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Supply Chain Resources and Economic Security Based on Artificial Intelligence and Blockchain Multi-Channel Technology

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ABSTRACT

With the rapid growth of social economy and the improvement of people's living standards, the logistics industry not only shows a trend of rapid development, but also faces various business risks. Therefore, supply chain management becomes particularly important. Strengthening supply chain management has become a general trend. The traditional cost-oriented supply chain management model has been unable to meet the requirements of modern enterprise development. Given that the changes in customer demand, production, and sales have not been considered, enterprise resources are easily wasted. How to build a new supply chain model driven by value and customer demand has become one of the problems that large enterprises must solve. The combination of artificial intelligence (AI) and blockchain technology (BT) can realize information sharing, risk sharing, data interaction, and other functions. Through smart contracts, the division of responsibilities among all roles in the supply chain is controlled, which makes the supply chain safer and more efficient. In this paper, the authors designed a new supply chain financial system model that can effectively reduce financial risks, improved the efficiency of capital use, and enhanced the competitiveness of enterprises. The authors compared the traditional supply chain management mode with the management mode under the combination of AI and BT. The supply chain resource and economic security management based on AI and blockchain multichannel technology was more efficient, the system security index was higher, and the internal employee satisfaction of the enterprise also increased by 5.98%. The simulation application system for the internet of things and edge computing has the characteristics of high real-time and scalability. By analyzing the differences between the internet of things and edge computing technologies in terms of device perception, communication mode, data processing, and processing performance, product manufacturing efficiency can be improved to a certain extent.

KEYWORDS

Artificial Intelligence, Edge Computing, Internet of Things, Multichannel Technology, Supply Chain Security

INTRODUCTION

As a new risk control theory, supply chain security has attracted the attention of an increasing number of enterprises. Its core is supply chain management, including supplier selection, partnership design, logistics services, and other links. To a large extent, it determines the distribution of interests

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among the main bodies in the supply chain and ultimately affects the overall performance of the entire supply chain, which may bring greater resource waste and economic losses (Hu et al., 2021). Only by establishing an efficient and stable supply chain can the production and operation activities be performed smoothly and orderly. Therefore, enterprises must strengthen the construction and improvement of their own supply chain system (Li & Zhang, 2021). A complete, reasonable, and effective supply chain system is the key to ensure that enterprises can obtain competitive advantages, enhance comprehensive competitiveness, and promote the healthy and steady development of the industry (He, 2021).

Supply chain resources and economic security are important guarantees for the development of modern enterprises, which many scholars have studied. Vlasov et al. (2020) established a mathematical model for the supply chain planning of business and economic security to evaluate the feasibility of production and determine the best value of capital, thereby increasing the profitability of enterprises. This model systematically improves the traditional risk decision-making theory and solves the problem of insufficient investment caused by limited resources, to a certain extent. Markina (2018) integrated the three concepts of social security, financial security, and food supply chain and proposed a multiobjective fuzzy comprehensive evaluation model based on system dynamics. According to the quantitative assessment of enterprise environmental risk based on economic behavior, Markina determined the importance of each indicator in different industries. This approach can preliminarily solve the financing problem of small and medium-sized enterprises and provide more accurate decision-making information for decision-makers, thereby promoting enterprises to improve their financial management. Kolesnikov (2020) studied the relationship between supply chain and enterprises from the perspective of agricultural exports. Through the analysis of the factors that affect the stability and efficiency of the supply chain in the production process of agricultural products, Kolesnikov constructed the supply chain collaborative operation model based on the network effect to optimize the resource allocation under the environment of asymmetric information. Martin et al.(2021) defined the trust system as a key tool for supply chain security assessment. In the supply chain environment, they established a security risk evaluation system based on trust mechanism and model, which can conduct the overall analysis and measurement of the entire supply chain. Bechtsis et al. (2022) proposed a framework containing challenges, gaps in literature and practice, and opportunities in supply chain management research. This framework emphasizes the demand for data-driven digital technology and realizes data collection and management, secure storage, and effective data processing. The model can also achieve supply chain security, cost competitive resilience, and terminal-to-terminal business sustainability. On the basis of the supply chain management and financial solutions of industrial enterprises participating in network architecture holding, Ryabchuk (2020) improved the efficiency of supply chain management and reduced operating costs through digital transformation. Supply chain security management is one of the most basic contents of supply chain strategy formulation, risk management, and control, which is also the key to ensure sustainable and healthy supply chain operation, meet customer requirements, and safeguard their own interests.

