The American Journal of Interdisciplinary Innovations and Research
ISSN 2642-7478 Volume 08 - 2026

The Role of Digital Transformation in The Strategic Management System of Construction Production

Iryna Vysochanska
Business Consultant, Construction Business, Ukraine

Received: 08 Jan 2026 | Received Revised Version: 19 Jan 2026 | Accepted: 16 Feb 2026 | Published: 28 Feb 2026

Volume 08 Issue 02 2026 | Crossref DOI: 10.37547/tajiir/Volume08Issue02-12

Abstract

The article examines the role of digital transformation in the strategic management system of construction production based on an analysis of contemporary empirical and theoretical research in the fields of construction management, building information modeling, digital twins, and logistical production systems. The study integrates data concerning the technological, organizational, and analytical factors of construction process controllability, emphasizing the multi-level and mediated nature of digital solutions' impact on the stability and predictability of production parameters. It is shown that digital technologies do not act as independent determinants of management efficiency but exert their influence through mechanisms of data integration, synchronization of project life cycle stages, and the formation of centralized analytical frameworks. Particular attention is given to the role of BIM environments, ERP systems, BI dashboards, and cloud platforms as key transformation mediators that ensure information comparability and the reproducibility of managerial procedures. The analysis demonstrates that full-cycle data processing mediates the connection between digital tools and the stability of schedule-network models, the allocation of resource flows, and the speed of managerial responses, whereas fragmented digitalization creates a "digital illusion" effect and increases the likelihood of uncoordinated changes. The informational density of the production environment can serve both as a factor in enhancing process transparency and as a source of managerial risks in the absence of centralized analytics and cross-platform compatibility. This article can be useful for researchers and practitioners in the fields of strategic construction management, the digital transformation of production systems, and the integration of information technologies into organizational management frameworks.

Keywords: *strategic management, digitalization, production management, data integration, managerial decisions, production processes, resource planning.*

© 2026 Irina Vysochanskaya. This work is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0). The authors retain copyright and allow others to share, adapt, or redistribute the work with proper attribution.

Cite This Article: Vysochanskaya, I. (2026). The Role of Digital Transformation in The Strategic Management System of Construction Production. The American Journal of Interdisciplinary Innovations and Research, 8(2), 95–102. https://doi.org/10.37547/tajiir/Volume08Issue02-12

Introduction

The development of digital technologies in construction is transforming strategic management systems for construction production, shifting the focus from the localized control of individual projects to the management of an aggregate of production processes, resources, and information flows. The classical model, which is oriented toward the linear execution of a project and the subsequent handover of the result to the client, is becoming increasingly inadequate for the conditions of the modern construction industry, which is characterized by high schedule variability, a multi-contractor structure, limited material and labor resources, and heightened sensitivity to schedule and cost deviations. The managerial focus is shifting from administering individual stages to establishing integrated digital frameworks for planning, dispatching, and control that consolidate data from design, construction, and production logistics. In this configuration, a construction company transitions from the role of an executor of isolated contracts to the role of a coordinator of distributed production systems and end-to-end information flows.

The significance of this transformation is amplified amid growing competition among construction companies and the increasing complexity of project portfolios, where the speed of managerial decision-making, supply synchronization, production capacity controllability, and schedule-network planning accuracy directly impact the financial stability and reputation of the organization. Integrating digital platforms, BIM environments, analytical dashboards, and data management systems creates a continuous information loop among design, construction, and production control, blurring the boundaries between operational management, project management, and strategic planning. Concurrently, a debate persists in the academic literature regarding whether the digitalization of construction production should be interpreted as an extension of traditional project management tools or as the formation of a new strategic management architecture for the production system.

The purpose of the study is to establish a systematic understanding of the role of digital transformation within the strategic management system of construction production and to identify the factors determining its stability, predictability, and effectiveness. To achieve this goal, the following objectives are addressed:

– analyze the limitations of forming digital managerial frameworks in construction production;

– systematize the key elements of strategic management regarding the construction project portfolio and production resources;

– uncover the mechanisms for integrating digital platforms, logistical modules, and analytical tools into a unified managerial environment;

– substantiate the consequences of transitioning from fragmented project control to platform-based and cyclical management of the production system.

