An Analysis of the Digital Development of the Supply Chain

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Abstract. With the continuous and deepening application of digital technology, digitization has become a crucial driving force for business transformation and upgrading in the era of the digital economy. The study gives an analysis of digital development from the perspective of the supply chain. Research finding indicates that the application of a digitized supply chain can promote the visualization of information, enhance the quality of products, and strengthen the risk management capabilities and competitiveness of enterprises. The ongoing shift towards digital supply chains has been somewhat effective, but it has also brought to light several issues. These include low information accuracy and transparency, high pressure on inventory management, a lack of standardization, and difficulties in ensuring product quality. In response to these tough issues, the study suggests measures to encourage businesses to establish digitalized supply chain systems, prioritize data analysis and management optimization, and establish and standardize digitalization standards. These steps aim to improve operational efficiency and overall economic benefits for the supply chain for enterprises.

Keywords: Supply chain, digital development, digitalization.

1. Introduction

In today's increasingly complex international environment, various unforeseen risks and uncertainties are emerging, posing unprecedented challenges to the survival and development of businesses. These risks manifest in interruptions of raw material supply, fluctuations in inventory costs, and shortages in labor and other aspects. With the advent of a new wave of technological revolution and industrial transformation, the importance of digital transformation is gradually becoming more prominent. Therefore, driven by the rapid development of the digital economy, an increasing number of enterprises are embarking on the development of digital supply chains. They leverage advanced digital technologies to propel supply chain operations and enhance their operational efficiency. Nevertheless, as a nascent field, the current digital development faces certain challenges that impede the reform and restructuring of enterprise supply chains. Undoubtedly, addressing these issues will provide significant assistance to businesses. Hence, based on the problems arising in the current digital transformation of enterprise supply chains, this research puts forth corresponding recommendations to explore new pathways for the digital development of businesses.

2. Trends

2.1. Driving End-to-End Visibility in the Supply Chain

In the information economy, digital technology is driving the shift of supply chains from information-based to end-to-end visualization. Informatization refers to storing and processing data based on information systems. In comparison, visualization involves using digital technology to present data and performance indicators in the supply chain in the form of images and simulated simulations, such as MATLAB and LINGO [1]. This helps businesses intuitively identify trends and interrelationships in data development. By combining historical data and cases, this new form facilitates better prediction and identification of potential risks and uncertainties in supply chain operations, enhancing the comprehensiveness and scientific basis of enterprise decision-making. This, in turn, promotes the restructuring and upgrading of the supply chain [2].

2.2. Enhancing Product Quality

The application of digitalization in the supply chain improves the safety, traceability, and quality risk control of products. Taking agriculture as an example, concerning issues such as irrigation, fertilizers application, pesticide usage, and residue testing of harmful substances in the soil, enterprises leverage Internet of Things (IoT) technology to monitor the production and storage status of agricultural products in throughout the entire supply chain [3]. Specifically, businesses can utilize digital censors and labels to track key information, including temperature, humidity, and pesticide residue, ensuring the safety of products throughout the supply chain. Moreover, a digitalized supply chain can standardize agricultural product management requirements to ensure compliance of processes with relevant regulations. This involves the management and supervision of different stages such as materials, production processes, and final product delivery to manufacture products in a legal and safe environment. In conclusion, the digitalization of the supply chain provides a more powerful tool for agricultural producers and regulatory agencies to cope with the increasingly complex and competitive product supply chain environment.

2.3. Boosting Risk Management Capacity and Competitiveness

In the era of Industry 4.0, digital transformation is imperative for enterprises to enhance their operational efficiency [3, 4]. Meanwhile, natural disasters have constrained economic activities. Take COVID-19 as an example, the long-lasting epidemic increases the risk of supply chain disruptions and hinders normal business processes. However, these disruptions are unavoidable in traditional supply chains [5]. Hence, developing the digitalization of the supply chain is advantageous for empowering businesses to improve their risk management abilities in uncertain times. It assists enterprises in promptly adjusting processes such as production and procurement planning, mitigating interruptions during the supply of raw materials or product deliveries, thereby preventing losses [4, 6]. Furthermore, the digital transformation of supply chains also elevates the competitiveness of businesses. Through data informatization and sharing, upstream and downstream companies in the supply chain aggregate product data, establishing an integrated collaborative relationship [2]. The formation of such an integrated relationship facilitates augmenting the manufacturing and operational capacities of the supply chain members, leading to maximizing the entire benefits and enhancing the overall strengths of the enterprise as a consequence.

3. Problems

3.1. Low Information Integrity and Transparency

When enterprises engage with multiple suppliers for the procurement of raw materials or components, based on the consideration of corporate self-interest, suppliers often resist collaborative efforts and refuse to provide comprehensive and detailed information. This reluctance poses challenges in ensuring the security and quality of products [6]. Throughout the production process, such as the design and assembly stages, there is a crucial need for extensive information exchange and sharing. However, the lack of information integrity and transparency across various segments of the supply chain hampers these essential exchanges. As product demand escalates from end customers with the transmission along the supply chain, businesses face difficulties in accurately predicting customer needs and market trends. This impedes enterprises from establishing a close and timely connection with customers and the market, hindering them from making prompt and precise decisions [7].

