

# *The Impact and Challenges of Digital Transformation on Supply Chain Resilience in Physical Enterprises*

Ruihan Li<sup>1,a,\*</sup>

<sup>1</sup>Logistics Engineering College, Chongqing Finance and Economic College, Chongqing, 401320, China

a. 15211040649@stu.cpu.edu.cn

\*corresponding author

**Abstract:** In the digital era, supply chain resilience (SCR) has become a key pillar of the real economy. Enterprises face various challenges, including cybersecurity threats, market volatility, technological change and changing global conditions. A strong SCR not only ensures continued business operations but also maintains market stability and consumer well-being. Digital transformation helps businesses anticipate market changes, optimize inventory management, improve operational efficiency, and assist in management decisions when necessary by providing unprecedented data transparency and real-time insights. The purpose of this paper is to examine the extent of digital transformation in the supply chains of physical firms globally through a literature review, to identify the factors influencing the resilience of digital transformation in the supply chains of physical firms, and to discover the barriers to digital transformation in the supply chains of physical firms. The study finds that the digital transformation of physical firms' supply chains is still in its infancy, and there are barriers at both managerial and physical levels. Solutions to address these barriers include enhancing employee training, correctly introducing appropriate digital technologies, and improving information security.

**Keywords:** Supply chain resilience, Digital transformation, Challenges, Solutions

## 1. Introduction

In the digital age, supply chain resilience (SCR) has become a key pillar of the physical economy. Similarly, businesses face increasing challenges, including cybersecurity threats, market volatility, technological changes, and shifts in global situations. Against this backdrop, robust SCR ensures the continuous operation of businesses and maintains market stability and consumer welfare. It enables effective responses to external shocks, swift recovery, and adaptation to environmental changes, maintaining competitive advantage and internal vitality of enterprises. Furthermore, as digital transformation represents the deep integration of modern information technology with the physical economy, it empowers traditional industries to transform and upgrade. It spurs the creation of new industries, business forms, and models, utilizing data and platform resources to enhance enterprise value creation [1-2].

The digital economy has become a new engine driving the upgrade of industrial chains for physical enterprises. The report of the 20th National Congress of the Communist Party of China highlights the need to accelerate the development of the digital economy, promote the deep integration of digital

publishing with the physical economy, and create digital industry clusters with international competitiveness. Digital technologies such as cloud computing, big data analytics, artificial intelligence, and the Internet of Things are transforming traditional supply chain management practices. These technologies provide unprecedented data transparency and real-time insights, helping businesses predict market changes, optimize inventory management, improve operational efficiency, and assist management decision-making when necessary. Therefore, systematically reviewing existing literature to summarize the impact of digital transformation on the resilience of physical enterprises' supply chains is essential. Accordingly, this paper aims to research the extent of digital transformation in the supply chains of physical enterprises worldwide through a literature review. It seeks to identify factors influencing the resilience of physical enterprises' supply chains due to digital transformation and discover obstacles in the digital transformation of physical enterprises' supply chains. Yang & Zhang note that by adopting digital technologies such as big data, cloud computing, the Internet of Things, and artificial intelligence, businesses can enhance their supply chains' transparency, flexibility, and responsiveness, thereby gaining a competitive edge [3]. Ivanov demonstrates that integrating digital technologies with supply chain management improves operational efficiency and strengthens businesses' ability to adapt to market changes and manage risks [4]. Future research should focus on effectively integrating and applying emerging technologies further to enhance the resilience and efficiency of supply chains. This paper innovates by moving away from directly stating the impacts and obstacles of digital transformation. Instead, it analyzes the influence of digital transformation on the resilience of businesses' supply chains by examining enterprises' internal and external environments. Finally, it summarizes the obstacles to digital transformation from two perspectives: management and the physical entity of the enterprise.

## **2. Digital Transformation and SCR**

### **2.1. Concept and Scope of Digitalization**

There are various explanations for digital transformation within the academic community, but discussions primarily revolve around four major dimensions: technological scope, transformation effects, fields, and subjects. The definition by Sebastian et al., which enjoys a high degree of acceptance, summarizes the new generation of digital technologies as SMACIT: Social-related technologies, Mobile technologies, Analytics, Cloud computing, and the Internet of Things (IoT) [5]. This includes big data, cloud computing, blockchain, IoT, artificial intelligence, and virtual reality technologies [5]. At present, physical enterprises in various countries face challenges in their digital transformation efforts, such as mismatches in the collaborative capabilities of supply chains upstream and downstream, inappropriate introduction of digital technologies, and insufficient product supply, indicating that the digitalization process is still at an initial stage. Qian and Xue, through their research on relevant digital economy data, found that with the revolutionary updates of digital technologies, the continuous deepening of enterprises' digital transformation has made the role of digitalization as an engine for the development of the digital economy even more prominent. Within the scope of digitalization research, Li and Lü pointed out that existing studies are mostly quantitative and case-based, which are insufficient to address systemic issues. Additionally, mechanical and theoretical research findings are scarce, leading to the reliance on alternative indicators to answer quantitative research questions.

