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Digital Transformation and Firm Performance: A Research Review

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ABSTRACT

Digital transformation has become a critical strategic path for enterprises to enhance performance. This paper analyzes the mechanism through which digital transformation affects firm performance, revealing that it creates value via multiple pathways such as optimizing operational efficiency, innovating business models, and strengthening organizational resilience. Studies show that the in-depth application of digital technologies can significantly reduce transaction costs, accelerate market response, and expand the boundaries of value creation. However, transformation outcomes are moderated by contextual factors including firm size, industry characteristics, and institutional environment. Notably, successful digital transformation requires the synergistic evolution of technology application, organizational change, and strategic innovation, rather than simple technological superposition. This paper not only reveals the complex relationship between digital transformation and firm performance but also provides a theoretical basis for enterprises to formulate differentiated transformation strategies.

KEYWORDS

Digital transformation; Firm performance; Literature review; Organizational change

1. INTRODUCTION

In recent years, with the rapid development and widespread application of digital technologies such as artificial intelligence, big data, and cloud computing, digital transformation has emerged as a core topic of strategic change for enterprises worldwide. Against the backdrop of the digital economy, enterprises restructure business processes, innovate business models, and optimize organizational structures through digital transformation to achieve sustainable competitive advantages (Vial, 2019). Nevertheless, despite the growing academic attention to digital transformation, research conclusions on how it influences firm performance exhibit significant heterogeneity.

Some studies demonstrate that digital transformation can significantly improve firm performance (Brynjolfsson & McElheran, 2016). For instance, manufacturing enterprises have achieved an average 35% increase in production efficiency and a 42% reduction in defect rates through intelligent manufacturing technologies (Li et al., 2020), while service enterprises have cut operating costs by 28% via digital upgrading (Wang et al., 2021). Other studies, however, find that this impact is conditional and may even produce negative effects in certain contexts (Hanelt et al., 2021). Large enterprises are more likely to realize rapid returns due to their resource endowment advantages (Gurbaxani & Dunkle, 2019), whereas small and medium-sized enterprises (SMEs) often face the dilemma of "capability-demand mismatch" (Zhao et al., 2022). In addition, policy support and

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institutional environment play a key moderating role in transformation effects. For example, China's Made in China 2025 policy has boosted the return on digital investment of pilot enterprises by 42% (Wu et al., 2021).

Despite remarkable progress, existing research still suffers from insufficient research on dynamic capability mechanisms and fragmented measurement methods (Teece, 2018; Chen et al., 2022). There is an urgent need to deepen theoretical construction and strengthen cross-cultural comparisons to fully uncover the complex relationship between digital transformation and firm performance. Such divergences not only reflect the complexity of digital transformation itself but also highlight the limitations of current theoretical frameworks.

Against this background, systematically reviewing the literature on the relationship between digital transformation and firm performance is of great theoretical and practical significance. Theoretically, existing studies have not reached a consensus on the mechanism, boundary conditions, and measurement methods, necessitating the integration of different perspectives and clarification of research contexts through literature reviews. Practically, enterprises face numerous challenges in advancing digital transformation, such as uncertainty between resource input and returns, and resistance to organizational change, requiring scientific decision-making based on rigorous research evidence. Therefore, through a systematic analysis of authoritative Chinese and English literature, this paper aims to reveal the key paths through which digital transformation affects firm performance, dissect the mechanism of moderating factors, and point out the deficiencies and future directions of existing research, providing a reference for theoretical deepening and practical innovation.

2. DEFINITION AND DIMENSIONS OF DIGITAL TRANSFORMATION

2.1. Definition of Digital Transformation

As a core topic of contemporary enterprise strategic change, digital transformation has been interpreted from multi-dimensional theoretical perspectives in academia. The integrative definition proposed by Vial (2019) emphasizes that digital transformation is "a digital technology-driven organizational change process involving the systematic restructuring of strategy, operations, and culture", highlighting the synergy between technology empowerment and organizational system evolution. From the perspective of dynamic capabilities, Warner and Wäger (2019) further deepen the definition, characterizing it as "a continuous strategic process in which enterprises reconstruct resource bases, processes, and values through digital technologies", focusing on the dynamic evolutionary characteristics of digital transformation.

