

Research on digital transformation of supply chain: research status and recommendations

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Abstract. This paper studies the relevant literature of digital transformation of supply chain, and obtains the necessity of research on digital transformation of supply chain. we use the visualization tool CiteSpace to analyze several key directions of digital transformation of supply chain: technology support, driving factors, capabilities.

1 Research background

With the rapid development of the world economy, the scale of enterprise organization industry has gradually expanded in recent years, but it is also faced with the problem of natural disasters, policy changes, political environment and other force majeure factors which may also lead to supply chain risks. [1] These problems not only hinder the organization 's own benefits, but also directly affect the overall performance of the supply chain. For example, in 2019, US imposed new import tariffs on various goods from China, so the global supply chain was affected to varying degrees. In 2020, the COVID-19 broke out. Various epidemic prevention materials were facing the threat of supply chain disruption, and the global supply chain has also suffered a major blow.[2]

In Figure 1, the number of articles shows an exponential growth trend from 2002 to 2021. Compared with 2020, the number in 2021 has almost doubled. Based on this analysis, it can be concluded that digital transformation of supply chain is not a mature research topic, and the existing research is in the stage of improvement. Under the influence of the COVID-19, the digital transformation of supply chain is more important and necessary. According to Research Report of China Enterprise Digital Development in 2021, the scale of China ' s digital economy in 2021 reached CNY 47.6 trillion, and 95.9% of enterprises have completed or are undergoing digital transformation. The surveyed enterprises all expect to meet the requirements of industry through digital transformation of supply chain. The research on digital transformation of supply chain is relatively few, and the research direction is not comprehensive. It can't provide sufficient theoretical basis and tool model for enterprises. It should be oriented to multi-faceted high-quality development to meet the growing needs of rapid development.

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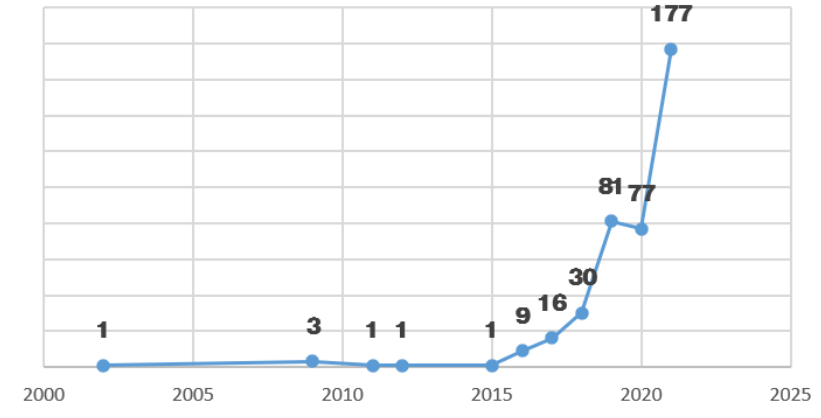


Fig 1. Quantity of papers related to digital transformation of supply chain 2002-2021.

2 Research directions

We use CiteSpace 5.8 R3 (64bit) version as the information visualization tool to analyze all the data. The time span is set from January 2017 to November 2021, the time slice is 1 year, and the threshold is Top50. The node type selection is keyword.

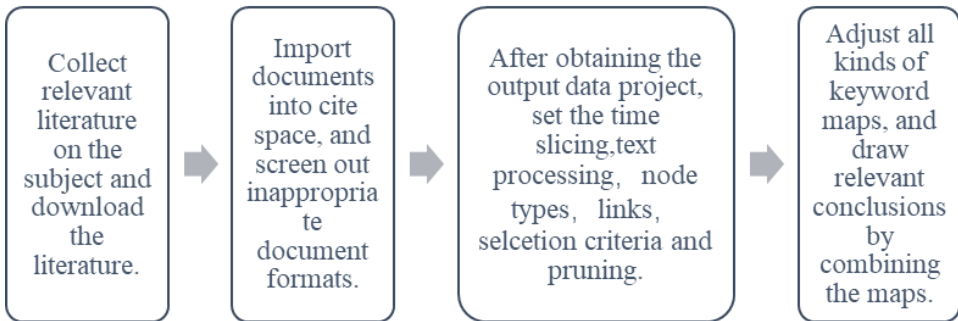


Fig 2. CiteSpace process map for digital transformation of supply chain.

2.1 Technology support of supply chain digital transformation

In this section, "subject = supply chain digitization" and "subject =technology support" are used for literature retrieval. The literature data are all from Web of Science database and Emerald database. A total of 197 relevant literatures have been retrieved after assembling and screening invalid literatures. By using CiteSpace to make collinear Atlas of keywords. From Figure 2, we can conclude that digital transformation of supply chain is mainly supported by three major technologies: big data, Internet of Things and blockchain.



Fig 3. Collinear atlas of keywords of research.