The research hypothesis posits that a construction company's competitiveness is determined not by the number of implemented digital solutions, but by the degree of their integration into a unified strategic production management architecture that ensures data comparability, schedule and resource controllability, and the reproducibility of managerial decisions. Fragmented digitalization does not generate a sustainable production advantage.

The scientific novelty of the work lies in systematizing the strategic management of construction production as a multi-level architecture of digital and organizational frameworks, uniting the management of projects, resources, logistics, and data into a single reproducible model of strategic coordination.

2. Materials and methods

A systematic review of scientific publications, structural-functional analysis, comparative analysis, and a configurational comparison of managerial models were utilized as research methods. This combination of methods enabled the identification of stable elements within strategic construction production management systems and the interpretation of various combinations of digital and organizational factors influencing the controllability of timelines, resources, and production flows.

The study was conducted in the format of a systematic review featuring a phased procedure for source identification, screening, and inclusion. The search was performed across international peer-reviewed open-access journals indexed in Scopus and Web of Science for the period spanning 2022–2025. The search strategy relied on combinations of the following keywords: "digital transformation in construction," "strategic management of construction production," "project management in construction," "building information modeling," "digital twin," "construction logistics," "data-driven management," "construction project portfolio," and "construction production systems," utilizing AND/OR logical operators.

During the identification stage, 126 publications were discovered. Following the removal of duplicates and an initial screening of titles and abstracts, 71 studies were excluded for lacking relevance to the managerial aspects of construction production or failing to address strategic and project management issues. At the full-text evaluation stage, an additional 45 papers were excluded based on criteria of a narrowly technical focus, the absence of a production-managerial interpretation of results, or a sole concentration on engineering calculations without an organizational context. The final sample incorporated 10 studies.

Inclusion criteria comprised the presence of a managerial or architectural framework for the digital transformation of construction processes, a connection to the construction project life cycle, and the applicability of

the findings to the strategic management of construction companies and their production systems. Publications focusing exclusively on software implementations, isolated technological solutions devoid of an analysis of managerial consequences, and papers neglecting the coordination of construction participants, resource management, or information flows were excluded.

In the study by Chen et al. [1], digital transformation is examined through the selection of building life-cycle BIM service providers as an element of the strategic integration of production data. Cocco and Tonelli [2] demonstrate the role of BIM, blockchain, and digital identifiers in ensuring the transparency of contractual and production supply chains, whereas the factors and configurations of digital transformation in construction companies are explored by Guo et al. [5]. The role of digital twins in monitoring technical condition and maintaining production cycle continuity is reflected in the works of El Mokhtari et al. [3] and Hosamo et al. [7], while the integration of BIM and GIS for managing distributed construction sites and project portfolios is presented by Meschini et al. [8]. The logistical and project frameworks for the digital management of production flows are discussed by Gehring and Rüppel [4] and Radman et al. [10], the institutional and environmental conditions for the digitalization of construction processes by Haag and Jünger [6], and the industry's level of digital readiness alongside managerial barriers to transformation by Naji et al. [9].

Thus, analyzing the selected publications permitted the identification of stable digital and organizational frameworks for the strategic management of construction production, which encompass the integration of BIM environments, digital twins of production and operational processes, logistical modules, centralized data management systems, and coordination mechanisms for the construction project portfolio. The derived results were utilized to structure a model of the strategic construction production management system, oriented toward enhancing schedule predictability, resource supply stability, and the reproducibility of managerial decisions.

Results

Within the scope of this study, results are understood as the identified stable configurations of digital and organizational factors that determine the controllability of timelines, resources, and production flows within the strategic management system of construction production. During the research, it was established that the digital transformation of construction production manifests as a reconfiguration of the managerial architecture, rather than the mechanical implementation of isolated software solutions. It was determined that the stability of the production system is linked to the presence of an end-to-end framework of comparable data, ensuring the synchronization of design models, schedules, and resource plans amidst changes in design documentation and production conditions. In the absence of integration, digital tools operate in isolation, which is accompanied by an increase in transactional operations for information alignment and elevated variability in work execution timelines [10].

