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Implementation of Big Data Techniques in Supply Chain Finance: Evidence from Jingdong E-commerce Platform

Jiayi Yu[1,a,*]

[1]*School of Finance, Nankai University, Tianjin, China*
a. 2111222@mail.nankai.edu.cn
**corresponding author*

Abstract: China is currently at a critical stage of promoting high-quality development of the real economy through innovation and fostering new growth drivers. The financing needs of small and medium-sized enterprises (SMEs) have become increasingly urgent, and supply chain finance (SCF) offers a novel solution to address this challenge. This study explores the intersection of big data technology and SCF. Drawing on relevant literature, the study clarifies the concepts of SCF and big data. A detailed case study of JingDong Group, one of China's leading e-commerce platforms, is conducted to reveal the practical application and significance of big data in SCF. According to the analysis, JD has successfully leveraged big data to improve customer acquisition, enhance risk management, and reduce financing costs for enterprises along the supply chain. As one of the pioneers in exploring the "e-commerce platform + supply chain finance " model, JD has built a robust SCF platform that not only supports its own supply chain but also enables technological innovation to be exported to other industries. These results provide practical recommendations for SCF companies looking to integrate big data into their operations and discusses both the potential and current limitations of these technologies. This research offers empirical support for the digital transformation of SCF and provides a theoretical foundation for enterprises aiming to use big data to drive innovation and improve financing efficiency.

Keywords: E-commerce platform, supply chain finance, big data technology.

1. Introduction

Supply chain finance (SCF) represents an innovative financial service model that centers on large enterprises as the core. This model effectively integrates upstream and downstream companies with financial institutions, creating a cohesive financial chain. The primary objective of SCF is to optimize the financing models for small and medium-sized enterprises (SMEs), enabling them to access capital more efficiently. Within this framework, companies participating in the supply chain can leverage their accounts receivable, inventory, or other assets as collateral to secure financing from financial institutions. This process has led to the development of three principal financing methods: accounts receivable financing, advance payment financing, and inventory financing.

The essence of SCF lies in its ability to efficiently integrate resources by breaking down information barriers. It fosters the sharing of resources such as commercial flows, logistics, and information, thereby enabling the flexible customization of financing and risk management services for target entities. This approach not only shortens the cash flow cycle within the supply chain but

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also enhances the efficiency of information and capital use, reduces operational risks, and increases overall profitability for the enterprises involved. Moreover, SCF facilitates the creation of a mutually beneficial ecosystem where core enterprises, SMEs, and financial institutions collaborate to build a sustainable and virtuous industrial cycle. By improving the overall creditworthiness of the entire supply chain, SCF promotes greater collaboration among buyers, suppliers, and financial service providers, ultimately maximizing the benefits for all parties involved [1].

SCF can be classified into three primary models based on the leading entity: supplier-dominated, dealer-dominated, and B2B e-commerce platform-dominated [2]. In its early stages, SCF often operated under a "1+N" model, where either a bank or a core enterprise led the financing efforts. This model primarily provided funding to midstream and downstream SMEs within the supply chain. However, traditional SCF was largely conducted offline, making it cumbersome, difficult to regulate, and challenging to trace data. Moreover, the reliance on bank approval meant that the focus remained on extending credit to core enterprises, leaving many SMEs struggling to secure the necessary financing due to limited access and persistent information asymmetry.

The emergence of Internet finance has significantly streamlined SCF, freeing it from the inefficiencies of offline operations [3]. Financial technologies such as blockchain, big data, and cloud computing have expanded the scope of SCF. Currently, SCF is still in a phase of online exploration and development. The introduction of digital platforms has reduced information costs and increased transparency across all levels of the supply chain, enabling resources to flow more efficiently. This shift has also relaxed collateral requirements for SMEs, alleviating their financing challenges and allowing core enterprises to expand their operations. As a result, more core enterprises are now actively engaging in SCF. For example, third-party logistics companies can leverage their extensive transaction and logistics data to play a central role in SCF. Additionally, many e-commerce platforms have obtained microloan licenses, enabling them to offer SCF services directly to SMEs trading on their platforms. Interest in SCF surged after the financial crisis, as bank loans became scarce and the need for better management of working capital emerged [3]. SCF offers innovative ways to coordinate financial, product, and information flows in supply chains, attracting increasing attention from both academics and industry [4].