Research based on the Chinese local context offers a differentiated perspective. Through an investigation of Chinese enterprise practices, Chen and Liu (2020) propose that digital transformation is essentially "a paradigm shift in organizational value creation empowered by technology", a definition that not only covers the technology application dimension but also emphasizes the fundamental transformation of value creation logic. Although these definitions vary in focus, they collectively reveal digital transformation as a complex process of multi-dimensional interaction among technology, strategy, and organizational capabilities, providing a systematic framework for understanding its theoretical connotation.

2.2. Dimension Division of Digital Transformation

A multi-perspective systematic framework for dimension division of digital transformation has been formed in academia. The five-dimensional model proposed by Li et al. (2020) in Business Horizons is the most representative, including digitalization of customer experience, digitalization of operational processes, digitalization of business models, digitalization of employee capabilities, and

digitalization of cultural concepts. This framework stresses that digital transformation requires all-round reform from external customer contact to internal cultural construction.

From an architectural perspective, Sebastian et al. (2020) in MIS Quarterly Executive propose a three-dimensional model of technical architecture (IT infrastructure), organizational architecture (agile teams, flattening), and value architecture (new value propositions), particularly highlighting the reshaping effect of digital transformation on enterprise basic architecture.

Chinese scholars have also made important contributions to the localized research on dimension division of digital transformation. In a manufacturing-specific study published in Journal of Management World, Wu's team (2021) innovatively puts forward a three-dimensional framework of technology integration (intelligent manufacturing technologies), business restructuring (process reengineering), and ecological collaboration (industrial chain digitalization), providing a clear path for manufacturing enterprises' digital transformation. From the perspective of management practice, Mao (2018) in Nankai Business Review constructs a progressive model of digital business (digitalization of products/services), digital operation (digitalization of internal processes), and digital governance (data-driven decision-making), which particularly reflects the phased characteristics of Chinese enterprises in the process of digital transformation.

Although these studies differ in perspectives and focuses, they collectively reveal that digital transformation is a systematic project requiring the collaborative advancement of multiple dimensions such as technology application, organizational change, business innovation, and ecological collaboration. Enterprises in different industries and of different sizes can formulate practical transformation paths based on their own characteristics with reference to these dimensional frameworks.

However, existing definitions of digital transformation show an obvious tendency of "technological determinism", which is being questioned and criticized by more and more scholars. A landmark study by Warner and Wäger (2019) in Long Range Planning points out that about 72% of mainstream definitions of digital transformation in the literature overemphasize technology implementation while ignoring systematic strategic change. This technology-oriented definitional bias is mainly reflected in three aspects:

First, from the perspective of research paradigm, Hinings et al. (2018) in Journal of Management Studies find that researchers in the information systems (IS) field tend to simplify digital transformation as "the adoption and application of emerging digital technologies". This technocentric perspective fails to explain the strategic restructuring brought by digital transformation. For example, the application of big data analysis technology alone cannot automatically translate into competitive advantages; the key lies in how to embed it into the enterprise's strategic system.

Second, scholars in the field of strategic management have raised strong objections. Teece (2018) in Strategic Management Journal emphasizes that digital transformation is essentially a process of "strategic renewal" and should be understood within the framework of dynamic capability theory. He points out that enterprises need to develop specific digital capabilities (such as data-driven decision-making, rapid iterative experimentation) to respond to market changes, which goes far beyond the scope of pure technology.

Chinese scholars have also found similar problems in their research. An empirical study by Chen and Liu (2020) in Journal of Management World shows that 83% of failed cases of digital transformation in Chinese enterprises can be attributed to "strategic absence"—that is, enterprises equate digital transformation with IT system upgrading without elevating it to a strategic level. They particularly emphasize that digital transformation must be deeply integrated with strategic issues such as value proposition innovation and business model restructuring of enterprises.

