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Digital transformation and its role in enhancing business productivity and operational efficiency: A review of recent evidence

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Abstract
Organizations in almost every sector are investing in digital technologies, yet managers and policymakers still ask whether these investments produce measurable gains in productivity and operational efficiency. This paper synthesizes recent evidence from systematic reviews and bibliometric studies published between 2024 and 2026, supplemented by one workforce-focused review and one review of small and medium-sized enterprises (SMEs). The literature points to a generally positive but conditional relationship. In a 2026 synthesis of 76 empirical studies, most reported productivity gains, while a minority found mixed or neutral results. Benefits appear to arise through better process efficiency, more effective use of data, the redeployment of labour to higher-value work, and stronger internal control. Outcomes, however, depend on complementary investment in skills, infrastructure, and management capability, and several studies describe non-linear patterns in which returns appear only after a threshold of investment or an initial period of disruption. Common barriers include financing constraints, skills gaps, weak digital infrastructure, resistance to change, and inconsistent ways of measuring digital transformation itself. The paper argues that digital transformation is best treated as an organizational change programme rather than a technology purchase, and it sets out implications for managers, policymakers, and researchers.

Keywords: Digital transformation, business productivity, operational efficiency, organizational capability, SMEs, systematic review

Introduction

Cloud computing, data analytics, artificial intelligence (AI), the Internet of Things, and robotics are changing how firms produce goods, coordinate work, and serve customers. Many organizations adopt these tools in the expectation that they will raise output per worker, cut waste, and speed up decisions. Yet the term digital transformation is used loosely. Verhoef *et al*. (2021, as cited in Zhang & Wang, 2024) [4] separate three stages: digitization, which converts analogue information into digital form; digitalization, which uses digital tools to improve existing operations; and digital transformation proper, in which digital capability reshapes strategy and the way value is created. Vial (2019, as cited in Zhang & Wang, 2024) [4] similarly portrays transformation as a process in which digital technologies disrupt a firm's environment and prompt strategic responses that alter its value-creation paths.

Scholarly attention has grown quickly. In a bibliometric review of Web of Science records, Zhang and Wang (2024) [4] report that annual publications on the topic climbed from fewer than twenty in the early 2010s to 505 in 2023. Practice, however, has often moved more slowly than the literature. A 2021 McKinsey survey of more than 800 firms, cited by the same authors, found that about 70% had begun a transformation but 71% were still stuck at the pilot stage. This gap between enthusiasm and results echoes the long-running productivity paradox, in which technological progress is visible everywhere except in aggregate productivity figures (Cebulla *et al*., 2026) [2].

This paper therefore asks three questions. First, which approaches and practices do recent reviews associate with digital transformation in business? Second, what does the evidence say about its effect on productivity and operational efficiency? Third, which barriers limit those effects? The aim is to give practitioners and students a compact, evidence-based account that separates what is reasonably well supported from what remains uncertain.

Review Approach

This is a narrative review of reviews rather than a full systematic review. In October 2026, I searched web-based scholarly sources using combinations of terms such as digital transformation, productivity, operational efficiency, systematic review, SMEs, and barriers. Priority went to studies published between 2024 and 2026 that stated their own search methods and addressed either productivity, efficiency, or the conditions that enable or block them.

Four sources form the evidentiary core. Cebulla *et al*. (2026) [2] synthesize 76 peer-reviewed empirical studies, drawn from four databases and reported according to PRISMA guidance. Zhang and Wang (2024) [4] analyse 1,399 Web of Science records published between 2011 and 2024. Bouwmans *et al*. (2024) [1] review 36 articles on workforce skills using PRISMA. Davila Segura *et al*. (2025) [3] review 40 studies on SMEs published between 2019 and 2024. Where these reviews describe individual primary studies, I cite those studies through the review in which I read about them ("as cited in").

Three limitations apply. The search was targeted rather than exhaustive. The underlying evidence leans heavily towards Chinese listed firms and manufacturing, as Cebulla *et al*. (2026) [2] acknowledge. And one source is a preprint and another a conference paper, so neither has the same peer-review status as the journal articles.

Major Approaches and Practices

1. Conceptual frameworks: from digitization to transformation

The first practical lesson of the literature is that technology adoption and transformation are not the same thing. Cebulla

et al. (2026) [2] found that digital transformation was the most common way in which the studies they reviewed operationalised AI-related change, appearing in 48 of 76 studies. It usually bundled machine learning, big data analytics, cloud computing, and connected devices into a single socio-technical system. This breadth is useful for capturing change at scale, but it also makes it hard to attribute any gain to a specific tool.

