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Research on optimisation of e-commerce supply chain logistics management mode under blockchain technology

Suyao Guo

Liaoning University, Shenyang, Liaoning Province 110136, China

Abstract: The introduction of blockchain technology in e-commerce supply chain logistics management can effectively improve the operation effect. The problems existing in the current e-commerce supply chain logistics management mode are analysed on the basis of an overview of blockchain technology, and then the feasibility of e-commerce supply chain logistics management mode under blockchain technology is explored. The study concludes that: blockchain technology has distributed bookkeeping characteristics, which can effectively solve the problem of information asymmetry in the e-commerce supply chain, and the programmable contract in the blockchain can match all the information in the process of payment and transaction of e-commerce supply chain, identify the responsibility of the transaction, realise the traceability of the goods, and reduce the risk of the transaction. Based on the conclusion of the study, the countermeasures of using blockchain technology to improve e-commerce supply chain logistics, optimizing logistics management with the concept of "blockchain + Internet of Things", and solving the problems of the traditional management mode with "blockchain + supply chain" finance are proposed.

Keywords: Blockchain technology; e-commerce supply chain; logistics management; management model.

1. Introductory

Supply chain logistics is a higher form of logistics development to a certain stage, is the commodity in the "demand - production - supply" process of each entity's activities and their interrelationship with the dynamic changes in the network performance. Supply chain logistics in the traditional logistics functions such as transportation, warehousing, distribution and other functions, through the application of information technology, to achieve the supply chain of each link of efficient collaboration and optimal allocation of resources. The use of systematic, integrated approach to the supply chain of information flow, logistics and capital flow for comprehensive management to meet customer demand, enhance enterprise competitiveness [1].

In the context of globalisation, supply chain logistics is faced with a complex environment of cross-border and cross-region, which requires the coordination and integration of multiple modes of transport and multiple regulatory systems. Advanced information technology, management concepts and scientific planning methods to make the modern supply chain logistics system is becoming more and more mature, the Internet of Things, big data, artificial intelligence and other emerging technologies to significantly improve the supply chain logistics visualisation, intelligence level. E-commerce enterprises can use modern technology to grasp the inventory status, transport dynamics and market demand changes in real time, so as to respond quickly, improve operational efficiency and reduce operating costs.

2. Overview of blockchain technology

The constituent units in the blockchain involve one or more transactions, which can be de-sent strings through cryptographic hash functions, and the information transactions are packed into blocks using data encoding, and each block contains a timestamp, and the time server of the blockchain is shown in Figure 1 below:

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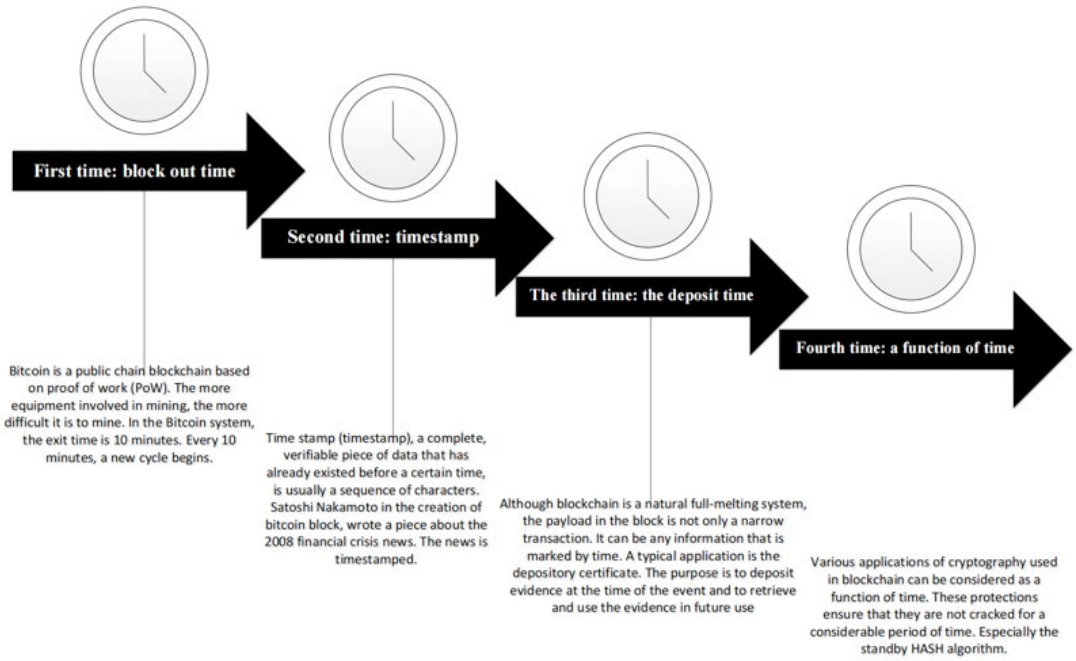