A comparative configurational assessment revealed a recurring correlation between the depth of digital platform compatibility and the predictability of production parameters. Companies maintaining continuous data transmission across the stages of design, planning, and production control exhibit a shorter managerial response cycle and a lower frequency of schedule adjustments. It was noted that digital maturity is expressed in the ability to ensure the reproducibility of information processing procedures and a unified format for interpreting metrics, whereas fragmented technology adoption is accompanied by source duplication and an increased burden on the managerial framework [1].

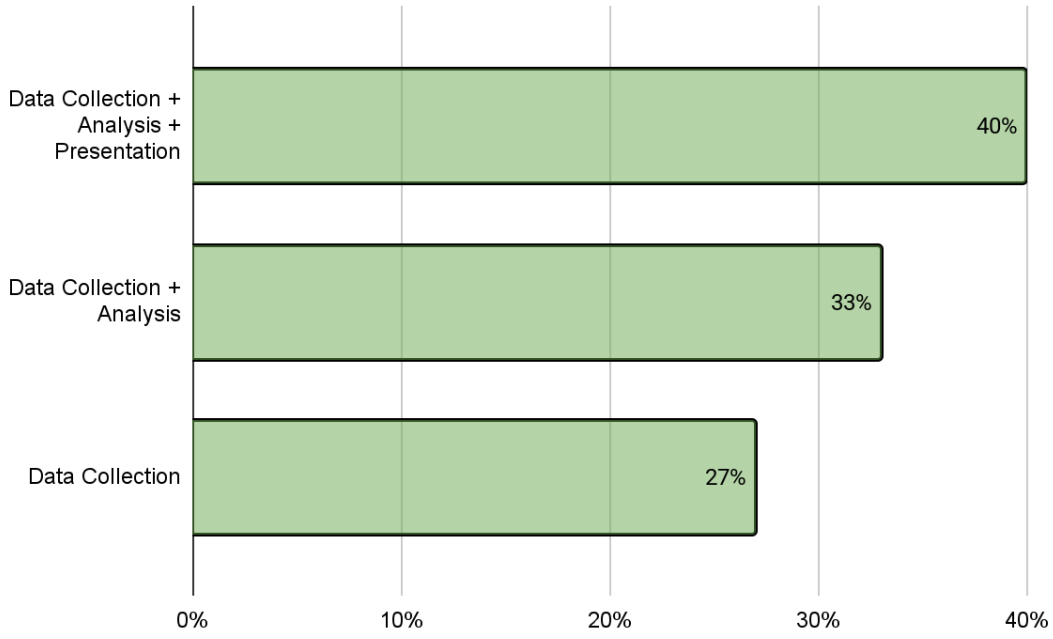
In the process of identifying the structural core of digital integration, the model for selecting a building life-cycle BIM service provider is interpreted as an architectural integrator of the production environment. This element functions as a mechanism for aligning changes in design data, regulations, and production metrics, ensuring the continuity of the managerial cycle and the compatibility of information flows. Table 1 examines the distribution of factors for selecting a digital partner and their relative weight in the final assessment.

Table 1 – Factors for Selecting a Digital Partner (BLSP) in the Strategic Management System of Construction Production (Compiled by the author based on source: [1])

Factor	Managerial Framework Content	Share, %
Project BIM Capability	System integration, platform compatibility, end-to-end project data management	29.1%
Organizational BIM Capability	Company stability, project execution experience, development strategy	25.1%
Past Performance and Quality	Project efficiency, client trust level, innovative practices	21.1%
Digital Service Reliability	Data confidentiality, information security, redundancy	13.0%
Documentation and Cost	Comprehensiveness of regulations, cost of services and support	11.7%

The quantitative distribution of factors establishes the dominance of parameters directly related to end-to-end data management and platform compatibility, while security and cost metrics form a supporting integration framework rather than acting as defining architectural elements. Organizational stability and proven outcomes in executing digital projects enhance the controllability of the production system through the reproducibility of integration procedures and accumulated operational experience [5]. An additional comparison with studies on digital twins and BIM integration reveals that maintaining the architectural compatibility of information environments reduces the frequency of uncoordinated changes and stabilizes the distribution of resource flows at the project portfolio level [3].