3.2. High Inventory Management Pressure

Nowadays, unpredictable market demand and increasing consumer preferences for personalized goods pose challenges for enterprises. This leads to significant fluctuations in order volumes and a gradual reduction in product delivery times. Faced with the uncertainty of orders, companies resort

to increasing inventory to enhance customer responsiveness [7]. Nevertheless, the shortage of information sharing contributes to low market responsiveness, causing potential product backlog and obsolescence. Additionally, for certain seasonal products, enterprises must conduct market research and analyze marketing trends before manufacturing the merchandise [6]. The extended product production cycle further compounds the pressure on inventory management for businesses. Addressing the challenge of effectively responding to market demand with less inventory presents a formidable dilemma for them.

3.3. Lack of Standardization, Challenges in Ensuring Product Quality

Supply chain digitization, as an emerging trend, is still undergoing continuous experimentation in its transformation and upgrade. However, the deficiency of established digitalization standards for products causes inconsistencies in product information handling and transmission standards among relevant enterprises in the supply chain. This makes collaboration between companies more challenging [8]. Moreover, the infrastructure related to digitization is not yet well-developed, posing multiple difficulties for the digital development of businesses. Concurrently, in the procurement of raw materials, there are differences in quality standards and manufacturing processes among various suppliers. Thus, it is difficult for companies to ensure that all materials meet the manufacturing standards of the products [6]. In actual production, companies often face the pressing issue of tight production schedules, resulting in insufficient time for product inspection. This increases the likelihood of missed inspections and misjudgments, consequently raising the risk of product quality issues.

4. Suggestions

4.1. Establish digitalized supply chain systems

Firstly, companies should choose a digital management strategy based on their own needs and circumstances, integrating digital technologies such as cloud computing, blockchain, and the Internet of Things (IoT) to establish their own digitalized supply chain system [6]. Simultaneously, they are required to exchange data with suppliers and end customers, fostering friendly and trustworthy cooperative relationships to monitor orders and logistics information promptly and enhance information visibility. This not only aids in identifying and addressing quality and safety issues promptly but also provides better services to customers [6]. Through real-time monitoring of information and the establishment of digital systems, businesses can not only respond quickly to market changes and customer demands, improving the flexibility of the supply chain but also alleviating the dilemma of information block and communication barriers between upstream and downstream partners. This facilitates collaborative cooperation among suppliers, leveraging complementary strengths.

4.2. Prioritize Data Analysis and Management Optimization

By applying big data analytics techniques for data analysis and management optimization, companies can better control their inventory costs, thereby enhancing operational efficiency and market competitiveness. Specifically, businesses can gather historical production and sales data, such as product data provided by suppliers and customer consumption data, to establish a database. Subsequently, through big data analysis, the data can be cleaned and mined to eliminate irrelevant and valueless information, identifying potential data relationships within the remaining dataset [6]. Following this, digital technologies can be utilized to forecast market demand, achieving refined production planning and inventory management strategies. Faced with varying orders in terms of quantity and from different suppliers, companies can use big data technology for automatic clustering. This allows businesses to complete production tasks with similar fabrics and processes from different orders, facilitating flexible production and reducing inventory backlog [9].

4.3. Establish and Standardize Digital Standards, Leveraging Digital Technologies

Unified digital standards are a prerequisite for enhancing the digitization of the supply chain. This encompasses three key elements: process standardization, document standardization, and product standardization. By regulating processes within the supply chain, unifying file formats and document content during transmission, and standardizing production specifications for identical products, communication discrepancies among relevant companies in the supply chain can be eliminated. This, in turn, reduces the costs of information processing for businesses and enhances operational efficiency [1]. Companies can leverage digital technologies to establish a risk alert mechanism. Using digital technologies as an auxiliary tool, businesses can trace the production processes and product distribution for each item. This enables swift rectification of potential issues during circulation [8, 10]. Additionally, based on a shared information platform, both suppliers and customers can promptly access and understand product quality and potential weaknesses in the production process. This facilitates targeted guidance for companies facing difficulties and assists them when they tackle product quality issues [8]. It strengthens collaborative efforts and develops the coordination capability of the supply chain.

5. Conclusion

This research analyzes the digital development of the supply chain. The study reveals that the digitization of the supply chain is an ongoing and maturing trend in line with the progress of the era. It facilitates the visualization of supply chain information, improves product quality, and strengthens the risk management capabilities and competitiveness of businesses, serving as a powerful tool for enhancing the value of the supply chain. The contribution of this study is identifying existing challenges in the current state of supply chain digital transformation. Three Recommendations are presented from technology, standards, and systems to offer theoretical guidance for enterprises undergoing digital transformation. This aims to promote supply chains' digital and informational development, ultimately improving business efficiency and competitiveness. However, this study does not validate the security of the utilization of digital tools, specifically whether these tools can ensure the confidentiality of sensitive information within a digital supply chain and prevent potential breaches caused by intruder attacks. Future research should address the theme of the security of digital tools in the context of supply chain digitization.

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