Figure 1. Time server for blockchain

In a blockchain system, every block generation and addition needs to be verified by a consensus mechanism. Common consensus mechanisms include Proof of Work (PoW), Proof of Stake (PoS), etc., which ensure the security and decentralised nature of the blockchain network. Through distributed ledger technology, blockchain achieves data transparency and non-tampering, all participating nodes have a complete copy of the ledger, and tampering by any node cannot escape verification and correction by other nodes. In supply chain management, blockchain can record the whole process of production, transport and delivery of products to ensure traceability and authenticity. It improves the credibility and transparency of data and reduces trust costs and transaction risks. In addition, smart contract is an important application of blockchain technology, which automatically enforces the terms of the contract through predefined programme codes, reducing human intervention and execution costs, and enhancing transaction efficiency and security. Smart contracts show a broad application prospect in financial services, legal contracts, copyright protection, and so on.

The classification of blockchain is shown in Figure 2 below:

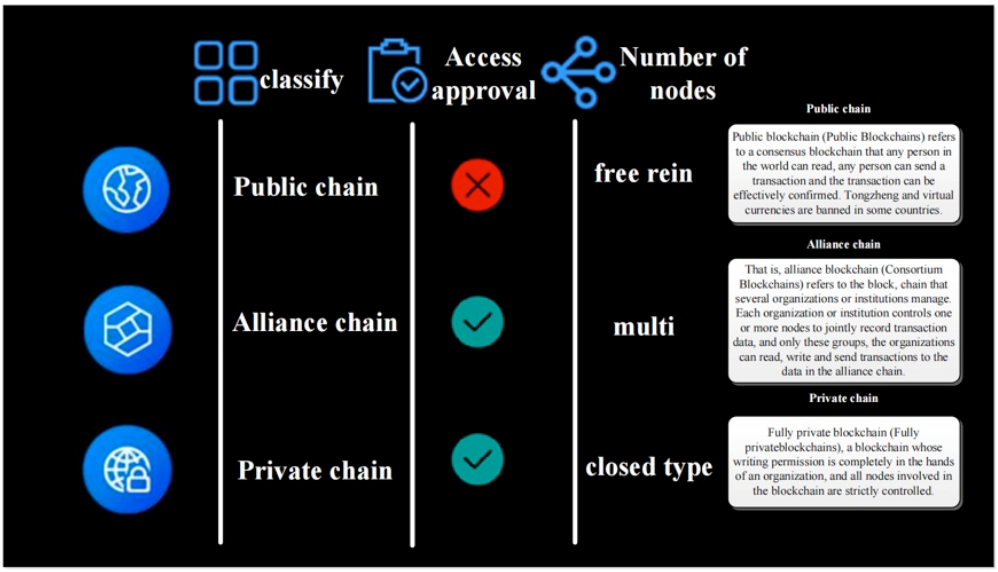

Figure 2 Classification of blockchain

In short, blockchain, as an innovative underlying technology, is reshaping traditional business models and industry ecology. With the continuous improvement of technology and the expansion of application scenarios, blockchain is expected to bring more far-reaching impact and value to various industries in the future.

3. Problems of e-commerce supply chain logistics management mode

3.1. Competitive market share gaming

Despite the rapid development of supply chain logistics, it is still at a disadvantage in the competition and intermingling with e-commerce platforms. Although traditional logistics enterprises endeavour to use information flow to serve the whole industrial chain and provide financing facilities for upstream and downstream customers through financial means, they are still deficient in integrating resources [2]. E-commerce platforms have obvious advantages in resource integration, data analysis and customer demand insight, making traditional logistics enterprises lag behind in response speed and service accuracy. E-commerce platforms try to grasp more control and expand to supply chain financial services by building their own logistics systems. However, this practice makes traditional logistics enterprises face pressure in competition. The self-built logistics of e-commerce platforms not only forms direct competition for traditional logistics enterprises, but also leads to further weakening of the voice of traditional logistics enterprises in the market.