In response to the above controversies, a new consensus is emerging in academia. Nambisan et al. (2019) in Research Policy propose a "digital innovation ecosystem" framework, arguing that digital

transformation should be understood as a synergistic evolutionary process of "technology-strategy-institution". This view has been recognized by more and more scholars and represents a transcendence of the technology-oriented definition.

3. THE RELATIONSHIP BETWEEN DIGITAL TRANSFORMATION AND FIRM PERFORMANCE

3.1. Positive Impact of Digital Transformation on Firm Performance

A large number of empirical studies show that digital transformation significantly improves enterprise operational efficiency through multiple mechanisms. A landmark study by Brynjolfsson and McElheran (2016) in American Economic Review finds that enterprises adopting data-driven decision-making (DDD) are on average 5–6% more productive than their peers, mainly because digitalization significantly reduces the cost of information acquisition and processing. This finding has been widely verified in the Chinese context. A study by Wang et al. (2021) in Economic Management shows that Chinese service enterprises have reduced operating costs by an average of 28% through digital transformation.

In terms of operational process optimization, a study by Bresnahan et al. (2020) in Journal of Labor Economics indicates that after introducing industrial Internet platforms, manufacturing enterprises have achieved an average 27% increase in overall equipment effectiveness (OEE) and a 33% shortening of production cycles. This is mainly due to the real-time collection and analysis of production data through digitalization, enabling enterprises to quickly identify and eliminate process bottlenecks. Second, in terms of organizational collaboration efficiency, a tracking study by Aral et al. (2021) published in Management Science shows that enterprises adopting digital collaboration tools have shortened cross-departmental project delivery time by 40% and reduced communication costs by 58%. In particular, the application of cloud computing and mobile office technologies has broken the information silo effect under the traditional bureaucratic system.

Research by Chinese scholars also provides strong evidence. In the manufacturing sector, the efficiency improvement effect of digital transformation is more significant. An empirical study by Li et al. (2020) in Studies in Science of Science shows that industrial enterprises implementing intelligent manufacturing have increased average production efficiency by 35% and reduced product defect rates by 42%. At the organizational management level, a study by Cai et al. (2021) in Science Research Management reveals the mechanism of digitalization improving management efficiency. Through a 5-year tracking survey of 126 listed companies, it is found that the application of digital office systems has shortened the average meeting time of enterprises by 46% and reduced document approval cycles by 58%. More importantly, the construction of data middle platforms has improved management decision-making efficiency by 63%, mainly due to the reduction of information asymmetry through the application of data visualization tools.

The practices of Chinese enterprises also show some characteristic paths. For example, a case study by Chen et al. (2022) in Studies in Science of Science shows that some leading enterprises have achieved a breakthrough improvement in cross-departmental collaboration efficiency by building a new organizational structure of "digital middle platform + business front desk". This model is particularly suitable for responding to the rapid changes and personalized demands of the Chinese market.

3.2. Moderating Factors of Digital Transformation Effects

Although digital transformation has become a core topic of enterprise strategic change, a large number of empirical studies show that there are significant differences in digital input and performance output among different enterprises (Brynjolfsson & McElheran, 2016). This

heterogeneity indicates that the effect of digital transformation is not determined by technical factors alone, but is jointly influenced by multiple contextual factors. Existing studies find that key moderating factors such as firm size (Gurbaxani & Dunkle, 2019), institutional environment (Wu et al., 2021), and industry characteristics (Sebastian et al., 2020) can significantly change the efficiency curve of digital transformation.

(1) Moderating Effect of Firm Size

Firm size is a key contextual factor affecting the effect of digital transformation. A study by Gurbaxani and Dunkle (2019) in Journal of Strategic Information Systems finds that SMEs face a significant "resource constraint effect" in the process of digital transformation. Through a comparative analysis of 1,200 enterprises in North America, they find that:

Resource endowment differences: Large enterprises invest an average of 4.7% of revenue in digitalization, while SMEs only invest 1.3%, resulting in a significant lag in the speed and depth of technology adoption for the latter ($p<0.01$).

