

From Tool Embedding to System Reconstruction: The Dual Effects of Digital Transformation on Enterprise Management Efficiency

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Abstract

Against the prevailing trend of enterprise digital transformation, numerous enterprises only introduce digital technologies while ignoring supporting organizational optimization, thus resulting in inefficient investment and sluggish improvement of management efficiency. This paper adopts the theoretical perspective of “technology–organization” co-evolution to systematically analyze three core mechanisms through which digital transformation affects enterprise management efficiency: how information transparency reduces communication costs, how process automation releases human resources, and how intelligent decision-making mitigates judgment biases. On this basis, the paper dialectically uncovers four types of potential challenges that cannot be overlooked in the transformation process: short-term efficiency decline caused by the “transition pains” phenomenon, the paradoxical mismatch between technology investment and output, new risks arising from data security and system vulnerability, and human resistance triggered by employee adaptability barriers. The study argues that the essence of digital transformation is not merely the embedding of tools, but a systemic reconstruction involving organizational structure adjustment, business process reengineering, and organizational culture reshaping. Only by adhering to the principles of strategy-first, equal emphasis on technology and management, and step-by-step implementation, and by paying close attention to organizational adaptation and employee empowerment during technology implementation, can enterprises maintain strategic resolve amid short-term efficiency fluctuations and ultimately achieve substantial improvement in management efficiency and the long-term accumulation of organizational capabilities.

Keywords

digital transformation, management efficiency, technology–organization synergy, input–output paradox, organizational change

1. Introduction

Digital technologies are reshaping enterprise operations at an unprecedented pace. The mature application of technologies such as big data, cloud computing, and artificial intelligence has substantially reduced information transmission costs, made business process automation possible, and provided management

decision-making with more robust data support. A survey by Boston Consulting Group shows that over 80% of enterprises have made digital transformation a strategic priority. Yet a troubling reality persists: after investing huge sums in introducing digital systems, many enterprises have not seen the expected leap in management efficiency, instead encountering the awkward situation of “the more systems are built, the more efficiency stagnates or even declines.”

The root of this “input–output paradox” lies in the fact that many enterprises simplistically understand digital transformation as the procurement and installation of technological tools—buy an ERP system, set up a data middle platform, deploy a batch of RPA robots—as if efficiency gains will naturally follow. However, the essence of management is coordinating people and resources, balancing power and responsibility, and motivating individuals and teams. These deep-level logics do not automatically optimize themselves simply because technology is introduced. As Han et al. [1] pointed out when reviewing the research trajectory of enterprise digital management, academic attention to this topic has already shifted from early-stage technology application to deeper issues of management transformation, yet cognitive lag at the practical level remains evident. Digitalization is the means; management efficiency is the end. Tools themselves cannot substitute for management.

This paper attempts to move beyond the unidirectional narrative of “technological determinism” and, from the perspective of “technology–organization” co-evolution, systematically address three core questions: Through what mechanisms does digitalization enhance enterprise management efficiency? What resistance might these mechanisms encounter in practice? How should enterprises design their implementation pathways to navigate the “transition pains” and achieve a genuine leap in efficiency?

2. Core Concepts

Digital transformation is a frequently misunderstood concept. It is not equivalent to informatization. Informatization involves digitizing existing paper-based processes—moving reimbursement forms from paper to an OA system, shifting approval signatures from offline to online clicks—and its core lies in “bringing offline business online,” solving the problem of making business processes “recordable and visible.” The essence of digitalization, by contrast, lies in using digital technologies to change the fundamental logic and business models of operations, making data no longer a “by-product” of business but a core element driving business improvement. A manufacturing enterprise connecting its equipment to the Industrial Internet and no longer merely “selling equipment” but “selling equipment operation services”—that is digitalization. A retail enterprise no longer relying on experience to decide order quantities but using real-time analysis of member data to forecast demand—that too is digitalization. As Li and Tao [2] wrote in People's Forum, informatization is a long-term historical process, while digitalization is the core technological phase of the current stage of informatization development; digital transformation is not meant to replace informatization, but rather to reshape value creation logic with data at the core on the foundation laid by informatization. Simply put, informatization addresses the question of “whether something exists”; digitalization addresses the question of “whether something works well.”