The application of artificial intelligence (AI) and blockchain technology (BT) in the field of supply chain finance has been the focus of attention and discussion in the academic community. Swanson and Suzuki (2020) described the new face of supply chain destruction during an epidemic, which caused extraordinary damage to the world economy. Retail sales fell at a record rate, and the unemployment rate rose rapidly. Global supply chain management was hit hard, affecting people's daily consumption activities and workplaces, to some extent. Hassija (2020) discussed the key application fields of supply chain security, introduced the security problems in the existing supply chain architecture in detail, and revealed the growing demand and application trend of the industry for emerging technologies. Shamsi (2019) conducted intellectual property protection and supply chain security management through logic confusion. He solved the transaction problems between enterprises and upstream and downstream partners, such as suppliers and retailers, and helped enterprises realize the digitalization of the whole process from the source to the terminal. Zalozhnev and Peremezhko (2022) optimized the supply chain of service operation in the implementation and maintenance phase of large Internet technology projects. They calculated the parameters of multichannel queuing model using mathematical models, which can be convenient for estimating the average time of maintenance and support work before the investment phase. Seyedghorban (2020) combined quantitative and qualitative technologies, proposed the supply chain management and supply chain agility realization path based on data science support, and realized humanized manufacturing and omni-channel experience through digital manufacturing strategy. The author comprehensively monitored, decided, and controlled the whole supply chain. Wen et al. (2020) analyzed the optimal decision making and system equilibrium results of retailers and self-logistics electronic platforms under different circumstances. They also collected and shared global information of the whole industry in the competition model of multichannel supply chain. As two core elements of the digital supply chain solution, AI and BT can improve the overall operation efficiency of the supply chain and bring customers a convenient, intelligent, and visual shopping experience.

Supply chain resources and economy are inseparable. Small and medium-sized enterprises often face financial and technical difficulties in the process of enterprise development due to their own conditions (Wang, 2021). As advanced information technologies, AI and blockchain multichannel technology can achieve low-cost and high-efficiency information transmission and help enterprises better adapt to the market environment. In this research, the authors analyzed the supply chain resources and economic security management based on AI and blockchain multichannel technology, providing reference for enterprises to solve practical problems.