The systematization of digital tools in construction production uncovers an uneven functional distribution across data life-cycle stages, enabling the interpretation of the managerial digital environment's maturity level not through the mere presence of individual technologies, but via the completeness of their stage-by-stage integration. Digital management of production processes within the industry is primarily built around tools for the initial recording of information, whereas analytical and presentation frameworks are utilized significantly less frequently [7]. This points to a structural asymmetry in the digital cycle and an increase in the latency of managerial responses. Such a configuration implies that data is present in the system, yet it is not always transformed into comparable and visualizable managerial information necessary for synchronizing design and resource decisions. Figure 1 presents the distribution of digital technologies across data processing stages.



Note. The categories are mutually exclusive and reflect the distribution of studies based on the completeness of the data processing life cycle (DC; DC+DA; DC+DA+DP), rather than sequential stages of a single process. The total value may differ from 100% by 1 percentage point due to the rounding of percentages in the original source.

Figure 1 – Distribution of Digital Technologies across Data Life-Cycle Stages in the Construction Production Management System (Compiled by the author based on source: [10])

The presented data demonstrate the uneven distribution of digital technologies across data life-cycle stages and capture the simultaneous coexistence of integrated and fragmented digital management practices. The largest share belongs to full-cycle "collection–analysis–presentation" technologies at 40%, indicating the emergence of a layer of comprehensive tools for continuous information processing and visualization. Simultaneously, a substantial volume of solutions is restricted solely to the primary data collection stage at 33%, reflecting the industry's lingering orientation toward recording information without systemic interpretation. An intermediate position is occupied by "collection–analysis" technologies at 26%,

characterizing a transitional level of digital maturity where data is structured but not consistently advanced to the stage of managerial visualization. This ratio highlights a structural gap between the informational density of processes and the completeness of their analytical-presentation processing, which influences the speed of managerial responses and the coherence of decisions.

Comparisons with research on digital twins and integrated BIM environments reveal that full-cycle technological connections ensure the stability of schedule-network models and the predictability of resource flows, whereas a disconnect between data processing stages increases the likelihood of uncoordinated changes and extends the managerial response horizon [3]. The distribution of digital tools across data life-cycle stages thereby reflects the industry's level of technological saturation and the degree of structural cohesion among information frameworks, which determine the actual controllability of construction production in a multi-project and resource-constrained environment.

Discussion

Unlike studies that interpret digital transformation primarily as a technological upgrade of construction management tools, the obtained results permit viewing it as an architectural shift in information processing and interpretation that determines the actual controllability of timelines and resources. The digital transformation of

construction production manifests as a change in the principles of information processing and interpretation, rather than a simple accumulation of technological modules. Individual digital solutions enhance the transparency of localized operations; however, they do not guarantee the stability of the managerial system unless integrated into a unified data comparison framework. Under the conditions of executing multiple concurrent projects, the organization's ability to maintain a continuous transmission of information among design, planning, the construction site, and financial departments becomes a critical parameter. In this configuration, the controllability of schedules and resources is defined not by the quantity of tools employed, but by the presence of a centralized analytical environment where data is transformed into comparable managerial metrics [10].

Practical operational stability coalesces around a nexus of information modeling systems, accounting platforms, and analytical dashboards interconnected via centralized databases. DBMS and BI environments serve as the process core, enabling the aggregation of flows from BIM models, schedules, sensor data, and ERP records into a cohesive interpretive structure. In the absence of such a core, digital tools continue to operate in isolation, accompanied by growing time lags between recording deviations and analytically comprehending them, an increased number of alignment procedures, and reduced predictability in production parameters. Tools acquire a strategic character only when integrated into an end-to-end information processing system, where technological modules perform complementary functions and data circulates without losing context or format. Table 2 illustrates the relationship among the managerial elements of digital transformation, their associated tools, functions, and practical effects.