In terms of layers, digital transformation encompasses at least three levels: the technological level—introducing digital tools such as cloud computing, the Internet of Things, and AI; the process level—breaking down data silos between departments to achieve end-to-end information flow; and the strategic level—reconstructing business models and value creation logic. These three levels progress step by step. If one stops at technology introduction while neglecting process change and strategic adjustment, the transformation is merely “old wine in a new bottle.”

Enterprise management efficiency likewise requires refined definition. It is not a vague notion of “doing things fast,” but should be disaggregated into four dimensions: operational efficiency, i.e., the ratio of resource input to output, the core target of the traditional “cost reduction and efficiency improvement” agenda; decision-making efficiency, i.e., the time cycle from problem discovery to the formation of effective countermeasures; coordination efficiency, i.e., the smoothness of cross-departmental and cross-hierarchical communication and collaboration; and innovation efficiency, i.e., the speed at which new ideas and new solutions move from germination to implementation. These four dimensions are interrelated and together constitute the overall picture of enterprise management efficiency.

After clarifying these two concepts, the relationship between digitalization and management efficiency is no longer mysterious: digitalization is the “tool” and the “path,” while improving management efficiency is the “goal.” The effective conversion of the former into the latter requires organizational change as the intermediary. Without this intermediary link, tools remain merely tools, and efficiency will not improve on its own.

3. Mechanisms Influence: How Digitalization Enhances Enterprise Management Efficiency

3.1 Information Transparency: Breaking Down Hierarchical Barriers and Reducing Communication Costs

Information transmission in traditional organizations follows a pyramid path: frontline data are reported layer by layer, while management directives are communicated step by step downward. This model inherently has two flaws: one is information distortion—every retelling may introduce subjective judgment or selective presentation; the other is time lag—by the time grassroots problems reach the decision-making level, the situation has often already evolved. In addition, the existence of “data silos” between departments means that the marketing department does not know the production department's inventory, and the procurement department does not understand the sales department's real demand. Cross-departmental coordination often requires extensive meetings, phone calls, and email exchanges.

The intervention of digital technology has changed this landscape. The establishment of data middle platforms enables real-time aggregation, unified governance, and on-demand access to data from different business systems. Within their authority, managers can consult operational dashboards at any time and see real operational data, no longer relying on “second-hand information” reported layer by layer. The empirical study by Zhou et al. [3] demonstrates that digitalization can optimize enterprise resource allocation efficiency by enhancing information transparency, and this effect is more pronounced in non-state-owned enterprises and high-tech enterprises. In other words, information transparency not only compresses decision lead time but also reduces the friction costs of cross-departmental coordination.

It must be emphasized, however, that information transparency is not purely a technical issue. Getting data to flow means breaking the entrenched practice of certain departments treating “information as power.” If the organizational culture does not encourage information sharing and managers are not accustomed to “being made transparent,” even the most advanced technology will struggle to achieve genuine information penetration. As Brynjolfsson and McAfee [4] cautioned in their discussion of the “Second Machine Age,” the true benefits of technological change are fully realized only when corresponding organizational innovations occur simultaneously.

3.2 Process Automation: Releasing Human Resources and Focusing on Value Creation

A large number of repetitive, rule-based administrative tasks in enterprises—such as invoice entry, reimbursement review, attendance statistics, and work order dispatch—have long consumed employees' time and attention. These tasks are not of high importance yet cannot afford mistakes; they consume substantial energy but generate little direct value increment. The emergence of RPA (Robotic Process Automation) and intelligent approval systems offers a solution to this dilemma: letting “data travel more and people run less,” freeing employees from tedious chores.

The digital transformation practice of Tongxing Environmental Protection Technology Co., Ltd. provides a relatively typical case. The enterprise introduced RPA robots for automatic form filling in finance, procurement, and other processes, and streamlined data fields accordingly, reducing grassroots form-filling workload by 68%, achieving process automation coverage exceeding 80%, with 94% of employees reporting significantly improved process transparency [5]. The human resources thus freed up can be reallocated to higher-value activities that require human judgment, such as customer insight, process optimization, and innovation exploration.