Research on SCF falls into two main perspectives: finance-oriented and supply chain-oriented. The financial view focuses on how institutions provide solutions to address funding needs, while the supply chain view emphasizes collaboration among members and inventory optimization [5]. Earlier studies mainly addressed product and information flows, often overlooking financial aspects [3]. Combining both perspectives leads to a more comprehensive understanding of SCF. For instance, Pfohl's model highlights how supply chain information reduces investment risks and capital costs. SCF benefits companies that are well-integrated within the supply chain and maintain strong cooperation [6].

To explore the potential of big data technology in China's SCF and provide new solutions to issues such as information asymmetry, this paper focuses on the application of big data in enhancing customer acquisition and risk control. Through the case study of JD, the paper demonstrates the practical application of big data technology and the resulting benefits. The rest part of the paper is organized as follows. Section 2 reviews the theoretical framework of SCF and big data, providing a brief overview of their relationship. Section 3 discusses the findings from the study of JD's "e-commerce platform + SCF" model, highlighting the practical application of big data and its impact on optimizing SCF. Finally, Section 4 offers recommendations for other SCF companies on integrating big data technology and discusses the future potential and current limitations of big data in this field.

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2. Descriptions of Big Data Techniques

Big data refers to datasets so large and complex that they surpass the processing capabilities of traditional tools. It represents an organizational capacity that integrates tools, techniques, and processes to efficiently handle, organize, visualize, and analyze data. This capacity generates insights that drive data-informed operational planning, decision-making, and execution [7]. Through the application of big data technologies, massive volumes of data can be rapidly collected, stored, transmitted, and managed. Specialized analytical processes are then employed to create precise data profiles, uncovering the inherent value within the data. These insights, derived from a combination of algorithms and models, serve as critical inputs for corporate decision-making and risk management strategies.

Traditional SCF models have been hindered by issues such as information asymmetry and complex offline operations, significantly limiting the growth of supply chain enterprises. However, the advent of financial technology, particularly big data, has addressed many of these pain points, offering new opportunities for innovation in SCF. By leveraging big data, intelligent information collection platforms and risk control systems can be established, integrating data-driven insights into every aspect of SCF services. Big data technology enhances the ability of financial institutions to attract clients within the supply chain, expanding the scope of financial services and addressing the financing challenges faced by SMEs. In traditional "1+N" models, client acquisition often depended on core enterprises, leading to inefficiencies and high costs. With big data, financial institutions can now actively identify and target companies in the supply chain with specific financial needs by analyzing various data streams such as cash flows and transaction records. This shift allows for more precise and targeted marketing, increasing customer acquisition and penetration rates.

Furthermore, big data simplifies the traditionally time-consuming and labor-intensive process of credit evaluation and approval. Advanced analytics help mitigate information asymmetry, enabling financial institutions to better assess credit risks. By continuously monitoring and analyzing diverse data sources in real-time, financial institutions gain a comprehensive view of the supply chain, which enhances the timeliness and accuracy of risk assessments [8]. Big data enables the consideration of both a company's financial performance and its supply chain relationships and operations. This approach not only reduces the cost of credit evaluation but also improves the efficiency of credit issuance [9]. Customer segmentation driven by big data allows financial institutions to offer more competitive SCF loan packages to lower-risk clients [10]. Through comprehensive analysis of the transaction behaviors of these selected enterprises, financial institutions can deepen their understanding of client needs and customize financial products and services accordingly. Real-time data analysis further enables institutions to fully grasp the financing requirements of enterprises, providing them with flexible, personalized financial solutions. Additionally, big data facilitates the creation of real-time risk assessment models, allowing for more thorough post-loan asset quality evaluations, reduced risk management costs, and timely adjustments to financial services and risk management strategies.

Big data also drives the full digitalization of financial services, lowering service costs and improving operational efficiency. For companies involved in SCF, big data enables the real-time capture, sharing, and analysis of information. This capability allows for better decision-making and faster loan processing, ultimately enhancing the effectiveness of SCF.

3. Introduction

The Case of JD’s SCF

As SCF and internet finance have evolved, various market players have actively engaged in developing supply chain financial technologies. The "e-commerce platform + supply chain finance"

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model has also emerged as a significant trend. E-commerce platforms, with their extensive user bases and vast transaction data, hold a crucial position within the supply chain. This advantage allows them to effectively address the information asymmetry challenges that have long plagued traditional SCF. Leveraging big data technology, e-commerce platforms can comprehensively integrate information from different segments of the supply chain, gaining deep insights into the financial needs of enterprises. This enables them to design tailored financial products and risk management strategies, thereby expanding financing channels for both upstream and downstream enterprises and improving overall financing efficiency. The e-commerce platform-centered model also capitalizes on the technological strengths these platforms have accumulated in big data and internet technologies.