Table 2 – Managerial Elements of Digital Transformation in the Strategic Management of Construction Production (Compiled by the author based on source: [10])

Managerial Element	**Digital Tool**	**Function in the Management System**	**Practical Effect**
Schedule Control	4D Models (BIM + Schedule)	Comparison of planned and actual parameters	Reduction in the likelihood of launch failures and schedule deviations
Resource Management	ERP Systems + Sensors	Tracking capacity utilization, supplies, and costs	Optimization of expenses and logistical flows
Progress Monitoring	Mobile Apps, RFID	Recording work statuses and movements	Enhancement of production process transparency
Decision Analytics	BI Dashboards, DBMS	Consolidation, processing, and visualization of data	Acceleration of managerial responses and reduction of decision latency
Participant Coordination	Cloud Platforms	Establishment of a unified information environment	Reduction of conflicts, duplication, and data inconsistency

Structuring managerial elements through digital tools demonstrates a direct correlation between the technological connectivity of the environment and the reproducibility of decisions. 4D BIM ensures the synchronization of design models and schedules, ERP frameworks stabilize resource flows, and BI dashboards alongside centralized databases forge an interpretive information space where metrics become comparable across varying management levels. Cloud platforms complement this framework, lowering transactional communication costs and sustaining a unified informational field. In this configuration, digital technologies function not as a collection of autonomous services, but as an interconnected system of operational controllability, where technological functions are sequentially transformed into managerial effects and cultivate the stability of strategic construction production management.

The fragmented digitalization of construction production engenders a "digital illusion" effect, wherein the presence of isolated technological solutions is interpreted as an indicator of managerial maturity, while the actual cohesion of information frameworks remains limited. A substantial proportion of tools, oriented predominantly toward initial data collection, creates a visually saturated digital environment; however, this alone does not guarantee the analytical comparability of metrics and their incorporation into planning procedures. Within such a setup, the information flow accumulates faster than it is interpreted, which widens the gap between operational digitalization and the strategic management of production parameters.

Utilizing BIM models, sensor systems, and mobile applications is frequently viewed as a sufficient condition for digital transformation; nevertheless, the isolated implementation of these tools fails to establish a stable framework for controlling timelines and resources. Lacking a centralized mechanism for data aggregation and verification, digital solutions begin to function as parallel environments for event recording rather than as components of a unified analytical architecture. This manifests as a rising number of uncoordinated schedule adjustments, duplicated information sources, and increased time required to verify the actual progress of work. Under these circumstances, the technological density of the production environment is not equivalent to managerial efficiency and does not guarantee the predictability of schedule-network parameters.

Disconnects between information processing stages exert a direct impact on the stability of the production cycle. Devoid of a sequential transition from collection to analysis and subsequent visualization, data is not transformed into managerial signals capable of timely adjusting supplies, capacity utilization, and labor resource allocation. A situation emerges where data resides in the system, yet its managerial value remains partial, and the reaction of the management framework shifts from proactive to delayed. Such a configuration heightens the probability of cascading schedule deviations and intensifies the reliance of decisions on the subjective interpretation of individual project participants.

The primary factor in this environment is not the volume of implemented digital solutions, but the degree of their integration into a unified cycle of information processing and interpretation. The strategic nature of digital transformation is exhibited by the presence of continuous cohesion among technological, analytical, and organizational elements, which shape a robust architecture of controllability. It is precisely the level of integration that dictates a construction company's capacity to maintain the alignment of timelines, resource flows, and project parameters within a multi-project and dynamic production environment, setting the boundaries for the actual predictability of managerial responses.

Conclusion

The digital transformation of construction production manifests primarily as a shift in strategic management architecture rather than the mere adoption of isolated technological solutions. The study indicated that the presence of an end-to-end framework of comparable data—ensuring the synchronization of design models, schedules, and resource plans—becomes the critical factor for production system stability. Within a multi-project environment, it is informational cohesion that governs the speed of managerial responses and the predictability of production parameters.

The derived results corroborate that a construction company's digital maturity is expressed not by the number of platforms and services utilized, but by the ability to ensure the continuous transmission and interpretation of data across the design, planning, and construction stages. Integrating BIM environments, ERP systems, analytical dashboards, and centralized databases establishes an operational management core where technological functions are transformed into

managerial effects, supporting the reproducibility of decisions.