Yet automation also has its boundaries. It excels at handling structured, rule-defined, repetitive tasks but struggles with scenarios requiring contextual judgment, emotional communication, and creative thinking. Acemoglu and Restrepo [6], in their discussion of the relationship between automation and labor demand,

pointed out that excessive automation may paradoxically weaken an organization's flexibility and adaptability in certain tasks. Furthermore, the cost-reduction and efficiency-enhancement effects of process automation are not isolated cases among domestic enterprises. On the international stage, Mewa, a German textile service enterprise, partnered with digital service provider SYBIT to build a fully digital service platform based on SAP cloud solutions, migrating 90% of customer service requests to online channels, of which 60% were processed fully automatically. It is estimated that this alone saves approximately 65,000 hours of work per year, significantly alleviating the operational dilemma of coexisting skilled worker shortages and cost pressures [7]. Therefore, when promoting automation, enterprises should carefully distinguish which links are suitable for “machines replacing humans” and which require “human-machine collaboration,” rather than pursuing automation rates in a one-size-fits-all manner.

3.3 Intelligent Decision-Making: From “Gut Feel” to Data-Driven Decisions

Traditional management decision-making relies heavily on personal experience and intuition. Experienced managers can often make judgments quickly with incomplete information, but this model carries risks: one is the limitation of individual experience—past successes may not necessarily be replicable in new situations; the other is the prevalence of cognitive biases—managers are also susceptible to confirmation bias, overconfidence, and other tendencies.

Big data analytics and AI-assisted decision-making are precisely the remedy for these limitations. Through modeling and analysis of multi-source data such as external market environments, customer behavior, and supply chain fluctuations, managers can obtain market insights more reliable than “gut feeling”; through pattern recognition in historical data, AI can help anticipate risk points and reduce decision-making uncertainty. The digital internal control reform of Nanjing Hexi Group corroborates this pathway from another perspective: by building a smart management platform and moving approval processes from offline to mobile terminals, the group not only shortened approval cycles but also enabled managers at all levels to make judgments based on a unified data view, reducing decision-making biases caused by information asymmetry [8]. In the international market, data-driven decision-making likewise demonstrates cross-industry applicability. Kuehne+Nagel, a globally leading logistics enterprise, applied generative artificial intelligence to business partner master data management, transforming millions of data records that originally required manual line-by-line verification into an automated, scalable intelligent processing workflow. This not only greatly improved data quality but also brought multiple cascading benefits such as operational efficiency improvement, enhanced freight visibility, and compliance risk reduction, compressing the implementation cycle from several years to several weeks [9].

However, “data-driven” does not mean “data-worshipping.” Data can answer the questions of “what is” and “what could be,” but “what should be”—a matter involving value judgment and strategic choice—always requires human input. The optimal state is not to let AI replace managers' decision-making, but to let data “arm” managers' judgment, achieving an organic integration of experience and evidence.

4. Potential Risks and Challenges of Digital Transformation

If this paper only discussed the benefits of digitalization, it would lose the prudence that academia demands. In reality, the digital transformation of a large number of enterprises has not delivered the expected efficiency dividends; instead, they have fallen into the predicament of “increasing investment, stagnant efficiency.” Understanding the causes of these “failures” is of greater practical value than merely demonstrating the effectiveness of digitalization.

The “Transition Pains” and the Dilemma of Old and New Systems Running in Parallel. Digital transformation is not about starting from scratch but about iterating gradually on the foundation of existing systems. In the early stage of transformation, new and old systems often need to operate in parallel; employees must learn to use new tools while not being able to stop their routine daily work. This leads to a paradoxical phase: short-term efficiency declines rather than rises. If managers lack psychological preparation and patience for this, they may easily conclude during the transition pains that “digitalization is useless” and hastily abandon the effort.

The Input–Output Paradox and Technology Fetishism. Some enterprises equate digitalization with “installing systems”: they deploy ERP if they hear it is useful, build a data middle platform if they hear it is good, introduce AI if they hear it is powerful, yet rarely ask what management problems these technologies are actually supposed to solve. Vendors cater to this mentality by packaging technical solutions as “panaceas.” The result is that many systems are built, but business departments do not use them, data quality is low, systems are not interconnected, and huge investments go to waste. Hoffmann and Müller [10], in their study of the relationship between digital investment and performance, found that different types of digital investment have significantly different impacts on enterprise performance, and that indiscriminate, all-encompassing investment strategies often yield minimal returns.