In recent years, an increasing number of e-commerce companies have ventured into SCF. By obtaining microloan licenses and establishing small loan companies, they have gradually expanded their SCF operations. Initially, the "e-commerce platform + supply chain finance" model relied heavily on partnerships with banks, where the bank provided the primary source of funds. This traditional model is shown in Figure 1 [11]. However, as the model has matured, companies with sufficient capabilities have begun to operate similarly to commercial banks, using their capital to offer more flexible and convenient financial services. This shift has significantly enhanced the financing efficiency of enterprises within the supply chain. By adopting a self-operated model, these companies have also reduced the principal-agent problem, allowing supply chain information to be more effectively converted into value. This, in turn, reduces the risk and associated costs of capital [12].

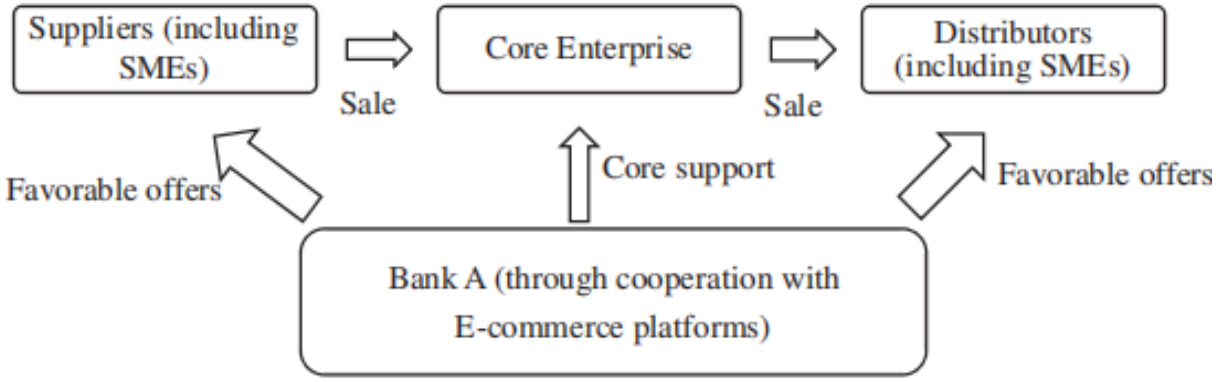

Figure 1: The online supply-chain financing where banks collaborate with e-commerce platforms [11].

As a leading enterprise in China's e-commerce platform sector, JingDong Group (JD) boasts advanced infrastructure and extensive experience in digital intelligence [13]. JD has leveraged its SCF model to provide efficient and convenient financing services to small and SMEs within its supply chain, progressively expanding the scope of these services to enhance the overall stability and liquidity of the supply chain. JD's application of supply chain financial technology serves as a successful example of the "e-commerce platform + SCF " model. JD's iterative process in relation to resource-based view and dynamic capabilities theory are shown in Fig. 2 [14].

In November 2012, JD signed a strategic cooperation agreement with the Bank of China Beijing Branch. This partnership aimed to offer financial services to JD's suppliers, using accounts receivable as collateral. It marked the beginning of JD's venture into SCF. Under this traditional bank-enterprise cooperation model, commercial banks often took the lead in SCF. The commercial banks helped SMEs within JD's supply chain secure financing, and accelerate cash flow turnover. This model overcame the challenges of low efficiency in traditional SCF, such as slow customer acquisition and lengthy credit evaluation processes. Building on its experience in cooperation, as well as JD's advantages in big data and its own logistics system, JD has deepened its involvement in SCF and begun independent explorations in this field.

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In 2013, JD Finance, one of JD Group's key divisions, was established, and it gradually introduced financing products like "JingBaoBei" and "JingXiaoDai." "JingBaoBei" provides JD's long-term suppliers with financing that can be completed within three minutes, becoming the industry's first product to complete risk control entirely online. JD assesses suppliers' financial data, logistics data, and other relevant information to approve and disburse loans within its system. This process is fully digitized and automated, significantly shortening service timelines. "JingXiaoDai" offers similar financing options but extends services to all suppliers and merchants within the JD ecosystem.