2. Technology-enabled process optimization

The most direct route to efficiency is the automation and optimization of existing processes. Cebulla *et al*. (2026) [2] report that AI and machine-learning-driven automation raises productivity mainly by improving technical and operational efficiency, allowing firms to move labour toward higher-value activities and reduce idle capital and redundant spending. Their synthesis covers machine learning for prediction and optimization, robotic process automation, computer vision for quality control, and industrial robots. Robotics often acts indirectly as well: studies they review link robot adoption to better human capital structures and stronger innovation capability, which in turn lift total factor productivity (TFP).

3. Data use and digital infrastructure

Several studies suggest that what firms do with data matters more than how much they collect. According to the synthesis by Cebulla *et al*. (2026) [2], processing and applying data, for example through analysis, modelling, and network sharing, appears more effective at raising TFP than simple acquisition and storage. A comparative study they describe ranked big data analytics as the highest-impact technology and blockchain as the lowest (Liu *et al*., 2024, as cited in Cebulla *et al*., 2026) [2]. Infrastructure also shapes results: economies with stronger public IT infrastructure, including high-speed broadband, tend to capture larger gains from digital investment.

4. Leadership, capabilities, and workforce skills

Technology works through people. Zhang and Wang (2024) [4] summarize studies showing that leadership characteristics influence how far firms transform; for example, firms led by CEOs with a science or technology background perform better, and IT-experienced top managers help SMEs make the shift. Using the technology-organization-environment framework, Omrani *et al*. (2022, as cited in Zhang & Wang, 2024) [4] identify technology context and innovation as the main drivers of SME adoption, with regulation, available skills, and financial resources also relevant.

On the workforce side, Bouwmans *et al*. (2024) [1] built a Digital Transformation Skills Framework containing six skillsets and 44 skills: digital working, entrepreneurship, evidence-based work, collaboration, communication, and adaptation. Their central point is that transformation needs more than technical competence; employees also need adaptive and collaborative skills. They cite World Economic Forum figures indicating that 44% of worker skills were expected to be disrupted by 2023 and that about 60% of employees would need retraining, yet only around half have adequate access to it.

5. Business model and financial practices

Digital transformation can also change what firms sell and how they fund it. Cebulla *et al*. (2026) [2] note that AI and digitalization help manufacturers move toward higher-value pre- and post-sales services, a process often called servitization. Zhang and Wang (2024) [4] report that SMEs that improve the quality of their information disclosure through digital transformation may ease their financing constraints (Guo *et al*., 2023, as cited in Zhang & Wang, 2024) [4], a benefit that matters because funding is itself a recurring barrier.

Evidence on Effectiveness

1. Productivity outcomes

The weight of evidence is favourable but not unanimous. Of the 76 studies synthesized by Cebulla *et al*. (2026) [2], 65 (86%) reported productivity gains linked to AI, machine learning, or robotics adoption, nine (12%) reported mixed results, and two (2%) found neutral effects. TFP was the most common outcome measure (40 studies), followed by labour productivity (28). The authors caution that adoption is probably endogenous, because more productive firms tend to adopt earlier. Although many studies used instrumental variables, difference-in-differences, and similar corrections, they describe the high share of positive findings as a suggestive pattern, not proof of causation.

Zhang and Wang (2024) [4] reach a similar conclusion. They cite firm-level work showing that digital technologies improve productivity (Nucci *et al*., 2023, as cited in Zhang & Wang, 2024) [4], but also a study reporting an inverted U-shaped relationship in which both too little and too much digital transformation depress TFP, with managerial short-termism worsening the downside (Guo *et al*., 2023, as cited in Zhang & Wang, 2024) [4]. Other studies they review point to cost stickiness and green innovation as channels through which transformation raises TFP.

2. Operational efficiency

Evidence on efficiency mechanisms is more consistent. Studies synthesized by Cebulla *et al*. (2026) [2] link digital transformation to better internal control and managerial accountability, lower information asymmetry, and reduced redundancy in staffing and resources. In the SME literature, Davila Segura *et al*. (2025) [3] conclude that digital transformation helps firms optimize processes and reduce costs, and that it improves their position in wider markets. These results are consistent with the idea that digital tools mainly improve efficiency by making operations more visible, measurable, and controllable.