Although logistics enterprises support online business through self-built or acquired network platforms, they still have difficulties in attracting and retaining customer traffic. E-commerce platforms are able to carry out marketing and user conversion more effectively through their huge user base and traffic advantages, while traditional logistics enterprises are relatively weak in this regard. In particular, there is a gap between logistics enterprises and e-commerce platforms in terms of information technology and service innovation. E-commerce platforms continue to improve user experience and service efficiency through technological innovation, while logistics enterprises are relatively lagging behind in the application of technology and service model innovation, making it difficult to meet the changing market demand.

In recent years, both e-commerce platforms and logistics enterprises have been actively developing supply chain financial services to provide value-added services and increase customer stickiness. However, e-commerce platforms are more likely to occupy a favourable position in the field of supply chain finance by virtue of their strong data analysis capabilities and user base, while traditional logistics enterprises face greater competitive pressure in this regard. In the final analysis, the competition between e-commerce platforms and logistics enterprises is the competition for market share. E-commerce platforms are rapidly expanding their markets through comprehensive services and a strong user base, while logistics companies are trying to gain more market share by improving their service quality and technological capabilities. However, in this game, logistics enterprises are often at a disadvantage and need to make more efforts in strategy and resource allocation to maintain competitiveness.

3.2. Differences in the scale of supply chain logistics operations

Supply chain logistics enterprises have been involved in the trading platform business, but the differences in business scale among enterprises have led to different challenges in entering online trading platforms. Logistics enterprises with larger market shares have certain advantages in developing online business, but smaller enterprises may be at a disadvantage in terms of resource integration and market competitiveness. Although some supply chain logistics enterprises have a large market share and market recognition, which is an important foundation for their reverse development of online business, this recognition has not been fully translated into online business success. In the construction and operation of online trading platforms, the role of market recognition is limited, and enterprises need to rely more on technological innovation and service optimisation to gain competitive advantages. At present, the online trading platform of many supply chain logistics

enterprises mainly stays in the stage of 020 (online to offline), although it can combine the offline resources with the online platform, but due to the highly standardised characteristics of the trading varieties, the promotion of the offline business is very limited. This means that the online business has not been able to realise its full potential to drive the growth of the offline business, limiting the innovation and development of the overall business model [3].

Many of the companies involved in supply chain logistics come from traditional overcapacity industries, and the performance growth of these companies is not obvious. Although the capital market has shown high recognition for the new business model of "online + offline", the actual business growth is still facing difficulties. This model may be difficult to effectively improve the profitability of enterprises in practice, and cannot solve the structural problems faced by traditional industries. The capital market's recognition of the "online + offline" model has led to high expectations for supply chain logistics companies. However, these expectations are sometimes divorced from reality, leading companies to ignore the nature of their business and the problems in their actual operations in the pursuit of market recognition. The recognition of the capital market does not directly translate into business growth, but may bring certain market pressure and business risks. In the online trading platforms that supply chain logistics enterprises are involved in, the trading varieties are often highly standardised. Although a high degree of standardisation improves transaction efficiency in some respects, it also limits the diversity and flexibility of the platform and fails to meet the diversified needs of different customers, thus limiting the attractiveness of the platform and its ability to expand the market.

4. Feasibility of blockchain technology application in e-commerce supply chain logistics management mode

The supply chain model from the direct mode, converted to the franchise model, and the blockchain on the e-commerce supply chain to achieve logistics remodelling, remodelling process is shown in Figure 3 below:

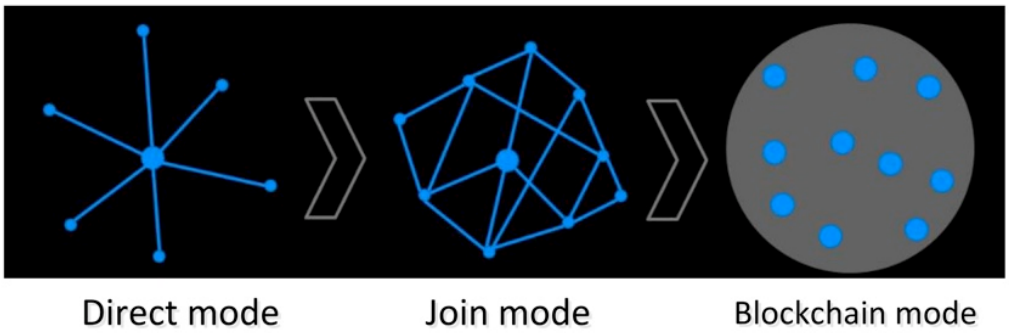

Figure 3. Blockchain's logistical reshaping of the e-commerce supply chain

4.1. Addressing information asymmetries

E-commerce supply chain logistics involves multiple subjects such as suppliers, manufacturers, intermediaries, retailers, logistics companies and customers, with a long management chain. Under the traditional model, information asymmetry is caused by the unwillingness or inability of certain subjects to share information in a timely manner, resulting in the formation of information silos [4]. Blockchain technology realises the openness and transparency of data through distributed ledgers, and all involved parties can access and verify logistics information in real time, thus eliminating information silos and promoting the comprehensive sharing of information.