By 2015, after stabilizing its operations, JD further expanded its financial services portfolio with offerings such as "Movable Property Financing" and "Enterprise JinCai." "Movable Property Financing" allows JD customers to use their movable assets as collateral for financing. JD collaborates with warehousing companies to fully integrate JD's and the warehousing management system's end-to-end data, enabling dynamic evaluation of pledged goods and addressing the shortcomings of traditional movable property financing. "Enterprise JinCai" provides credit purchasing services, such as "business of money of buy or sell on credit" options and payment term management, enhancing procurement efficiency for enterprises.

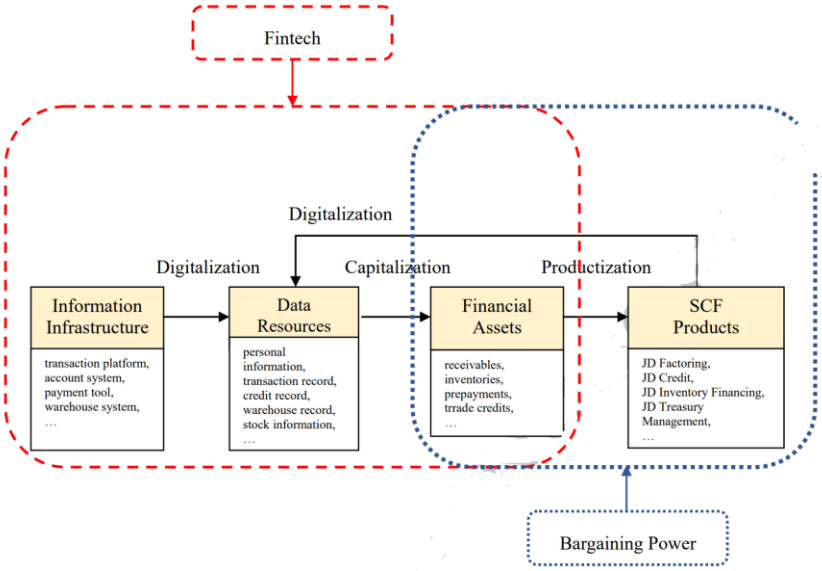

Figure 2: The iterative system of products and resources development [14].

4. Analysis

Big data has a profound impact on customer acquisition efficiency and risk management technologies in SCF. The success of JD's "e-commerce platform + supply chain finance" model is inextricably linked to its robust foundation in big data and advanced data technology. JD Finance has consistently prioritized its data capabilities, establishing the JD Big Data Division to focus on data research and operations. It has developed numerous proprietary big data technologies and made significant investments in the data sector. JD Finance has invested in several data companies, including Tianju Dihe (Suzhou) Technology Company Limited, ChinaScope, and Shanghai Chengshu Information Technology Company Limited, which span various areas such as data bank, data mining, and machine learning. In its early stages, JD's SCF operations relied on the strengths provided by its e-commerce platform, particularly in data support and technological empowerment. Through big data technology, JD tracked and managed logistics and information flows at every node in the supply chain, ensuring access to accurate and reliable data. JD Finance utilized the platform's transaction data to integrate and analyze financial and credit information from supply chain enterprises, continuously identifying

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and targeting customers. Leveraging big data, JD effectively helps financial service providers (FSPs) offer tailored financing schemes to SMEs and perform precise management [15]. This approach meets the financing needs of upstream and downstream enterprises and enables targeted marketing to different types of industrial clients. As a result, despite JD's late entry into SCF, it rapidly expanded its scale and significantly increased its visibility, broadening its financial services customer base.

JD was one of the first companies in China to apply big data technology and artificial intelligence at scale in financial risk control. Big data supports the acquisition and processing of large, multidimensional datasets, addressing the information asymmetry that traditionally exists between companies and financial institutions in SCF. This capability allows JD to identify potential risk factors more accurately and in a timelier manner, offering early warnings of risks that conventional analysis methods might miss [8]. JD employs dynamic risk control and credit strategies, establishing models for risk control, quantitative operations, user evaluation, and credit inquiry. In 2023, JD introduced the 3.0 Digital Intelligence Risk Control System for SCF, achieving millisecond-level approval times for individual transactions with an automation rate exceeding 95%. The integration of big data and artificial intelligence has enabled JD's SCF to realize fully online, standardized, and automated execution processes, enhancing JD's risk control capabilities while reducing costs.