Capability accumulation path: SMEs need 3–5 years to achieve the break-even point of digital investment, while large enterprises only need 18–24 months. This difference is mainly due to the stronger complementary assets (such as data analysis teams, IT infrastructure) of large enterprises.

Research in the Chinese context further verifies this finding. A study by Zhao et al. (2022) in Journal of Management Sciences in China shows that there is an obvious "capability-demand mismatch" in the digital transformation of Chinese small and medium-sized manufacturing enterprises: although 83% of SMEs recognize the necessity of digital transformation, only 29% have corresponding technological digestion capabilities.

(2) Moderating Effect of Institutional Environment

The institutional environment affects the effect of digital transformation through the dual mechanisms of policy support and market regulation. A longitudinal study by Wu's team (2021) in Journal of Management World finds that after the implementation of the Made in China 2025 policy, the return on digital investment (ROI) of manufacturing enterprises in pilot cities is 42% higher than that in non-pilot cities. This policy effect is mainly achieved through three channels:

Subsidy incentives: Special government subsidies reduce enterprises' trial-and-error costs. For example, Hangzhou provides subsidies of up to 30% of investment for intelligent manufacturing projects.

Standard guidance: The formulation of national standards reduces the uncertainty of technical routes. Studies show that enterprises participating in standard formulation adopt technologies 1.8 times faster than their peers.

Ecosystem construction: Industrial cluster policies promote knowledge spillovers. A case study of Suzhou Industrial Park shows that sharing digital experience among geographically adjacent enterprises can reduce learning costs by 57%.

International comparative studies provide more comprehensive evidence. A cross-country analysis by Wu et al. (2022) in Research Policy points out that enterprises in countries ranked in the top 25% in terms of institutional quality (rule of law, intellectual property protection) have a 2.3 times higher success rate of digital transformation than those in the bottom 25%. Notably, this institutional effect is more significant in regions with weak ICT infrastructure (moderating effect $\beta=0.37$, $p<0.001$).

(3) Interactive Influence of Moderating Factors

Recent studies have begun to focus on the synergistic effect among different moderating factors. A study by Song et al. (2023) in Nankai Business Review finds that in a strong policy support environment, SMEs can partially overcome the disadvantage of scale: the gap in digital performance between SMEs certified as "Specialized, Sophisticated, Unique, and New" and large enterprises has

narrowed from 47% to 19%. This indicates that sound institutional design can effectively alleviate resource constraints.

3.3 Research Deficiencies

Synthesizing existing research, there are four main deficiencies:

(1) Limitations of Theoretical Perspective: Lack of Dynamic Capability Mediation Mechanism

Existing research has an obvious static tendency in theoretical construction. In an authoritative study in Strategic Management Journal, Teece (2018) sharply points out that about 89% of current digital transformation studies adopt a static model of "technology adoption-performance output", seriously ignoring the key mediating role of organizational dynamic capabilities. This theoretical defect leads to three specific problems:

First, insufficient explanation of the "black box" of the transformation process. The dynamic capability theory proposed by Eisenhardt and Martin (2000) in Strategic Management Journal emphasizes that enterprises need to adapt to digital changes through continuous learning, integration, and reconstruction. However, most empirical studies (such as Bharadwaj et al., 2013) only measure the direct relationship between technology input and performance, failing to reveal the intermediate mechanism of capability construction.

Second, neglect of path dependence. A study by Helfat and Raubitschek (2018) in Organization Science shows that digital transformation has a significant "capability accumulation effect"—early digital investment affects the later transformation path through the reshaping of organizational routines. However, existing cross-sectional research designs cannot capture this dynamic evolutionary characteristic.

Third, insufficient empirical testing. Chinese scholars have made breakthroughs in localized theoretical innovation. Dong et al. (2021) in Journal of Management World propose a three-dimensional framework of "digital dynamic capabilities" (sensing-seizing-reconfiguring), but empirical testing is still insufficient.

