DIGITAL TRANSFORMATION IN THE RETAIL SUPPLY CHAIN - BARRIERS TO CONSIDER

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Abstract: ***In the context of the Fourth Industrial Revolution (Industry 4.0) and the post-Covid-19 era, many retail companies are reassessing their supply chains to ensure long-term survival and sustainable development. For this purpose, digital transformation in the supply chain or the digital supply chain has emerged as a critical concept receiving growing attention from managers. Digital transformation in the supply chain can enhance the resilience of supply chain operations by providing greater tools for visibility, control, and demand forecasting. This paper aims to clarify the requirements for digital transformation in the retail supply chain, identify the fundamental barriers influencing the decision to implement a digital supply chain, and describe several emerging technologies that are currently being widely adopted in supply chain management.***

• Keywords: *digital transformation, supply chain, retail.*

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1. Introduction

In today's volatile global business environment combined with the impacts of the post-Covid-19 era, several vulnerabilities in global supply chains have been exposed, placing significant pressure on enterprises to find solutions that enhance supply chain network resilience while striving to improve competitiveness. In this context, digital supply chain transformation is considered a promising solution to effectively manage risks. At the same time, the rapid development and widespread adoption of digital technologies clearly underline the need for businesses to digitally transform their operations. Moreover, these digital technologies can help optimize cost structures through tools such as blockchain, the Internet of Things (IoT), and virtual assistant platforms, while also improving operations and reducing supply chain costs. The benefits of digital transformation in the retail supply chain are undeniable. However, it is crucial that all stakeholders involved in supply chain recognize the potential advantages of adopting new technologies and digitizing their supply chain operations.

This paper highlights the essential requirements for digital transformation in supply chains and explores the key barriers affecting the adoption of digital supply chains in the retail environment.

2. Digital transformation in the supply chain

Digitization, digitalization and digital transformation are terms that frequently appear among the top priorities of today's business leaders. Although often used interchangeably, these concepts have distinct meanings and require entirely different approaches. According to Verhoef et al. (2019), these represent three stages of digital transformation. Specifically, digitization refers to the conversion of information, data, and documents from physical or analog formats into digital form. Digitalization involves the use of this digitized data and documents to improve or modify operational processes, workflows, and business activities. Digital transformation, in contrast, goes beyond digitization and digitalization by driving a comprehensive shift in a company's overall business strategy. Vial (2019) defines digital transformation as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies".

Within the context of supply chain management, digital transformation begins by integrating all processes and data into a unified platform, automating core functions, and applying advanced technologies to analyze large-scale datasets for the purpose of identifying, predicting, and mitigating potential disruptions. This paradigm shift has given rise to the concept of the Digital Supply Chain (DSC), which emphasizes a digitally driven approach to managing and optimizing supply chain operations. Büyüközkan and Göçer (2018) conceptualize the DSC as an intelligent technological system that leverages big data capabilities and facilitates seamless collaboration and

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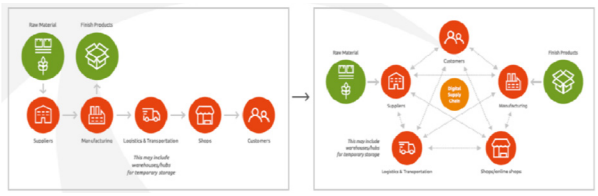
communication through the integration of hardware, software, and digital networks. The DSC aims to enhance value creation, improve accessibility, reduce costs, and ensure operational consistency, flexibility, and efficiency. Similarly, Kinnet (2015) describes the DSC as a value-based, intelligent network that harnesses emerging technologies to enable new business models. According to Bhargava, Ranchal, and Ben Othmane (2013), the DSC is grounded in technological infrastructures, including software, hardware, and communication networks, that support interaction among globally distributed entities and coordinate the key activities of supply chain partners, including procurement, production, warehousing, transportation, and distribution.

The distinction between traditional supply chains and digital supply chains is illustrated in Figure 1. Fundamentally, the core processes and values delivered by traditional supply chains and digital supply chains are similar. However, the key differentiating factor lies in the approach adopted for supply chain operations in practice.