However, the singular advantage of online channels soon faced challenges due to shifts in the Chinese e-commerce landscape, with the rise of new e-commerce platforms prompting JD to intensify its research and application of financial technology. JD solidified its core competitiveness by focusing on big data technology and technological output capabilities. JD stands out in the industry for its pioneering efforts to establish an integrated SCF framework that covers all essential transaction nodes within the supply chain, leveraging its sophisticated logistics infrastructure, which is difficult for other firms to replicate [14]. Over the years, JD has successfully built the JD SCF technology platform, connecting the industrial chain with financial institutions and centering on digital intelligence supply chains and SCF. Drawing on its extensive experience and expertise in big data within the SCF sector, JD has continually optimized its supply chain risk control systems, rapidly expanding its customer base to include local governments, enterprises, and financial institutions. JD's technology output supports core enterprises in achieving digital transformation, and the company is gradually evolving towards a model that encompasses a comprehensive digital internet ecosystem. This ecosystem enabled by the Internet is shown in Fig. 3 [11]. To date, JD SCF technology has served hundreds of core enterprises, helping major companies such as Anhui Gujing Distillery Company Limited, China National Offshore Oil Corporation, and Fawer Smarter Energy Technology Company Limited to enhance the financing capabilities of SMEs within their respective supply chains.

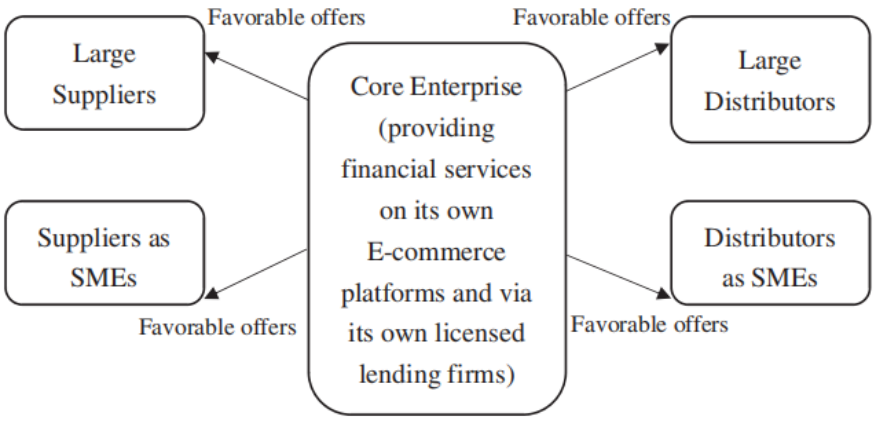

Figure 3: The ecosystem of online supply-chain financing facilitated by core enterprises [11].

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5. Suggestions and Implications

With the recovery of China's real economy, the demand for capital from small and SMEs is on the rise, making SCF an increasingly competitive market. The development of SCF depends on the optimization and innovation of key processes such as sales, product development, and risk management, as well as the integration of financial technology throughout these processes. High-quality SCF products and services are the core competitive advantage of financial institutions. To stay competitive, financial institutions must leverage financial technologies such as big data, blockchain, and artificial intelligence. By analyzing customer transaction habits and financial data, institutions can precisely target potential clients and continuously introduce innovative, personalized SCF solutions and product matrices. Additionally, promoting the continuous innovation and transformation of big data across various stages—research, production, sales, service, and logistics—will ultimately lead to the creation of a new enterprise supply chain system.

Risk management is a critical component of SCF services. SCF companies must establish standardized risk control procedures. This starts with strengthening internal management by providing specialized training and attracting external talent to enhance staff technical skills and information management capabilities. Effective post-loan management is essential to reducing operational risks. Moreover, by utilizing data monitoring and analysis technologies, companies can continuously optimize risk management models, improve risk prediction and identification capabilities, and reduce the costs associated with risk management.

The move towards platformization and digitalization remains a key trend in SCF development. Financial institutions should actively build SCF platforms and seek close collaboration with companies involved in logistics, warehousing, and other supply chain segments to enhance overall supply chain stability. As the SCF ecosystem and related research continue to evolve, the SCF framework must also adapt [16]. On existing SCF platforms, the introduction of multiple stakeholders, i.e., financial institutions, core enterprises, SMEs, and government entities, can help create a robust business ecosystem by linking multiple industrial chains. Through the sharing of platform information, the transparency of all processes can be improved, allowing for the automated and intelligent tracking of capital flows and all economic activities within the supply chain. This approach can also lead to the full automation and intelligent management of client credit processes, financing services, and risk monitoring procedures.