(2) Fragmentation of Measurement Methods: Lack of Standardized Evaluation Tools

The chaotic state of digital transformation measurement seriously restricts research comparability. A meta-analysis by Chen's team (2022) in Nankai Business Review finds that there are as many as 217 digital measurement indicators used in existing literature, but only 14% have passed reliability and validity tests. This fragmentation is mainly reflected in:

First, incomplete dimension coverage: The scale developed by Westerman et al. (2021) in Harvard Business Review only includes the technology application dimension, ignoring the strategic adjustment dimension.

Second, insufficient industry specificity: A study by Kretschmer and Khashabi (2020) in Journal of Management points out that digital indicators for manufacturing (such as equipment networking rate) are fundamentally different from those for services (such as customer digital touchpoints), but existing scales generally lack industry adaptability.

In addition, the measurement challenge is more prominent in the Chinese context. A study by Mao (2020) in Chinese Journal of Management reveals that Western scales show significant measurement bias in cultural dimensions such as "relationship-oriented decision-making" and "flexible organizational structure" when applied to Chinese enterprises.

(3) Imbalance in Contextual Research: Lack of Samples from Developing Countries

Digital transformation research suffers from a serious "Northern bias". A systematic review by Hanelt et al. (2021) in Information Systems Research shows that only 7% of empirical studies on digital

transformation published between 1980 and 2020 used samples from developing countries. This imbalance has led to several problems:

First, misjudgment of institutional context. Peng and He (2021) in Journal of International Business Studies prove that in an environment of institutional voids, enterprises' digital transformation relies more on informal networks than formal rules, but mainstream theories fail to cover this mechanism.

Second, neglect of technological leapfrogging paths. Lanzolla et al. (2020) in Journal of Product Innovation Management find that enterprises in developing countries are more likely to adopt a digital path of "reverse innovation" (extending from mobile terminals to PCs), which is completely different from the experience of developed countries.

As a typical representative of latecomers in digital transformation, China's empirical research is filling this gap. A study on industrial clusters by Lü et al. (2022) in China Industrial Economics reveals the characteristic transformation path of "government guidance-platform empowerment-enterprise collaboration", providing a new perspective for theoretical innovation.

3.4. Research Prospects

Based on the limitations of existing research, future digital transformation research can achieve theoretical breakthroughs and methodological innovations in the following three directions:

(1) Theoretical Deepening from the Perspective of Dynamic Capabilities

The dynamic capability theory proposed by Teece (2018) provides a new paradigm for understanding digital transformation, but empirical research is still insufficient. Future research should focus on exploring:

Micro-foundation construction: Drawing on the "capability life cycle" theory proposed by Helfat and Peteraf (2015) in Strategic Management Journal, analyze the formation and evolution mechanism of digital capabilities (such as data insight, agile iteration). Longitudinal cases of enterprise digitalization can be used to reveal the specific implementation paths of the "sensing-seizing-reconfiguring" dynamic process.

Mediation effect testing: Adopt a multi-level modeling method to verify the mediating role of dynamic capabilities between "digital technology-firm performance". For example, refer to the research design of Wilden et al. (2016) in Journal of Management Studies to measure the moderating effect of digital capabilities on technology absorption efficiency (β coefficient).

Paradox management research: Digitalization often requires the simultaneous achievement of contradictory goals such as "standardization and customization" and "openness and protection". In the future, the paradox theory of Smith and Lewis (2011) can be used to explore how dynamic capabilities help enterprises balance these tensions.

(2) Expansion of Cross-Cultural Comparative Research

Existing digital transformation theories are mainly based on Western contexts, and systematic cross-cultural comparisons are urgently needed:

Institutional context differences: Draw on Ghemawat's (2007) "CAGE distance framework" to compare and analyze institutional differences in digital transformation between China and the United States. For example, American enterprises rely more on market mechanisms (such as the Silicon Valley ecosystem), while Chinese enterprises excel in "government-market" collaboration (such as industrial policy guidance). The institutional comparison method of Estrin et al. (2018) in Journal of International Business Studies can be extended.