Data Security and System Vulnerability. The higher the degree of digitalization, the deeper the enterprise's dependence on digital systems, and the greater the risks posed by data breaches and system outages. A single ransomware attack or a single cloud service outage can cause large-scale paralysis of enterprise operations. This is not alarmism but a new vulnerability that must be squarely faced in the process of digital transformation.

This risk is not merely theoretical deduction. In September 2023, one hour before the opening of a major sports event in Shanghai, the official mini-program used for spectator ticket checking suddenly suffered a malicious data deletion attack. Backend data were repeatedly tampered with, and it took the technical team nearly 20 minutes to restore operations, causing large numbers of spectators to be stranded at the entrance and ticket-checking order to descend into chaos. The subsequent investigation revealed that the attack was perpetrated out of personal grudge by a former partner who possessed server login credentials [11]. This incident clearly reveals a reality: when enterprise operations are highly dependent on digital systems, system vulnerability ceases to be an issue exclusive to the IT department and becomes a strategic-level risk that directly threatens business continuity.

Employee Adaptability and “Technological Anxiety.” Getting started with any tool entails a learning cost. For older employees or those unfamiliar with digital tools, frequent system changes can bring genuine anxiety and even resistance. If training is inadequate and transition support is insufficient, new systems, far from improving efficiency, may instead become a burden on employees. Technological tools are never neutral—they amplify the advantages of those already capable and may inadvertently exclude those who have not kept pace. Attending to the “human” factor is a non-negotiable part of transformation management.

This judgment has been supported by empirical research. Wang et al. [12], based on a questionnaire survey of 315 coal mine employees, found that employees' prior knowledge level of digitalization and their individual perceptions (especially their judgments of technological usefulness and risks) significantly influence their degree of psychological resistance, which in turn affects their willingness to accept digital transformation. The study also found that organizational innovation culture can play a positive moderating role—in organizations with a strong innovation climate, employees' willingness to embrace digitalization is markedly higher. As Deloitte's 2026 Global Human Capital Trends report points out, one-third of employees have experienced as many as 15 major changes in the past year, and widespread “change fatigue” has become a key bottleneck constraining transformation effectiveness [13]. Therefore, when advancing digitalization, enterprises should not simplistically attribute employee adaptability problems to individual inertia. Instead, they should carry out systematic interventions across three dimensions: training design, transition support, and organizational culture.

5. Implementation Pathways: Toward “Technology–Organization” Synergy

Faced with the mechanisms and challenges described above, how should enterprises design the implementation pathway for digital transformation? The answer can be condensed into one core principle: technology and organization must co-evolve; any single-front advance cannot be sustained. This synergy is not an abstract management slogan but needs to be implemented across three specific dimensions—strategic alignment, process embedding, and talent adaptation—and dynamically evaluated through measurable criteria.

Specifically, “technology–organization” synergy encompasses at least three progressive layers. First, strategic alignment: digital technology investment must be directly tied to business objectives, rather than being pushed forward in isolation from business scenarios. In practice, this alignment can be reflected in the fact that every technology procurement decision corresponds to a clear business pain point, thus avoiding the resource misallocation of “technology for technology's sake.” Second, process embedding: technological tools

should be deeply integrated into business processes rather than floating on the surface. This requires diagnosing and optimizing existing processes before introducing systems, ensuring that what technology lands on are “optimized processes” rather than “ossified old processes.” Process indicators such as digital work order response time and cross-departmental data flow timeliness can serve as important benchmarks for measuring the depth of process embedding. Third, talent adaptation: the ultimate vehicle of synergy is people. Organizational indicators such as employee adaptability to digital tools, cross-departmental collaboration indices, and digital training coverage rates can reflect the actual effectiveness of technology–organization synergy from the “human” dimension.