### **2.2. Concept of SCR**

This section will explore three key concepts in supply chain management: SCR, supply chain agility, and supply chain robustness. SCR emphasizes how businesses maintain the stability of their supply chain when faced with external shocks, prevent disruptions, adjust and return to the operational state

before the shock, and even leverage these challenges to optimize and upgrade the supply chain. This concept includes two dimensions: supply chain robustness and supply chain agility. It emphasizes resisting changes without adjusting the initial stable configuration and quickly adapting to environmental changes to synchronize supply with demand.

Physical enterprise SCR refers to the supply chain system's ability to maintain stability, prevent disruptions, and adjust to the operational state before the shock when faced with external impacts. Furthermore, it can turn risks into opportunities, optimizing and upgrading the industrial supply chain [6]. SCR is also defined as the system's capacity to return to its original state within an acceptable time frame after disruption. Ponomarov and Holcomb consider SCR the supply chain's adaptive capacity for preparation and response to sudden and unexpected events. The core attribute of resilience is the ability to reduce the impact of disruptions to below the threshold of a breaking point. Research on enterprise SCR primarily includes two dimensions: rootedness and shock resistance. The supply chain needs not only to be shock-resistant but also to have the ability to avoid relocation due to changes in the internal and external environment of the enterprise. Within enterprises, the most direct manifestation of supply chain digitalization is seen in the profound impact on management models, structures, and processes of enterprise nodes, and it plays a positive role in business transactions and supply chain risk management. Currently, physical enterprise supply chains in various countries face the triple challenges of needing to be completed, robust, and stable, with disruption being a significant factor hindering the enhancement of SCR.

Supply chain agility is considered one of the fundamental characteristics of a successful supply chain in today's environment. Supply chains that adopt reactive strategies are often called agile supply chains. In the global market, enterprises with agile supply chains can adapt to changes in the business environment by better synchronizing supply with demand [7].

A robust supply chain implies adopting preemptive measures to deal with changes without needing adjustments during those changes. Supply chain robustness, however, has multiple definitions. Wieland et al. consider supply chain robustness as the ability of a supply chain to resist changes without adjusting its initial stable configuration. Kitano views supply chain robustness as the capacity to maintain its functions during internal or external disruptions. Adobor defines supply chain robustness as the capability to resist or avoid changes, and robustness is a characteristic that can be enhanced during the decision-making process [8]. Existing research indicates that robustness includes resilience to specific damages to system components and general environmental fluctuations while also being related to durability, sensitivity, and decision-making flexibility. The definition of robustness focuses on the ability to continue operations and withstand the impacts of supply chain disruptions. Supply chain robustness is the capacity to ensure product availability, meeting customer demands on time and at the lowest possible cost.

The impact of digital transformation on the resilience of physical enterprises' supply chains

External influences on enterprises include market dynamics, technological advancements, and changes in policies and regulations. These external factors provide both opportunities and challenges for digital transformation. Similarly, changes in policies and regulations may also affect enterprises' digital strategies and supply chain management practices. On the other hand, internal influences focus on how enterprises adapt to and implement digital transformation internally and how these changes affect the supply chain's resilience. This includes reorganization of organizational structure, management changes, enhancement of employee skills, and optimization of internal processes and technological systems. Analyzing internal influences can reveal how enterprises can improve their supply chains' efficiency, flexibility, and adaptability by reorganizing internal resources.

In summary, analyzing from the dual perspectives of external and internal influences provides a comprehensive, multidimensional analytical framework for understanding how digital transformation affects the resilience of physical enterprises' supply chains.

### 3. External Influences on Enterprises

Changes in market composition. With the acceleration of digitalization and the expansion of the digital economy market, digital transformation is changing consumer behavior and expectations. In traditional supply chains, physical enterprises rely excessively on tangible assets and energy consumption. However, there are no physical limitations in the network space constructed by the digital economy, enabling the circulation, reorganization, and reconfiguration of resources across different regions. This reorganizes the spatial layout of supply chains and facilitates effective regional circulation. Thanks to advances in digital technology, consumers can more easily access enterprise information through technological means, allowing them to participate more directly in supply chain activities and become participants in these activities.

Accelerating the integration and development of the digital economy and traditional enterprises. In the new industrialization, digital industrialization extends its boundaries from cyberspace to physical space, promoting an evolutionary paradigm characterized mainly by industrial integration. Centered on informational transformation and based on the integration of internet technology and communication technology, this drives the interconnection of various elements upstream and downstream of the supply chain. Digital transformation is thereby introduced into multiple domains, such as production and consumption, upgrading traditional industries and facilitating the integration of the digital economy with traditional enterprises.