Figure 1. Traditional supply chain vs digital supply chain



Source: De Souza et al, 2021

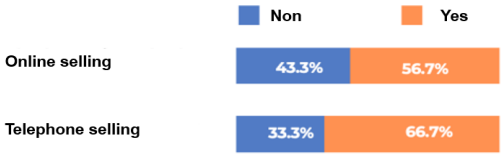
The traditional supply chain is a complex system in which raw materials are transformed into finished goods and subsequently distributed to end users. This supply chain structure encompasses multiple entities, such as suppliers, processing centers, warehouses, distribution hubs, and retail outlets. Traditional supply chains are typically designed based on the assumption of stable input supply and predictable output distribution. Processes are specifically planned and handled separately to ensure a continuous flow of product supply and information. However, the traditional supply chain model suffers from limited connectivity, primarily due to a lack of coordination among its various components. This lack of integration often results in suboptimal overall performance and restricted adaptability in dynamic environments.

In contrast, the digital supply chain leverages advanced technological processes to optimize operations and adapt to rapidly changing conditions. These supply chains operate in real time and are inherently predictive, allowing for the early identification of potential disruptions or inefficiencies. By integrating cutting-edge technologies such as artificial intelligence (AI), robotics, the Internet of Things (IoT), and other digital innovations, digital supply chains enable enterprises to enhance operational efficiency, reduce costs, and achieve superior visibility across the entire value network. The advantages of digital supply chains include increased speed, flexibility, global connectivity, real-time management, transparency, scalability, innovation, proactivity, and environmental sustainability.

3. The rise of e-commerce in retail supply chains

E-commerce and online shopping are no longer unfamiliar concepts to today's consumers. As a sector that heavily depends on consumer behavior and purchasing power, retail has been significantly influenced by recent shifts in consumption habits. Particularly in 2020, the Covid-19 pandemic served as a major catalyst for the accelerated growth of e-commerce, driven by the increasing demand for online shopping during periods of social distancing and mobility restrictions. In addition, the advancement of digital technologies and widespread internet accessibility have given rise to new consumer expectations and increased demands on suppliers. These developments have also established a new retail channel, online platforms, which retailers can leverage to better serve evolving customer needs.

Figure 2. The business's sales model



Source: Ministry of Planning and Investmen, 2022

The results of a survey conducted with 1,000 enterprises, presented in the 2022 Annual Report on Digital Transformation in Enterprises by the Ministry of Planning and Investment, indicate that in addition to two traditional sales methods, namely in-store and telephone-based sales, online sales have become significantly more prevalent. This growth is largely attributed to the active involvement of various online sales platforms (e.g., Shopee, Lazada, Tiki) and social media channels (e.g., Facebook, Instagram, Zalo, and more recently, TikTok), with the majority of businesses adopting a multichannel sales strategy (Figure 2). The surge in business activity on e-commerce platforms and social networks became a defining feature of Vietnam's e-commerce

landscape in 2022 and the first quarter of 2023. According to the Vietnam E-commerce Association (VECOM), 65% of surveyed enterprises reported conducting business on social platforms such as Zalo, WhatsApp, Viber, Facebook Messenger, and TikTok Shop. Meanwhile, business activity on e-commerce platforms continued to grow steadily, with 23% of enterprises selling products on such platforms in 2022 (VECOM, 2023). This trend has persisted into subsequent years. Specifically, in 2024, VECOM estimated that the size of Vietnam's e-commerce market reached USD 32 billion, with a growth rate of 27%. Of this, online retail sales accounted for USD 22.5 billion, representing a 30% increase compared to the previous year. Consequently, e-commerce contributed approximately 12% to the country's total retail sales of goods and consumer services, higher than the 10% level in 2023. Notably, the proportion of online retail sales to total retail sales of goods reached 11%, compared to 8.8% in 2023 (VECOM, 2025).

To further assess the adoption of e-commerce by businesses, VECOM conducted a nationwide survey of over 5,000 enterprises in 2025. The findings reveal that the most commonly used e-commerce formats include company websites, social media platforms, e-commerce platforms, and mobile platforms (Table 1). Specifically, 46% of surveyed enterprises reported operating a dedicated website for promotional and commercial purposes. Among those with websites, 56% had integrated online ordering functionalities, while 75% had embedded customer interaction tools (e.g., Zalo, Facebook) directly into their websites. Regarding social media (Facebook, Zalo, Instagram, etc.), 52% of businesses indicated using these channels for commercial purposes, although this percentage reflects a slight decline compared to 2021, 2022, and 2023. Participation in e-commerce platforms has also received growing attention, with 26% of surveyed enterprises reporting active business operations on these platforms in 2024 - particularly in the latter half of the year, where marketplace engagement became a strategic priority for many firms. Among all online business formats, mobile platform-based commerce had the lowest adoption rate. Only 15% of surveyed enterprises reported developing e-commerce applications (apps) for mobile devices, a noticeable decline from previous years. Among those adopting mobile platforms, 46% allowed customers to complete the entire shopping process through the app, while 18% implemented promotional programs exclusively for customers using mobile applications. As mobile app usage has become more widespread, the level of business prioritization aimed at driving mobile commerce has declined significantly over the past two years.