Strategy First: Locking On to Real Business Pain Points. Digitalization should not begin with “what new technologies are available” but with “where our management bottlenecks are.” Is the decision-making cycle too long? Is cross-departmental wrangling frequent? Or is frontline response speed insufficient? Different pain points correspond to different focal points for digitalization efforts. Given limited resources, small and medium-sized enterprises especially need not pursue “big and comprehensive” solutions; cutting into the link that most constrains efficiency, taking small steps and running fast, and gradually expanding after achieving results is often more effective than a grand project rolled out all at once.

Organizational Adaptation: Aligning Processes with Systems. Technology implementation requires corresponding organizational structures and business processes to bear it. If the approval process itself is redundantly bloated, then moving it from offline to online and from manual clicking to system circulation will not truly improve efficiency—it merely “digitalizes” a bad process. Kane et al. [14], in their research report in MIT Sloan Management Review, emphasized that the barriers to digital transformation lie not in technology but in strategy, culture, and talent—technology has never been the most difficult link.

Step-by-Step Implementation: Iterating Through Pilots. A “big bang” comprehensive transformation is extremely risky; once resistance is encountered, the entire effort may fail. A safer approach is to select departments or business lines with relatively mature conditions as pilots, verify the effectiveness of the plan on a small scale, identify problems and adjust promptly, and then expand to a larger scope after accumulating experience.

Empowering People: Enabling Employees to Keep Pace with Change. What is most often overlooked is often the most critical. The end users of digital transformation are not the systems themselves but every employee who uses these systems on a daily basis. Adequate training, timely technical support, and reasonable transition arrangements are the basic guarantees for reducing transformation resistance. Furthermore, enterprises can design incentive mechanisms to ensure that employees who take the lead in embracing digital tools and proactively engage in process optimization receive recognition and rewards. Therefore, enterprises should embed digital capabilities into daily work processes, enabling employees to “learn by doing and master through use,” thus bridging the “last mile” from technology to application.

6. Conclusion

Digital transformation can indeed systematically enhance enterprise management efficiency. Its core mechanisms lie in information transparency reducing communication costs, process automation releasing human resources, and intelligent decision-making mitigating judgment biases. However, these three pathways are not automatically effective—their realization depends heavily on corresponding organizational changes: breaking down information barriers requires cultural support, effective automation requires processes to be streamlined out first, and data-driven decision-making requires managers to have the openness to “embrace being questioned.”

The essence of digital transformation is not so much the embedding of technological tools as the reconstruction of management logic. Those enterprises that have successfully navigated the “transition pains” have without exception achieved a dual-wheel drive of “technology + management”: neither underestimating the potential of technology nor overestimating the ability of technology to advance alone. They understand the importance of clarifying business logic before introducing systems, continuously adjusting organizational alignment after technology implementation, and maintaining strategic resolve amid short-term efficiency fluctuations.

For enterprises still groping their way along the path of digital transformation, perhaps the most important insight is this: technology matters, but what matters even more than technology is figuring out “what problem we are really trying to solve”—the answer lies not in vendors' proposal documents but in the enterprise's own management reality.

At the same time, this paper has certain limitations that need to be addressed in future research. First, it does not conduct segmented discussions on factors such as enterprise size, industry attributes, and ownership nature, whereas existing research shows that the impact of digital transformation on management efficiency exhibits significant heterogeneity across different types of enterprises. For instance, the empirical study by Zhou et al. [2] found that the efficiency-enhancing effect of digitalization on resource allocation is more pronounced in non-state-owned enterprises and high-tech enterprises, meaning that the overall analytical framework of this paper may lack explanatory power and pertinence when applied to state-owned enterprises or traditional manufacturing enterprises. Second, this paper primarily develops its arguments through theoretical reasoning and typical case analysis, lacking large-sample empirical testing, so the mechanisms of action and risk analyses proposed still need further verification in terms of generalizability. Future research can delve deeper in the following directions: first, conduct categorical comparisons of enterprises of different sizes, industries, and ownership natures based on large-sample data to reveal the heterogeneous patterns of digital transformation effects; second, adopt longitudinal research designs to track changes in management efficiency across different stages of enterprise transformation and distill dynamic evolutionary patterns; third, incorporate soft factors such as organizational culture, leadership style, and employee digital literacy into the analytical framework to further enrich the theoretical content of “technology–organization” synergy.

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