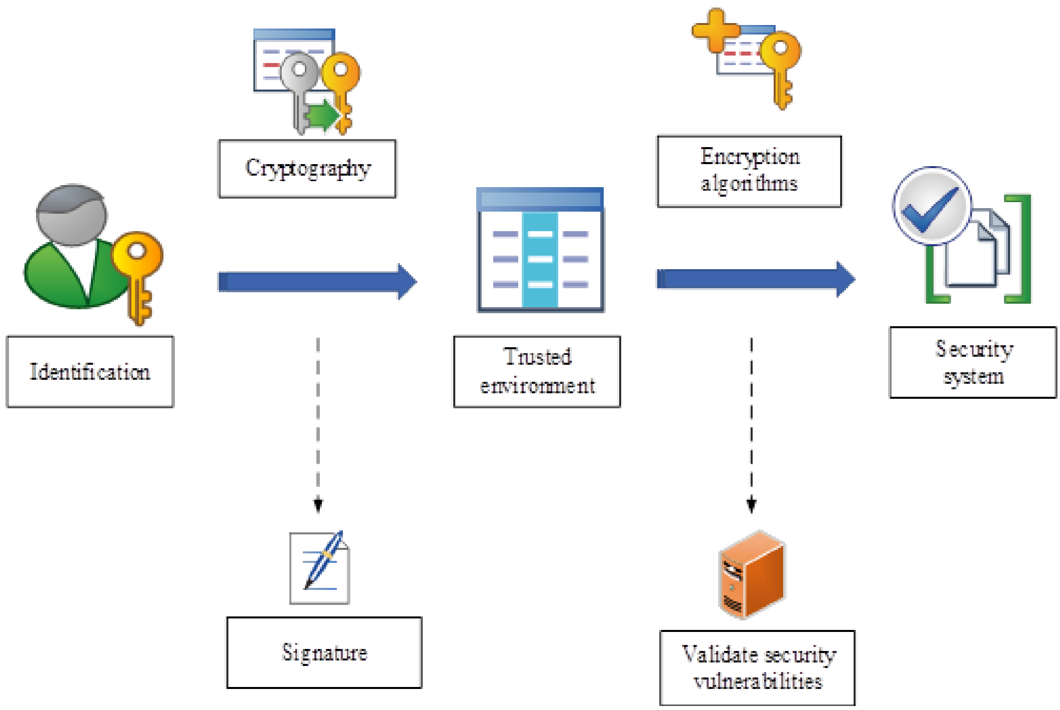
SUPPLY CHAIN RESOURCES AND ECONOMIC SECURITY

Artificial Intelligence and Blockchain Multichannel Technology Principle

AI is a new emerging technology and has broad prospects for development (Zhou et al., 2018). With the accelerating process of global economic integration, trade between enterprises has become increasingly frequent, which raises people's demand for Internet finance day by day. In the Internet era, BT is a new concept of network trust mechanism (Yang et al., 2021). It connects all the people involved in the transaction to ensure that the information cannot be tampered with or lost. At the same time, as a new decentralized ledger form, BT can solve many problems in the traditional bookkeeping mode. Multichannel technology can solve the problems in traditional accounting systems and improve the efficiency of capital flow, thereby providing more possibilities for smart contracts. Figure 1 presents the specific technical principles.

First, multiple identity authentication technology can be used to build a trusted environment, in which all participants can conduct transactions. Cryptographic methods can prove that the signatures of all people in this trusted environment are unforgeable. Such methods ensure that each participant has their own real identity and password to settle transactions with others through the network, which can guarantee the authenticity and security of information. Finally, an encryption algorithm is used to verify whether the trusted environment has security vulnerabilities, which ensures that the security system cannot be damaged by malicious attacks and prevents fraud from causing losses to transaction data. BT has a wide range of application scenarios, mainly including supply chain finance, Internet of things payment, smart contract services, and digital asset trading platforms. In these areas, data collection and transmission can be involved, which is difficult for traditional financial businesses to achieve. As a new generation of decentralized accounting system, distributed ledger can provide users with more efficient and convenient data processing services, solve the problem of cross-regional capital flow among enterprises, and improve market competitiveness. The integration of AI and BT has been a general trend. The fusion of the two can effectively improve data security and effectiveness. For example, in the field of Internet finance, business transaction settlement can be achieved through smart contracts to reduce operating costs and improve service efficiency.