### 4. Internal Influences on Enterprises

Digital transformation empowers enterprises [9]. In the context of digitalization, physical enterprises are gradually moving away from extensive growth patterns, shifting from labor-intensive supply chains to technology-intensive supply chains. Data, as a new type of production factor constantly in high-speed flow, replicable, and editable, differs from the traditional resources that are hard to move. In the case of a medical device manufacturing company, digital transformation can reorganize the original capabilities of the manufacturing industry to form and utilize research and development organization capabilities [10].

Enhancing the overall operational efficiency and strengthening the resilience of the supply chain. Digital transformation highlights the limitations of traditional physical enterprises. Through business process automation, data integration, enhanced coordination, and process optimization, digital transformation significantly enhances the overall efficiency and sustainability of the supply chain, adapting to market changes and competitiveness. Zhang et al. propose that through the informational, financing, and learning effects of supply chain digitalization, organizations can effectively enhance their capacity to bear risks, maintaining supply chain security and stability. Digitalization can improve the supply chain's resistance and recovery capabilities, promoting an increase in the level of SCR. In research at the industrial chain level, the development of the digital economy can significantly promote the resilience level of the industrial chain. It has been found that digital transformation can significantly enhance SCR and improve enterprise total factor productivity, achieving high-quality development for traditional enterprises.

### 5. Conclusion

This paper reviews concepts such as SCR and digital transformation, the impact of digital transformation on the resilience of physical enterprises' supply chains, and the obstacles to digital transformation faced by physical enterprises. It finds that the digital transformation of supply chains within physical enterprises worldwide is preliminary. There is a substantial body of literature on the impact of digital transformation on SCR, with most focusing on internal enterprise management.

The research identifies the following issues by categorizing obstacles into management and physical enterprise levels: First, there is no universally accepted concept of digital transformation, which is unfavorable for conducting in-depth empirical research. Second, more successful cases of digital transformation in physical enterprises need to be conducted to facilitate detailed study.

Solutions to the transformation obstacles include: First, from a management perspective, guiding employees to accept digitalization through relevant training and skills development. Decision-makers must fully understand how various digital technologies affect enterprise operations and correctly introduce appropriate digital technologies second, from the perspective of the enterprise entity, by increasing information security to prevent data breaches and enhancing customer satisfaction. Gradually introduce digital technologies and ensure their organic integration to prevent the discord between digital technologies and enterprises from leading to losses.

## References

- [1] Peukert, C., & Reimers, I. (2022). *Digitization, prediction, and market efficiency: Evidence from book publishing deals*. *Management Science*, 68(9), 6907-6924.
- [2] Benner, M. J., & Waldfogel, J. (2023). *Changing the channel: Digitization and the rise of “middle tail” strategies*. *Strategic Management Journal*, 44(1), 264-287.
- [3] Yang, M., Fu, M., & Zhang, Z. (2021). *Adopting digital technologies in supply chains: Drivers, process and impact*. *Technological Forecasting and Social Change*, 169, 120795.
- [4] Ivanov, D., Dolgui, A., & Sokolov, B. (2019). *Digital technology and Industry 4.0 impact the ripple effect and supply chain risk analytics*. *International journal of production research*, 57(3), 829-846.
- [5] Sebastian, I. M., Ross, J. W., Beath, C., Mocker, M., Moloney, K. G., & Fonstad, N. O. (2020). *How big old companies navigate digital transformation*. In *Strategic information management* (pp. 133-150). Routledge.
- [6] Lee, H. L. (2002). *Aligning supply chain strategies with product uncertainties*. *California Management Review*, 44(3), 105-119.
- [7] Dubey, R., Altay, N., Gunasekaran, A., Blome, C., Papadopoulos, T., & Childe, S. J. (2018). *Supply chain agility, adaptability and alignment: empirical evidence from the Indian auto components industry*. *International Journal of Operations & Production Management*, 38(1), 129-148.
- [8] Adobor, H. (2020). *Supply chain resilience: an adaptive cycle approach*. *The International Journal of Logistics Management*, 31(3), 443-463.
- [9] Li, H., Yang, Z., Jin, C., & Wang, J. (2023). *How an industrial internet platform empowers the digital transformation of SMEs: theoretical mechanism and business model*. *Journal of Knowledge Management*, 27(1), 105-120.
- [10] Hanelt, A., Bohnsack, R., Marz, D., & Antunes Marante, C. (2021). *A systematic review of the literature on digital transformation: Insights and implications for strategy and organizational change*. *Journal of Management Studies*, 58(5), 1159-1197.