4.2 Enhancing data credibility and transparency

Blockchain technology uses cryptographic hash functions and consensus mechanisms to ensure data tampering and transparency. The operation records of each link in the e-commerce supply chain can be tracked and verified, enhancing the credibility of the entire supply chain. Enterprises can grasp the

logistics status in real time, ensure transparent operation of the supply chain, and reduce misunderstandings and wrong decisions caused by information asymmetry. The non-tamperable nature of blockchain makes logistics tracking and product traceability more accurate and reliable. The entire process of each item from production to final delivery to customers can be recorded on blockchain, ensuring that every link can be traced, improving logistics management efficiency and enhancing customers' trust in product quality and origin.

4.3 Enhancing cross-system linkages and coordination

Insufficient interaction between different sub-systems in the e-commerce supply chain system leads to poor cross-system linkage coordination. Blockchain technology, through decentralisation, enables systems to seamlessly connect and share data, enhancing overall linkage efficiency. Each participant can record and view information on the same platform to avoid working separately and enhance the collaborative ability of the supply chain. Through the application of blockchain technology, the use of automatic recording and verification of transactions reduces the need for manual auditing, reduces the risk of human error, improves the efficiency and accuracy of supply chain operations, reduces the operating costs of intermediate links, and improves the overall efficiency of the supply chain.

4.4 Optimising supply chain financial services

The application of blockchain technology in e-commerce supply chain financial services can automatically execute financing and payment terms through smart contracts, reduce human intervention, and improve efficiency and security. Each subject in the e-commerce supply chain can carry out credit assessment and financing operations through the blockchain platform, reduce financing costs, enhance capital liquidity, and promote the healthy development of the supply chain.

5. Optimisation path of e-commerce supply chain logistics management mode under blockchain technology

5.1 Improving e-commerce supply chain logistics using blockchain technology

Through blockchain technology, a transparent e-commerce supply chain management system is constructed to record the data of every link in the supply chain on the blockchain. All participants, including suppliers, manufacturers, logistics companies and consumers, can access this data and learn about the production, transport and inventory of goods in real time. The transparent mechanism prevents information tampering and data loss and ensures that every step of the supply chain operation is traceable. Each participant can use a unified standard to record and transmit data, ensuring compatibility and collaborative work between different systems [4]. The commodity traceability blockchain platform is shown in Figure 4 below:

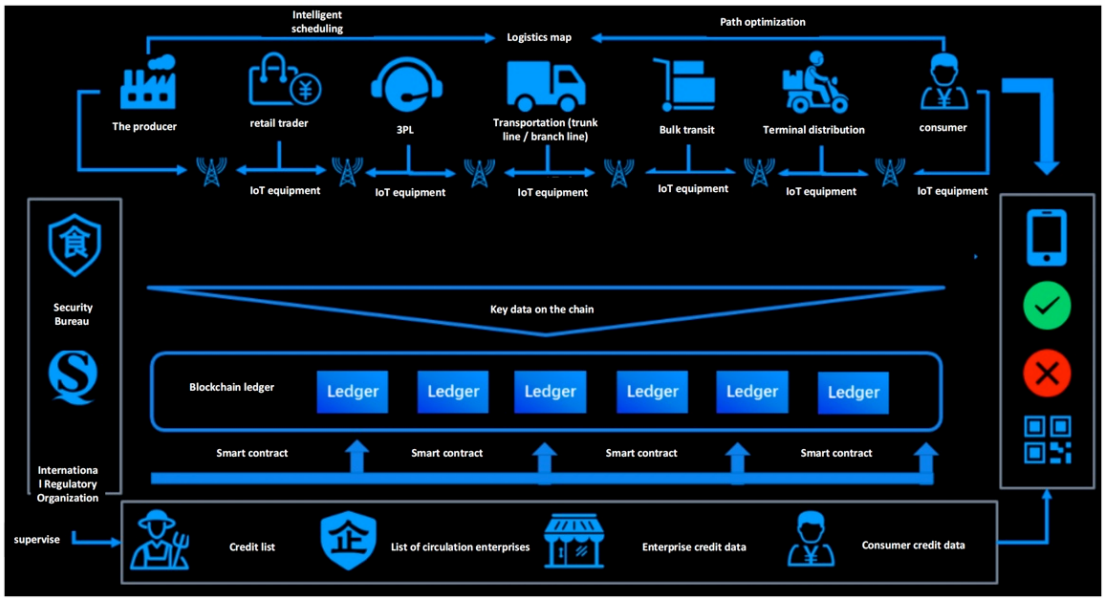

Figure 4 Commodity traceability blockchain platform

Blockchain technology allows nodes in the supply chain to share data in real time. Through the distributed ledger, all parties update and view the dynamic information of the supply chain in real time to understand the inventory status, transport progress and order fulfilment, reducing information asymmetry and improving the responsiveness and coordination of the supply chain. Using the smart contract function of blockchain, key operations in the supply chain are automatically executed. Through encryption and decentralisation mechanisms, it improves data security and privacy protection, encrypting and preserving and other sensitive data in the e-commerce supply chain, which can only be accessed and decrypted by authorised parties, thus preventing data leakage and tampering.

5.2 Optimising e-commerce supply chain logistics with "blockchain + internet of things" in depth

With the development of the Internet of Things (IoT), the connection between blockchain and IoT is getting closer and closer. Business flow, logistics, capital flow and information flow as the main components of the e-commerce supply chain, IoT is able to realise the four streams in one using blockchain technology.

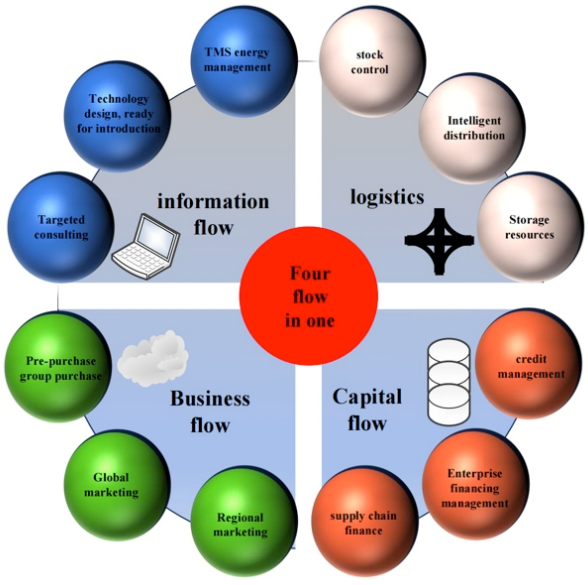

Figure 5: Structure of the four streams based on blockchain + IoT

The four-stream unity theory is introduced in e-commerce supply chain logistics to improve the participation of upstream and downstream enterprises and achieve unified management. The integration between blockchain and e-commerce logistics under the concept of four-stream unity is shown in the figure below:

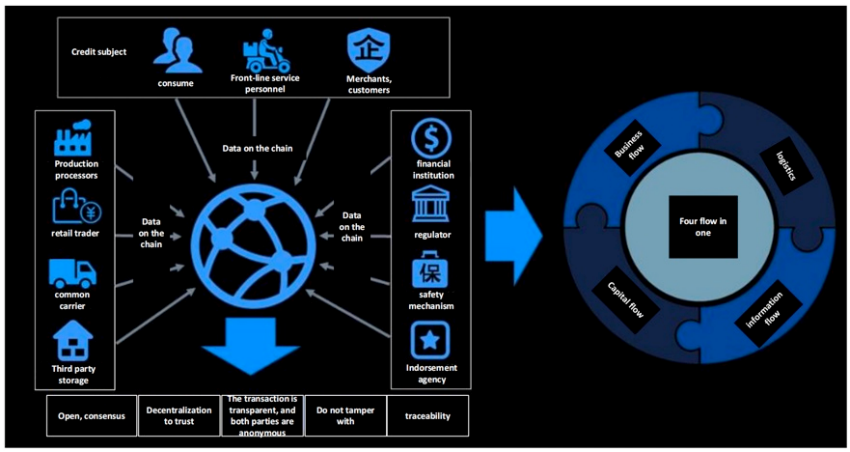

Figure 6 Convergence between blockchain and e-commerce logistics

Install IoT tags on each product and use the product traceability function of the blockchain to record its whole process data from production to delivery. By installing IoT devices, such as sensors and RFID tags, at key nodes of the e-commerce supply chain, real-time logistics data is collected and transmitted to the blockchain using IoT, so that all participants can view the status of the entire logistics process in real time, ensuring the safety and quality of goods in transit. Automated logistics operations are realised through the combination of blockchain and IoT. When the sensors detect that the goods have reached their destination, the blockchain smart contract automatically triggers the confirmation of receipt and payment and settlement, reducing manual intervention and operational errors. Automatically adjust transport routes and scheduling plans based on real-time data to optimise logistics efficiency.