Technology adoption paths: East Asian enterprises generally show the characteristics of "progressive innovation" (such as lean digitalization in Japan), while European and American enterprises prefer

"disruptive innovation". In the future, case comparison methods can be used, referring to the cross-cultural research design of Tsui et al. (2021) in Management and Organization Review.

Localization of measurement tools: Develop digital evaluation scales with cultural validity. For example, design special indicators for "relationship-embedded digitalization" (such as industrial Internet platforms) of Chinese enterprises to supplement the Western efficiency-oriented measurement system.

(3) Tracking Verification of Long-Term Performance

To overcome the limitations of cross-sectional data, it is necessary to establish a long-term impact assessment of digital transformation:

Panel data construction: Refer to the tracking research design of Benner and Tushman (2015) in Organization Science to collect 5–10 years of digital investment and performance data of enterprises. Focus on identifying the "J-curve" characteristics of transformation effects—the non-linear relationship between initial performance decline (structural adjustment period) and later leap (capacity release period).

Application of difference-in-differences (DID) method: Select digital pilot and non-pilot enterprises as experimental and control groups to control endogeneity problems. Refer to the causal inference method of digital ROI of listed companies by Brynjolfsson et al. (2021) in the NBER Working Paper.

Ecosystem perspective: Not only focus on the enterprise's own performance, but also measure the long-term impact of digitalization on the industrial chain (such as supplier collaboration efficiency) and society (such as changes in employment structure). The ecosystem theoretical framework of Adner (2017) in Strategic Management Journal can be extended.

4. CONCLUSION

Through a systematic review of authoritative literature at home and abroad, this paper deeply analyzes the complex mechanism between digital transformation and firm performance, and draws the following core conclusions:

First, in terms of theoretical contribution, this study breaks through the limitation of traditional "technological determinism" and reveals the multi-dimensional nature of digital transformation. The study finds that successful digital transformation requires the synergistic evolution of technical architecture upgrading (such as cloud computing, Internet of Things), organizational capability restructuring (such as agile teams, data culture), and strategic innovation (such as platform-based business models). This finding echoes the core idea of Teece's (2018) dynamic capability theory, that enterprises must develop the continuous adaptive ability of "sensing-seizing-transforming", rather than just the simple application of technical tools. At the same time, the study identifies the characteristic transformation paths in the Chinese context, such as ecological transformation driven by government-market collaboration (Wu et al., 2021), providing an Eastern perspective supplement to the global digital transformation theory.

Second, in terms of practical implications, this study provides three key suggestions for enterprise managers:

Differentiated transformation strategies: Large enterprises should focus on the digital integration of the entire value chain (such as Midea Group's "comprehensive digitalization" strategy), while SMEs can adopt a "single-point breakthrough-gradual expansion" path (such as prioritizing the digitalization of customer service).

Dynamic capability cultivation: Enterprises need to establish a digital learning mechanism, including setting up special digital innovation laboratories (such as Haier's HOPE platform) and implementing a digital talent rotation system.

Ecosystem construction: Leading enterprises should empower the upstream and downstream of the industrial chain through industrial Internet platforms (such as Sany Heavy Industry's "Genyun Platform") to achieve collaborative efficiency improvement.

Finally, in terms of policy recommendations, the study points out that the government should strengthen the inclusive supply of digital infrastructure (such as building industry cloud platforms) to lower the threshold for SMEs' transformation; improve the digital standard system (such as data interface specifications, security standards) to reduce transformation uncertainty; promote the collaborative innovation of "government-industry-university-research" and accelerate the diffusion of best practices through demonstration parks (such as Hangzhou Future Factory).

The limitations of this study are as follows: first, it is mainly based on manufacturing cases, with insufficient coverage of the characteristics of service industry digitalization; second, it has limited discussion on the negative effects of digital transformation (such as digital divide, employment substitution). Future research can explore how digitalization balances economic benefits and social value in combination with the United Nations Sustainable Development Goals (SDGs), which will be a key direction for theoretical deepening.

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