Table 1. Percentage of enterprises adopting different E-commerce model

	2021	2022	2023	2024
Website	43%	44%	44%	46%
Social media platforms	57%	65%	58%	52%
E-commerce platforms	22%	23%	24%	26%
Mobile platforms	17%	22%	20%	15%

Source: Vietnam E-commerce Association, 2025

Digital transformation yields benefits across all operational dimensions of enterprises - from strategic management to daily operations. The most observable advantages include reduced operational costs, expanded customer reach within shorter timeframes, and improved decision-making speed and accuracy through timely reporting systems. In addition, it enhances labor productivity, thereby increasing both operational efficiency and competitiveness. As businesses undertake digital transformation, disruptive technologies are employed to provide more accurate and real-time insights into the market. Technology further assists enterprises in collecting, processing, and analyzing market data, generating deeper understanding of customer trends and sentiment, while also enabling the design of more effective customer experiences and operational processes. Today's consumers increasingly demand more convenient shopping experiences, broader product choices, easier access, simpler interfaces, and a wider array of supplementary services. Consequently, businesses that are able to effectively leverage customer data can take proactive measures to strengthen their competitive advantages. This is precisely what digital transformation delivers - it enables firms and their supply chains to meet the diverse demands of customers while responding agilely to continuously evolving market conditions.

4. Barriers to digital transformation in retail supply chain

To assess the barriers that affect the digital transformation capabilities of enterprises within the retail supply chain, this study adopts the Technology–Organization–Environment (TOE) framework. Originally proposed by Tornatzky and Fleischer (1990), the TOE framework is a theoretical model that explains how technological, organizational, and environmental factors influence the adoption and implementation of new technologies in organizations.

4.1. Technological factors

According to the TOE framework, technological factors play a pivotal role in determining the success

of digital transformation initiatives. These encompass both internal and external technologies available for organizational use. Technological attributes such as complexity, usability, and learnability directly influence the likelihood of adoption. In the context of the Fourth Industrial Revolution, companies are rapidly transitioning to digital platforms that leverage technologies such as SMAC (Social, Mobile, Big Data Analytics, and Cloud Computing). However, if customers and stakeholders perceive these technologies as overly complex, a lack of trust may become a significant barrier to the adoption of digital supply chains. Another notable barrier in the retail sector is financial capability. According to Harvard Business Review (2015), some retail companies may abandon technology deployment due to high investment costs. While digital supply chains can reduce inventory-related operational and management expenses, transitioning from traditional (paper-based) systems to digital systems often requires substantial upfront investment including infrastructure installation, procurement of new technological resources, and deployment costs. As such, technological costs may represent a considerable hindrance to adoption, particularly in the retail context. Additionally, cybersecurity concerns continue to present challenges especially in developing countries where infrastructure and data protection tools are often insufficient. The growing frequency of cyberattacks acts as a deterrent to the adoption of digital supply chains. Nevertheless, partnerships with cybersecurity providers can enhance protection capabilities and mitigate these risks. The concept of relative advantage is another crucial determinant of adoption. As noted by Rogers (2003), relative advantage refers to the extent to which an innovation is perceived as superior to the idea it supersedes. Organizations are more likely to adopt new technologies when they perceive these innovations as offering substantial benefits beyond current methods. Moreover, the concept of compatibility must be considered: a new technology is more readily accepted when it aligns with the organization's existing values, processes, and IT infrastructure. When these compatibility conditions are met, the likelihood of technology adoption increases significantly.

Clearly, the success of digital transformation initiatives is largely dependent on the accessibility, affordability, and suitability of the technology being adopted. In the retail sector where customers are at the center user experience and the ability to learn and adapt become even more important. Therefore, to foster effective digital transformation, firms must not only invest in appropriate technologies but also consider internal capabilities, employee readiness, and customer trust. When implemented effectively, digital transformation can enhance inventory management and demand forecasting while simultaneously generating sustainable competitive advantage for the organization (Daniels & Jokonya, 2020).