By incorporating Big Data 5V features into the initial planning phase of supply chain projects, the risk of planning errors can be minimized. Therefore, the combination of structured and standardized planning, relying on the RAMI 4.0 model and the 5V features, can accelerate integration of enterprise supply chain management. The application of big data in supply chain improves the efficiency of network planning and demand forecasting. At the same time, real-time data and historical data are both important in avoiding risks, predicting events and proposing solutions, so that enterprises can process data in a more accurate and fast way to obtain prediction results. [3]

The IoT architecture is the core of enterprise supply chain digitalization, which enables enterprises to fully capture operational data, connect assets, promote data flow, and enable data to reach people with corresponding decision-making authority in time. [4] IoT provides enterprises with real-time, end-to-end visibility and control across supply chains, as well as higher automation and big data analysis. IoT allows enterprises to reduce costs by improving efficiency, and make more wise decisions around a large number of new market opportunities by using data analysis.

Blockchain is a shared and tamper-evident account, which aims to facilitate the transaction record and asset tracking process in the business network. Blockchain is the driving force of digital transformation of supply chain. First of all, because blockchain can reduce the cost of search information, blockchain can significantly reduce the cost of supply chain transactions and governance. Secondly, the blockchain-based economy pushes many transactions to a more market-oriented governance structure, fully stimulates and releases enterprise vitality, and improves market competitiveness and development leadership.[5]

2.2 Drivers of supply chain digital transformation

In this part, "subject = supply chain digitization" and "subject = drive" are used for literature retrieval. All the literature data come from the Web of Science database and Emerald database. After matching and screening out invalid literature, 58 related literatures were retrieved. By using CiteSpace to cluster the literatures to get Figure 3. The analysis shows the internal driving factors are mainly divided into: the internal factors and the external driving factors.[6]

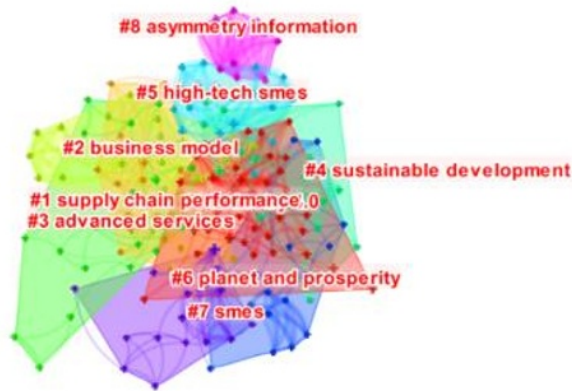


Fig 4. Cluster co-occurrence map of research hotspots.

2.2.1 Internal factors

The first internal factor is corporate strategy-sustainable development. Digital transformation of supply chain should be a long-term strategy for enterprise development, and it is also an integral part of the overall strategy of enterprises. Sustainable development of supply chain is to ensure the reduction of natural or political environmental impact in the whole supply chain cycle and better safeguard human rights and ethical work practices. So digital transformation of the supply chain is necessary, both in terms of corporate and environmental sustainability.[7]

The other factor is business operations-supply chain performance. Enterprise using digital technology can improve its operational performance in the supply chain. At the initial stage of supply chain business, some manufacturers and suppliers have a good foundation for digital transformation, and the transformation is relatively easier and more active. In terms of distributors, the digital supply chain platform can predict goods sales and sales climbing speed to guide manufacturers, thus bringing a better shopping experience to customers and efficiency improvement for supply chain members, and achieve a win-win situation.

2.2.2 External factors

Firstly, advanced service for customer demand is important. In the traditional supply chain model, the data resources held by customers and enterprises are not equal. Customers can only choose among the known products. However, with the advent of e-commerce, customers need fast, high-speed and detailed logistics methods. Digital supply chain is a dynamic, intelligent, visible and predictable supply chain system centered on customer needs. Each department can be in direct contact with customers, and the changes of customers' needs can be directly returned to various departments through a mesh, which can improve efficiency and reduce risks while responding quickly. [8]

The second factor is supply chain partners-high-tech SMEs. The digital transformation of partners can transform the traditional chain structure into a network supply chain, which will promote the interconnection of members in the supply chain in terms of information,

technology, management, knowledge, etc. High-tech partners establish an intelligent and digital supply chain system, connect the upstream and downstream information of the supply chain to realize the transparency of sourcing and price verification business.

Last external factor is Competitiveness-asymmetry information. With the development of the Internet era and the iteration of e-commerce, the supply chain needs to meet the requirements of scene, digitalization and rapid iteration. Therefore, the earlier you use digital technology, the better you can obtain market data and forecast market demand. You can also adjust the inventory and orders in time according to the needs of customers to maximize the performance of supply chain operation. [9]

2.3 Supply chain digital transformation capabilities

In this part, "subject = supply chain digitization" and "subject = capability" are used for literature retrieval. All the literature data come from Web of Science database and Emerald database. After matching and screening out invalid literature, 70 related literatures are retrieved. Using CiteSpace to get the time zone map of keywords Figure 4, it can be seen that keywords are mainly divided into two parts in 2020.