Figure 1. Principle of AI and blockchain multichannel technology

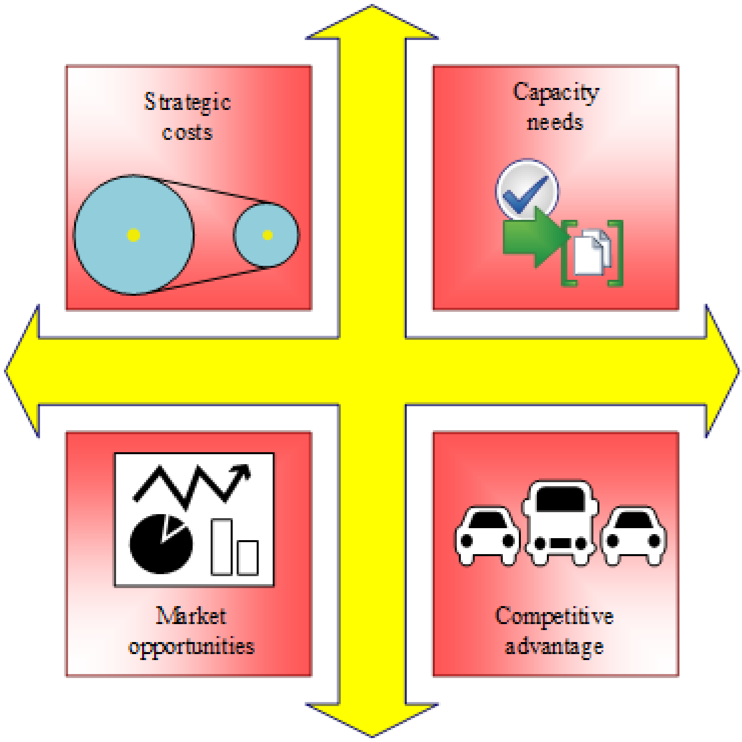


Supply Chain Risk Indicator System

With the continuous progress of economic integration, the financial environment is becoming increasingly complex (Miller & Engemann, 2019). Various trade frictions emerge one after another, and supply chain resources and economic security are facing unprecedented challenges. Especially in the context of the current worldwide financial crisis, enterprises need to pay more attention to the overall quality and value improvement of the supply chain to reduce losses and avoid operational risks. For the supply chain, its internal links are highly dynamic. Without a good operating mechanism and an effective organizational structure, ensuring the smooth implementation of supply chain objectives is a challenge. Many factors affect the implementation of the supply chain, mainly including enterprise scale, cost control, and efficiency; at the same time, supply chain risks are not only limited to internal factors, but external factors may also cause certain risks (Liu et al., 2021). Therefore, strengthening the construction and improvement of the supply chain and building a good supply chain operation mechanism are urgent needs. Figure 2 shows the supply chain resource and economic security risk indicator system.

The supply chain resource and economic security risk index system includes four dimensions, namely, strategic cost, capacity demand, market opportunity, and competitive advantage. Strategic cost is the basis of supply chain operation, which can be divided into two aspects, namely internal and external environment changes. The internal environment is mainly reflected in the influences of business objectives, development direction, management ideas, and other factors on the supply chain operation (Hwang et al., 2021). The internal environment determines the organizational structure and resource allocation of the supply chain. External factors are mainly reflected in the activities and related behaviors of suppliers, customers, government agencies, and third-party logistics companies, which affect the cooperation among all parties in the supply chain. Capacity demand is a highly important resource in the supply chain operation process, which can generally reflect the demand of supply chain participants for specific products or services, as well as their supply quantity and quality. It involves many links, such as research and development and

Figure 2. Supply chain risk indicator system



design of products and services, production and manufacturing, logistics system, and marketing network construction. Market opportunity refers to the market demand stage of supply chain members; it is usually determined by the development of their industry, including potential competitor threats, policy change risks, and new technology revolution. Market opportunity also directly determines whether the supply chain is likely to become an enterprise with certain attraction and strength. Competitive advantage refers to the degree to which cost minimization, efficiency maximization, and revenue maximization are achieved through efforts. The competitive advantage of enterprises is mainly reflected in the overall scale of the supply chain. Only by cooperating with one another and actively using information technology to improve operational efficiency can risks be reduced and the enterprises' own interests be guaranteed, thereby reducing the supply chain operating costs. Interdependence exists between nodes in the supply chain. If a certain type of supply chain cannot meet the requirements of the whole supply chain, then local bottlenecks may occur. These hindrances may lead to the failure of the overall function or part of the function of the supply chain, which will result in the failure of the supply chain. Therefore, the core determination of the supply chain must be improved to obtain higher competitiveness.

Supply Chain Resources and Economic Security Based on Artificial Intelligence and Blockchain Technology