- Organizational factors

According to the TOE framework, organizational characteristics such as size and structure significantly influence the adoption of new technologies. For a digital transformation to be effective, it requires clear leadership from top management. These leaders must not only articulate a digital vision but also align it with the strategic objectives of the entire organization. To overcome barriers such as the complexity of emerging technologies like the Internet of Things (IoT), change management programs must be implemented to address the fear and uncertainty associated with digital disruptions in the retail sector. Wade and Marchant (2014) emphasize that, in the absence of human resource mechanisms that create added value for stakeholders during the digital transformation process, the adoption of digital supply chains may be negatively impacted and could encounter resistance from employees. Moreover, managerial competence and employees' technological skills are considered key factors in the successful adoption of digital supply chains. Successful managers, such as at Amazon, have demonstrated the critical role of collaborative planning and forecasting in production. In contrast, when managers fail to analyze inventory and distribution data streams effectively, digitalization may backfire and produce unintended outcomes. Furthermore, technical expertise particularly in data science is essential for leveraging advanced analytics tools that are integral to digital transformation. Many retail firms, especially those in developing countries, face a shortage of in-house IT professionals, which limits their ability to analyze and use data effectively, while also increasing internal resistance to digital initiatives. Implementing digital transformation initiatives requires personnel who possess both technological expertise and domain-specific knowledge in supply chain management. Firm size may also influence the adoption of technological innovations within supply chains. Typically, larger organizations are more capable of adopting innovations due to their greater financial resources, which support implementation efforts and reduce

the risks associated with transformation (Daniels & Jokonya, 2020).

- Environmental factors

Environmental factors play a critical role in shaping a firm's decision to adopt digital technologies, particularly in the retail sector. These include industry structure, regulatory conditions, the presence of IT service providers, customer expectations, and competitor actions. Firms are more likely to adopt digital supply chains if they believe they will receive adequate technical support from IT providers throughout implementation and operations. This confidence in technical collaboration mitigates the perceived risks of technological innovation. Competitive pressure is another major driver. When firms perceive that failing to adopt new technologies could result in a loss of competitive advantage or customer base, they are more inclined to pursue early adoption. In addition, trust-based relationships with customers can further motivate innovation, as customer expectations regarding service speed and personalization continue to rise. At the same time, national policies and regulations governing information technology affect how data is shared and utilized within enterprises. Digital transformation fosters innovation by enabling firms to make effective use of data across domains such as sales, inventory management, and logistics. The OECD (2017) highlights that data serves as the foundation of digital trade, enabling firms to coordinate global production through complex value chains. Therefore, appropriate data governance policies must be established to ensure smooth data flows while safeguarding privacy and cybersecurity. Trade policies should also foster a digital environment that is open yet secure, balancing public interest with individual privacy rights. Ultimately, the essence of any business is to serve its customers. This fundamental purpose compels organizations to innovate continuously even when such innovations are reactive or not cost-optimized. Growing customer expectations have emerged as a key pressure point, compelling businesses to adopt new technologies at an accelerated pace. In the digital era, failure to innovate may equate to a loss of market share (Daniels & Jokonya, 2020).

5. Orientation for digital transformation of vietnam's retail supply chain

Pham Thi Huyen (2022) argues that digital transformation is likely to be a costly and complex journey, especially considering that the majority of Vietnamese retail companies are small and medium-sized, and have long operated using traditional methods. Therefore, digital transformation should be approached step by step, beginning with digitization, then progressing to digitalization in order to optimize inefficient operational areas, and finally culminating in digital transformation.

The first step involves transferring information, workflows, tasks, and data into digital environments. This step requires proactive efforts to change habitual behaviors among all members of the supply chain, and must also include procedures to ensure the quality and accuracy of digitized data.

The second step is process digitalization. This involves increasing the level of automation in supply chain operations through the application of digital technologies. It enables supply chains to more quickly detect inefficiencies and identify areas for optimization.

Finally, digital transformation refers to transitioning toward a new business model and a novel operational paradigm. For example, if the data reveals that online shoppers significantly outnumber in-store customers, the enterprise may choose to shift entirely to an online business model and enhance customer experience through the use of virtual reality technology and electronic payment systems.

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