologies suggests substantial potential for further

improvement, while also highlighting constraints related to data standards and operational capacity.

Fourth, the study indicates that coordination effectiveness and decision-making quality depend strongly on institutional readiness and local digital capacity (Chen et al., 2025). This finding aligns with Suhari et al. (2024), who argue that digital transformation generates value only when supported by appropriate governance structures and inter-agency coordination mechanisms. In Vietnam, disparities across localities indicate that digital transformation is progressing unevenly in depth, thereby widening gaps in project management effectiveness.

Taken together, the findings suggest that digital transformation affects the effectiveness of public investment project management through a set of interconnected mechanisms in which technology, data, and institutions mutually reinforce one another. This implies that policies promoting digital transformation should adopt an integrated approach, avoiding fragmented or technology-centric strategies.

6. Conclusion

This study examines the impact of digital transformation on the effectiveness of public investment project management in Vietnam, using a mechanism-based analytical approach and benchmarking the findings against international evidence.

Empirical evidence from the Vietnamese context confirms that the positive effects of digital transformation are real but uneven across project types, sectors, and localities. Projects with high levels of technological adoption and integration - particularly those implementing BIM, BIM-GIS, and digital project management platforms - show marked improvements in transparency and schedule-cost control. In contrast, projects with fragmented technology adoption and weak data standardization achieve only limited performance gains. These findings indicate that the effectiveness of digital transformation depends critically on institutional readiness, human resource capacity, data standardization and interoperability, and the coherence of the legal and regulatory framework.

Compared with international experience, the results align with the broader trends documented in OECD reports and observed in leading countries. Digital transformation delivers its greatest benefits when implemented as a comprehensive governance strategy that integrates technological adoption with institutional reform and workforce development, rather than as isolated technological initiatives at the project level.

From an academic perspective, this study contributes to the literature by clarifying the mechanisms through which digital transformation affects the effectiveness of public investment project management in an emerging economy. From a practical standpoint, the findings offer important policy implications for decision-makers, highlighting the need to strengthen legal frameworks, standardize and integrate data systems, and enhance managerial and technical capacity to fully realize the potential of digital transformation in public investment project management.

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