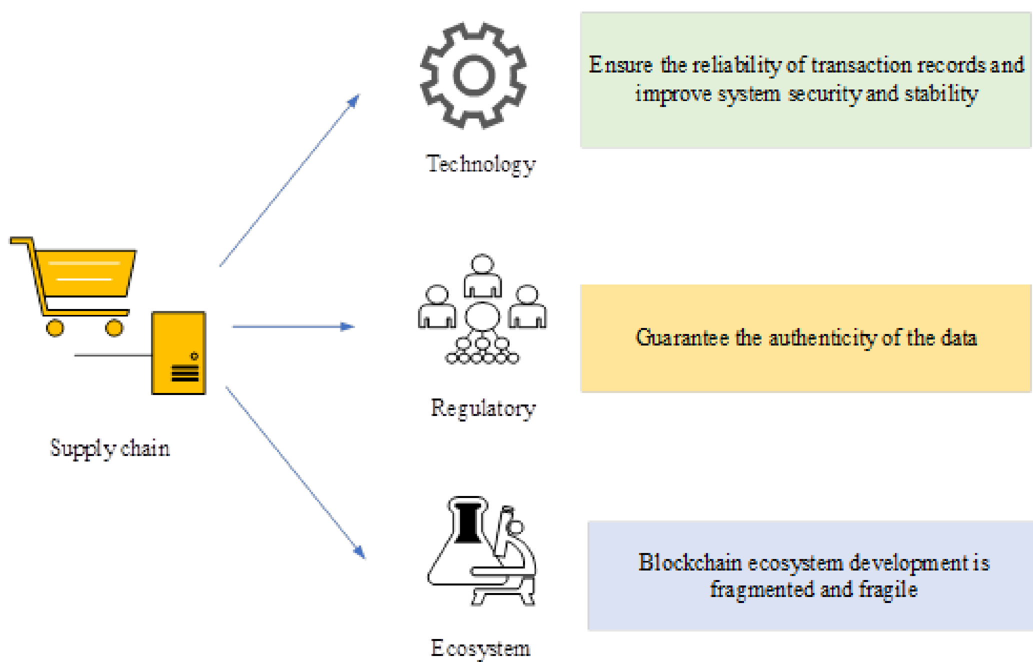
Blockchain is decentralized and tamper-proof; thus, it can effectively solve the problems of complex payment and settlement processes and management, difficult tracking of transaction records, and high security risks in the financial industry. At the same time, blockchain is a distributed network storage and trust mechanism based on the cryptography principle for achieving data encryption. Consensus algorithm can guarantee information to be tamper-proof, traceable and system operation to be stable. With the development and application scope of BT, blockchain has become the focus of social attention. An increasing number of financial institutions have begun to explore innovative models and solutions in the field of financial services. At present, such methods are widely used in digital payment, supply chain management, bill trading, and other fields worldwide. Figure 3 shows the role of AI and BT in the management of supply chain resources and economic security.

First, on the technical level, the asymmetric encryption algorithm in BT can ensure the reliability of transaction records. The multichannel technology can transmit data to multiple terminals simultaneously. Even one server can transmit data, which is considerably helpful for improving the security and stability of the entire system. Second, at the regulatory level, the decentralization of the blockchain is jointly maintained by all parties involved on an equal footing, which ensures data authenticity. Particularly, the characteristics of the regional blockchain in the financial field are tamper-proof and traceable, thereby offering higher requirements for information confidentiality, integrity, availability, and other aspects. At present, covering all aspects of this new technology is difficult for a single regulatory agency and system. Finally, the mature field of BT application at the ecosystem level is still digital currency, represented by Bitcoin. Its development and deployment lack standardized guidance. Moreover, the application, credibility, interoperability, and information security of related basic businesses have not formed a sound technical solution. This inadequacy can lead to the fragmentation and fragility of the blockchain ecosystem development and difficulty in supporting the normal operation of social and economic activities, which will restrict the development of the industry. Therefore, constructing a blockchain based on “smart+” ecosystem is urgently needed to meet the requirements of enterprise digital transformation and upgrading, which can promote the healthy development of the industry.

Application of Edge Computing in Supply Chain

In recent years, with the rapid development of the Internet of things, cloud computing, and other technologies, the traditional manufacturing industry has been facing the challenge of transformation and upgrading from the production mode of “people–machine–goods” to “machine–network–terminal–intelligence.” Enterprises urgently need to improve the automation level to meet the growing demand.