Simultaneously, it was revealed that a significant portion of digital tools in the industry is still utilized primarily to record information without subjecting it to systemic analytical processing. This configuration generates a "digital illusion" effect, where technological density is not accompanied by increased controllability over schedules and resources. Disconnects among the data collection, analysis, and presentation stages escalate the latency of managerial responses and heighten the probability of uncoordinated changes in the production cycle.

Thus, the strategic role of digital transformation in construction lies in forging a unified, integrated environment for information processing and interpretation, where technologies serve not as autonomous modules, but as elements of an interconnected system of controllability. The level of integration between digital and organizational frameworks becomes the defining parameter for the stability, predictability, and competitiveness of construction production amidst resource constraints and high project variability.

References

1. Chen G., Feng Q., Jiang C., Zhang S., Li Q. Towards Digital Transformation in the Construction Industry: A Selection Framework of Building Information Modeling Lifecycle Service Providers (BLSPs) [Electronic resource]. Systems, 2025, Vol. 13, No. 9, p. 816. Available at: https://doi.org/10.3390/systems13090816 (accessed: 26.01.2026).
2. Cocco L., Tonelli R. Digital Transformation in the Construction Sector: Blockchain, BIM and SSI for a More Sustainable and Transparent System [Electronic resource]. Future Internet, 2024, Vol. 16, No. 7, p. 232. Available at: https://doi.org/10.3390/fi16070232 (accessed: 27.01.2026).
3. El Mokhtari K., Panushev I., McArthur J. J. Development of a Cognitive Digital Twin for Building Management and Operations [Electronic resource]. Frontiers in Built Environment, 2022, Vol. 8, 16 May. Available at: https://doi.org/10.3389/fbuil.2022.856873 (accessed: 27.01.2026).
4. Gehring M., Rüppel U. Data Fusion Approach for a Digital Construction Logistics Twin [Electronic resource]. Frontiers in Built Environment, 2023, Vol. 9, 06 Mar. Available at: https://doi.org/10.3389/fbuil.2023.1145250 (accessed: 28.01.2026).
5. Guo X., Zheng D., Huang D., Gu J. Research on Influencing Factors of Digital Transformation of Construction Enterprises Based on SEM and fsQCA Methods [Electronic resource]. Buildings, 2025, Vol. 15, No. 18, p. 3302. Available at: https://doi.org/10.3390/buildings15183302 (accessed: 28.01.2026).
6. Haag P., Jünger H. C. Turning a Spotlight on Construction Logistics for a Sustainable Urban Environment — A Review of Current Policy Concepts and Literature [Electronic resource]. Frontiers in Built Environment, 2023, Vol. 9, 16 Oct. Available at: https://doi.org/10.3389/fbuil.2023.1202091 (accessed: 29.01.2026).
7. Hosamo H. H., Nielsen H. K., Alnmr A. N., Svennevig P. R., Svidt K. A Review of the Digital Twin Technology for Fault Detection in Buildings [Electronic resource]. Frontiers in Built Environment, 2022, Vol. 8, 09 Nov. Available at: https://doi.org/10.3389/fbuil.2022.1013196 (accessed: 30.01.2026).
8. Meschini S., Pellegrini L., Locatelli M., Accardo D., Tagliabue L. C., Di Giuda G. M., Avena M. Toward Cognitive Digital Twins Using a BIM-GIS Asset Management System for a Diffused University [Electronic resource]. Frontiers in Built Environment, 2022, Vol. 8, 01 Dec. Available at: https://doi.org/10.3389/fbuil.2022.959475 (accessed: 30.01.2026).
9. Naji K. K., Gunduz M., Alhenzab F., Al-Hababi H., Al-Qahtani A. Assessing the Digital Transformation Readiness of the Construction Industry Utilizing the Delphi Method [Electronic resource]. Buildings, 2024, Vol. 14, No. 3, p. 601. Available at: https://doi.org/10.3390/buildings14030601 (accessed: 31.01.2026).
10. Radman K., Babaeian Jelodar M., Lovreglio R., Ghazizadeh E., Wilkinson S. Digital Technologies and Data-Driven Delay Management Process for Construction Projects [Electronic resource]. Frontiers in Built Environment, 2022, Vol. 8, 21 Dec. Available at:

https://doi.org/10.3389/fbuil.2022.1029586
(accessed: 31.01.2026).