Introduce IoT devices to monitor the inventory in the warehouse in real time and upload the data to the blockchain to achieve dynamic management of inventory. Through the blockchain, all parties can know the inventory status in real time to avoid the problem of overstocking or shortage. Smart contracts automatically generate replenishment orders based on inventory data to ensure the continuity and stability of the supply chain.

5.3 Continuous Improvement of E-commerce Supply Chain Logistics with Blockchain + Supply Chain Finance

The purpose of finance is to serve the entity and industry, the new financial technology should be empowered to create value in finance, and blockchain needs to seek a fit with the real economy of financial services. "Blockchain + supply chain finance" will have a broader market space and development prospects in the e-commerce supply chain. Transaction and credit data in the supply chain are recorded through blockchain to establish a transparent and credible credit assessment system. Financial institutions can assess the credit status of enterprises by analysing the data on the blockchain, make quick decisions on whether to provide financing services, reduce the time and cost of credit assessment, and improve the efficiency of financing. The application scenarios of "blockchain + supply chain finance" are shown in the figure below:

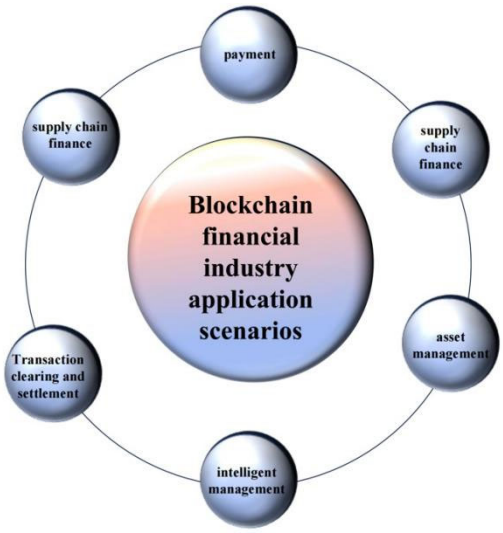

Figure 7 Application Scenarios of Blockchain+Supply Chain Finance

According to the above figure, it can be seen that the blockchain platform can provide e-commerce enterprises with diversified supply chain financial products, such as accounts receivable financing, order financing and inventory financing. E-commerce enterprises can choose suitable financing products according to their needs and quickly obtain funds through the blockchain platform. Financial institutions are analysing the data on the blockchain to customise personalised financing solutions to meet the funding needs of different enterprises. The introduction of blockchain technology realises the rapid flow and settlement of funds. Parties in the supply chain can make direct payments and settlements through the blockchain platform, reducing intermediate links and time costs. When abnormalities occur in the operating conditions of the enterprise, the data on the blockchain can react in real time, and financial institutions can take rapid measures to reduce risk exposure.

6. Concluding remarks

The introduction of blockchain technology has brought about a profound change in the e-commerce supply chain logistics management model. Through its distributed ledger, non-tamperable and transparent characteristics, blockchain can effectively solve the problem of information asymmetry and lack of trust in the traditional supply chain, and improve the transparency and security of data. In addition, combined with the Internet of Things (IoT) technology, it realises real-time monitoring and automated operation of the whole process of logistics, and improves the response speed and efficiency of the supply chain. Further combined with supply chain finance, blockchain can simplify the financing process, optimise credit assessment and risk management, and enhance the liquidity and stability of supply chain funds.

Overall, the application of blockchain technology in e-commerce supply chain logistics management not only improves the operational efficiency and reliability of the supply chain, but also promotes the development of supply chain management in the direction of intelligence, refinement and transparency. With the continuous development of technology and the depth of application, blockchain is expected to further expand its application scope in supply chain management in the future, helping e-commerce supply chain to achieve a higher level of management optimisation and value creation. E-commerce enterprises should actively explore and make use of blockchain technology to seize the opportunity of digital transformation, build a more efficient, transparent and secure supply chain logistics system, and enhance market competitiveness and customer satisfaction.

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