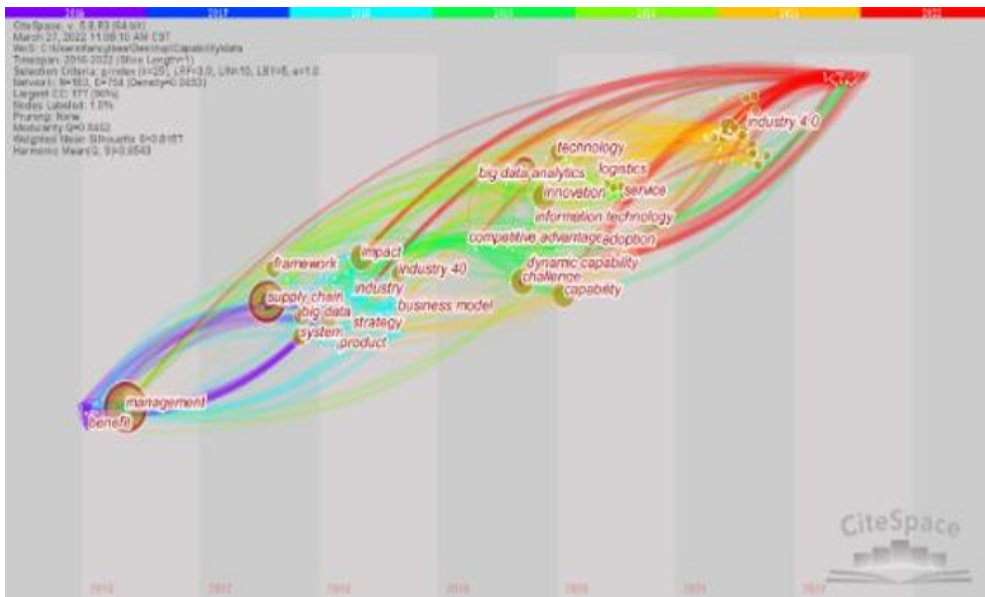


Fig 5. Keywords co-occurrence network time zone map.

2016-2019 is a period of rapid development of science and technology. During this period, technologies such as big data predictive analysis, IoT, AI and other technologies began to be applied to enterprise supply chains. Technology innovation capability can enable enterprises to use supply chain intelligence to improve their performance and financial performance. Innovation means pursuing something new to the company, while effective innovation can improve the performance of the company or broaden the market.

After the outbreak of COVID-19 in 2020, enterprises had to deal with emergencies. According to the World Economic Outlook Report released by the International Monetary Fund in 2021, the world economy declined by 3.1% year in 2020. Digital supply chain has two major contributions to risk resistance. First of all, it can increase the flexibility of the supply chain, which is conducive to enhancing the ability of information processing, improving the ability to dynamically respond to risks. Secondly, digitalization of supply

chain can enhance the agility of supply chain. Through the collaboration of various departments of enterprises, the business process of supply chain can be greatly optimized, and the response speed to the market can be significantly improved. [10]

3 Conclusions

3.1 Research conclusion

For supply chain digital transformation technology, we think that big data analysis, Internet of Things and blockchain are the main applications of enterprises in the process of transformation, and they affect supply chain through different principles. The driving factors of digital transformation of supply chain are mainly divided into internal factors and external factors. The internal factors are mainly related to the company's sustainable development strategy and the operation. The external driving factors are the customer demand that needs better service, the application of high-tech supply chain to cooperate with small and medium-sized enterprises, and the core competitiveness. 2020 is the turning point of the research on transformation capability. Before 2020, the enterprise capability of supply chain digital transformation mainly focused on the innovation capability. Post 2020, affected by the COVID-19, the research focused on how to improve the supply chain risk response capability.

3.2 Research contribution

This paper adds the discussion on the direction of digital transformation of supply chain. With the development trend of the times towards intelligence, the research on digital transformation of supply chain is constantly enriched.

Through the current research and analysis, I think the future research can be carried out from the following potential topics. Firstly, the digitalization of ERP, which is one of the core systems in the supply chain management system. The traditional ERP system is huge and inflexible, and most of it is just a data recording system, lacking modern business intelligence. Therefore, it is hoped that more research can involve the digital transformation of ERP. Besides, the digital supply chain control tower is a new subject. The control tower is a single command center of supply chain management, which is used for end-to-end visibility and decision-making and action based on real-time data. The control tower uses digital intelligence technology to centrally control and manage single or multiple or global supply chains, which is a useful direction for large-scale digital transformation of supply chains.

3.3 Research restrictions

This article also has its own shortcomings. As the research on digital transformation of supply chain is still in the developing stage, the available literature data is limited. Therefore, the keyword analysis chart obtained by CiteSpace can't fully show all the research contents, and only the hot research directions can be picked up, and relevant conclusions can be drawn by analysis and summary. Despite the limitations, we have made theoretical contributions to the digital transformation of supply chain through our framework and expansion.

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