Currently, many SCF products are highly homogeneous and lack green loan options. Financial institutions can actively respond to green finance policies by establishing green SCF platforms. These platforms would enhance the monitoring and management of corporate green indicators, such as carbon emissions, and provide favorable financing conditions for sustainable development projects, offering SMEs customized green SCF services.

6. Limitations and Prospects

Although China's SCF has made significant strides, the exploration of financial technologies such as big data in this field remains in its early stages. In the initial phase of the FinTech revolution, implementing an adaptive regulatory framework can be beneficial in promoting its growth while mitigating potential systemic risks before they escalate beyond legal control [11]. However, the country still lacks comprehensive laws, regulations, and supportive policies to encourage the rapid development of big data in SCF. The application of big data technology by banks, financial institutions, and core enterprises remains superficial and limited, and the shift to online operations alone is insufficient to drive deeper transformations in SCF.

Establishing a fully functional SCF platform requires substantial investment in capital, time, and expertise. Beyond the initial development and launch of the platform, SCF companies must also take

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responsibility for ongoing operations and maintenance. The widespread use of emerging technologies significantly increases operational risks, leaving many companies overwhelmed by the demands of running an SCF platform. To overcome these challenges, companies should actively draw on the experiences of successful SCF products, enhance collaboration with government entities, e-commerce platforms, logistics companies, and warehousing firms, and increase investment in funding and technological development. Additionally, companies should seek external partnerships with research institutions and universities while internally improving their teams' technical capabilities, fully utilizing big data to inform decision-making and guide business strategies.

The availability of source data for many SMEs is often not promising, leading to potential discrepancies in service planning, credit evaluation, and risk management. The supply chain involves numerous stages, and the levels of digitalization and management vary significantly among different enterprises. For example, micro and small enterprises often lack standardized management practices and comprehensive online business processes, resulting in compromised data availability and authenticity. Furthermore, enterprises across various supply chain stages may be reluctant to disclose information, leading to incomplete and inconsistent data on the platform. In addition to the issue of information silos, there are significant data barriers between companies. Data monopolies persist in the market, with companies lacking the incentive to share data. More mature SCF companies, with their established technology and client bases, create further barriers to entry for newer firms, thereby reducing the overall utilization of big data.

Credit risk models (e.g., the Altman Z-score and the Merton model), have been adapted for SCF to evaluate the financial health and default risk of supply chain partners. While these models offer a quantitative approach to risk assessment, they are limited by their reliance on historical financial data, which may not accurately predict future risks in the dynamic supply chain environment [8]. To address these challenges, financial institutions need to enhance their big data capabilities and establish expert teams to maintain SCF platforms. Additionally, they must implement stricter client screening processes and conduct comprehensive, real-time monitoring of the supply chain post-lending to better mitigate systemic risks stemming from data quality issues.

Digital SCF relies heavily on robust big data technology, making information security a top priority. Given the numerous stages involved in SCF, any breach in information security could have widespread consequences across the entire supply chain, eroding the platform's trustworthiness among clients. The responsibility of protecting sensitive data primarily lies with the data collector, while data miners should focus on safeguarding sensitive mining results from untrusted parties [17]. Platforms must balance the need for comprehensive data collection with customer privacy, ensuring that data acquisition, integration, and analysis are conducted within legal bounds. Moreover, companies must be equipped to handle potential data breaches, malware attacks, and theft of funds. The lack of robust legal mechanisms to protect customer data security and privacy further hampers the application of big data in SCF.

7. Conclusion

To sum up, this study explores the significance of big data technology in enhancing connectivity, integration, and risk management within SCF. Through the analysis of JD's "e-commerce platform + supply chain finance" model, the research findings show that by integrating data from logistics, cash flow, and information flow, companies can achieve significant benefits. These include the reduction of financing costs, lowering of operational risks, and improvement in service quality. Additionally, the construction of digital SCF platforms fosters better optimization and collaboration across the entire supply chain. However, the application of big data in SCF still faces challenges related to regulation, data accessibility, and technological capabilities. Beyond addressing these challenges, providing customized and dynamic solutions for SCF services tailored to different industries and

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companies will be an important direction for future research. These results offer valuable insights into the role of big data in empowering SCF and provide practical recommendations for SCF companies to advance their digital transformation.

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