Figure 3. Role of AI and BT in supply chain resource and economic security management



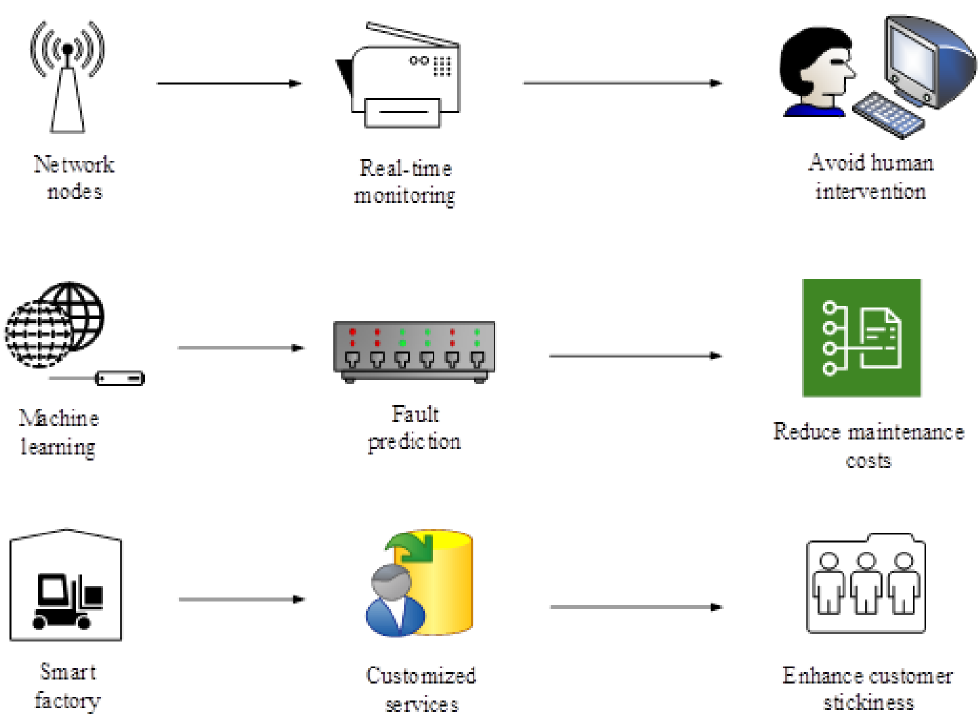
Edge computing has attracted considerable attention, and it has been widely used in industrial production due to its distributed processing capability, low latency, and high reliability. Improving manufacturing efficiency and quality through edge computing has become a practical requirement in industrial control (Jha, 2020). Figure 4 shows the specific application of edge computing in supply chain management.

First, monitoring the industrial production process based on real-time data collection of network nodes can effectively avoid human intervention and ensure product quality and safety (Smith, 2020). Second, the machine learning method is used to mine the equipment status information for fault prediction, which can reduce the maintenance cost and improve the profitability of enterprises. Finally, the construction of an intelligent factory management platform can realize intelligent decision making and control, provide customized services for users, and meet personalized needs, thereby enhancing customer stickiness. Industrial Internet technology based on the Internet of things can be divided into two levels: One is to obtain information about the on-site production environment through sensing, communication, and other means; the other is to achieve automatic operation and maintenance of the production line by controlling computers or other terminals. In practical applications, for industries with unstable supply chain resources and economic conditions (e.g., steel, chemical industry, electric power, coal, and nonferrous metals), edge computing technology can be used to conduct research and analysis. Key elements in different business links can be modeled and analyzed as object sets, and a complex system model can then be established to support the formulation of corresponding policies.

Supply Chain Security Modeling Based on Blockchain Bloom Filter Mining Algorithm

Smart contracts provide a scalable application platform for the blockchain on the basis of ensuring the security and stability of the system. Decentralized applications running on smart contracts can achieve safe and stable operation in a distrustful network environment. People have been paying

Figure 4. Edge computing in the supply chain



increasing attention to the considerable development potential of the high security of decentralized applications. The bloom filter mining algorithm is a distributed decentralized application framework based on BT. It can effectively solve the problems caused by the difficulty of traditional encryption technology to meet the high unforgeability and traceability of data. This algorithm can also greatly reduce the risk of information disclosure in the blockchain and improve transaction efficiency.

Set $A = \left\{a_1, a_2, a_3, \ldots a_N\right\}$ is defined, and each element in the set is a random variable. If any element a_i has $0 < i \leq N$, then the uniform distribution *P* of the elements is:

$$P\left\{a_i = j\right\} = \frac{1}{b} \tag{1}$$

Similarly, the following can be obtained:

$$P\left\{a_i \neq j\right\} = 1 - \frac{1}{b} \tag{2}$$

where *j* satisfies $0 \leq j \leq b - 1$, and *b* is the number of filter array elements.