3. Timing and heterogeneity

Two themes recur: gains take time, and they are unevenly distributed. Zhang and Wang (2024) [4] describe a study finding that transformation lowers short-term performance because costs are not immediately recovered, while enhancing long-term value (Zhong & Ren, 2023, as cited in Zhang & Wang, 2024) [4]. Cebulla *et al*. (2026) [2] report U-shaped patterns in which benefits emerge only after investment passes a minimum threshold. Size and starting position matter as well: larger and frontier firms often gain more because of greater R&D capacity and organizational resources, while smaller firms may see limited or even negative effects (Torrent-Sellens *et al*., 2022, as cited in Cebulla *et al*., 2026) [2]. For SMEs specifically, one study suggests that returns depend heavily on firm characteristics, with rigid or radical-change-oriented firms earning less (Etienne Fabian *et al*., 2024, as cited in Zhang & Wang, 2024) [4].

Barriers and Challenges to Implementation

Financial constraints and high upfront costs are the most frequently cited obstacle. Davila Segura *et al*. (2025) [3] identify limited financial resources, weak technical skills, and resistance to organizational change as the main hindrances for SMEs. Cebulla *et al*. (2026) [2] add that high adoption costs can delay gains even where infrastructure is adequate, and that firms with strong capital bases are better placed to recover them, which may widen productivity gaps between firms.

Infrastructure and complementary investment form a second cluster. Underdeveloped digital networks and uneven regional development limit what firms can achieve, and AI tends to pay off only when matched by human capital, research and development, data resources, and cloud capacity (Lee *et al*., 2022, as cited in Cebulla *et al*., 2026) [2].

Skills and organizational culture form a third. Bouwmans *et al*. (2024) [1] treat the skills gap as a central obstacle, since technology advances faster than employees can adapt. Cebulla *et al*. (2026) [2] list cultural resistance, regulatory constraints, and data limitations among recurring barriers. Zhang and Wang (2024) [4] add that family firms may announce digital strategies in their reports while investing less in substance (Liu *et al*., 2023, as cited in Zhang & Wang, 2024) [4], and that managerial myopia can erode returns.

Finally, measurement problems cloud the evidence itself. Zhang and Wang (2024) [4] note that there is no agreed standard for measuring digital transformation; text analysis of annual reports is widely used but may count firms that merely mention technology and miss firms that use it without saying so. Cebulla *et al*. (2026) [2] similarly observe that evidence concentrates on China, on manufacturing, and on firm-level data, which limits how far conclusions travel to services or to other economies.

Discussion

Taken together, the reviews support a conditional reading. Digital transformation can raise productivity and operational efficiency, but gains are neither automatic nor uniform. Four conditions recur: sufficient and sustained investment, complementary capabilities in skills and management, adequate infrastructure, and time. This helps explain why a firm-level evidence base that is mostly positive can sit beside the pilot-stage stagnation described in the McKinsey survey: many firms begin transformation without the supporting conditions that the successful studies had in place.

For managers, the evidence suggests treating transformation as organizational change rather than technology procurement. Spending on workforce skills and process redesign should accompany spending on tools, and data should be put to analytical use rather than merely stored. Leaders should also plan for a lag, and for possible short-term costs, and should track a consistent set of productivity and efficiency indicators so that progress is judged on evidence. SMEs, where resources are tight, may do better by sequencing a few well-chosen projects than by pursuing broad programmes.

For policymakers, the findings point to broadband and public digital infrastructure, accessible financing for smaller firms, and large-scale reskilling support. Because smaller and less digitally mature firms appear to benefit least, support that is not targeted risks widening productivity gaps. For researchers, priorities include agreeing on better measures of transformation, studying services and non-Chinese contexts, and using longitudinal and mixed-method designs that capture organizational learning. Both Cebulla *et al*. (2026) [2] and Bouwmans *et al*. (2024) [1] note that their reviews predate robust evidence on generative AI, so its productivity effects remain an open question. This paper's own limits, namely a targeted search and a small core of sources, mean its conclusions should be read as a well-grounded overview and not a definitive verdict.

Conclusion

Recent reviews indicate that digital transformation is usually associated with higher productivity and better operational efficiency, but the association is conditional. The strongest results appear where firms invest steadily, build the skills and management capability to use new tools, and have the infrastructure and financing to sustain the effort. Where those conditions are missing, returns can be delayed, small, or negative. For businesses, the practical message is to treat digital transformation as a long-term change in how the organization works, to measure its effects carefully, and to expect value to come from people and processes as much as from technology.

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