Assuming there exists probability fraction W_i, then:

$$W_i = \begin{cases} 1 & a_i = j \\ 0 & a_i \neq j \end{cases} \tag{3}$$

In the mining process, the elements of *N* pseudorandom number sets should be calculated in turn to obtain a distribution result *H*, as follows:

$$H = \sum_{i=1}^{N} W_i \tag{4}$$

The success criterion of this model is that the sum of the element values of the first array and any of its array elements is equal to *S*, such that:

$$H_1 = \sum_{i=1}^{N} W_i = S_1 \tag{5}$$

$$H_2 = \sum_{i=1}^{N} W_i = S - S_1 \tag{6}$$

H_1 and H_2 satisfy a binomial distribution, representing the element value of the first array and the element value of any other array, respectively:

$$H_1, H_2 \sim B\left(N, \frac{1}{b}\right) \tag{7}$$

Then, the probability of the occurrence of H_2 under the condition that H_1 occurs is:

$$P\left\{H_2 = S_2 \middle| H_1 = S_1\right\} = C_{N-S_1}^{S_2}(\frac{1}{b})^{S_2}(\frac{1}{b})^{N-S_1-S_2} \tag{8}$$

Therefore, the probability of mining success is:

$$P\left\{H_1 + H_2 = S\right\} = \sum_{S_1=0}^{N} P\left\{H_1 + H_2 = S \middle| H_1 = S_1\right\} P\left\{H_1 = S_1\right\} \tag{9}$$

which can be simplified to the following:

$$P\left\{H_1 + H_2 = S\right\} = \sum_{S_1=0}^{N} S_1!(S - S_1)!(\frac{1}{b})^S(\frac{b-1}{b})^{2N-S-S_1} \tag{10}$$

According to the bloom filter mining algorithm, the information of the blockchain equipment can be encrypted, which has a good protection effect on supply chain resources and economic security.

COMPARATIVE EXPERIMENT OF SUPPLY CHAIN RESOURCES AND ECONOMIC SECURITY MANAGEMENT

Experimental Methods

The authors selected four factories from a manufacturing industry to conduct a questionnaire survey on enterprise supply chain security management. The researchers set the questions from the security index of resources, economic risks, technical means, and other aspects. Table 1 shows the results.

As Table 1 illustrates, among the four factories, the resource protection security of Factory 1 is relatively high, and its economic security risk is relatively low. Therefore, the development level and enterprise scale of the factory should be relatively high, which is conducive to its more comprehensive and in-depth management of the production system. Factory 2 adopts the traditional electronic data encryption method for supply chain security management, which has a certain confidentiality performance; however, its performance in resource security and economic risk is not as good as that of Factory 1, so it cannot effectively organize information leakage. Factory 3 uses information system and cloud computing technology to effectively improve the efficiency of enterprise risk control and management of the supply chain system; however, the security performance of its resource protection is average. Factory 4 uses the online detection system for real-time monitoring. It has strict requirements on the integrity, authenticity, and reliability of information resources, and it can meet the personalized customization of products or services, making the enterprise's decision making more scientific and reasonable. However, the enterprise's

Table 1. Survey results of enterprise supply chain resources and economic security management

Factories	Resources	Economy	Technical Means
Factory 1	High safety index	Low risk	AI and BT
Factory 2	Low safety index	Higher risk	Traditional electronic data encryption
Factory 3	Average	Low risk	Information systems and cloud computing
Factory 4	High safety index	Average	Online monitoring systems

economic management level is average, and it does not have a strong coping ability. In sum, the survey result of Factory 1 is the best, Factories 3 and 4 meet the requirements of general supply chain security management, and Factory 2 has the worst results.

According to the results of the questionnaire survey, Factories 1 and 2 have distinctive characteristics and are representative, to some extent. Therefore, the authors took Factories 1 and 2 as the research objects and selected 10 employees from each of the two factories. The employees in Factory 1 are named Group A, and those in Factory 2 are named Group B. Both groups of employees are engaged in the same type of work, and their working hours are similar. The authors established the comparative experiments in three aspects of safety and satisfaction and recorded and analyzed the experimental data.

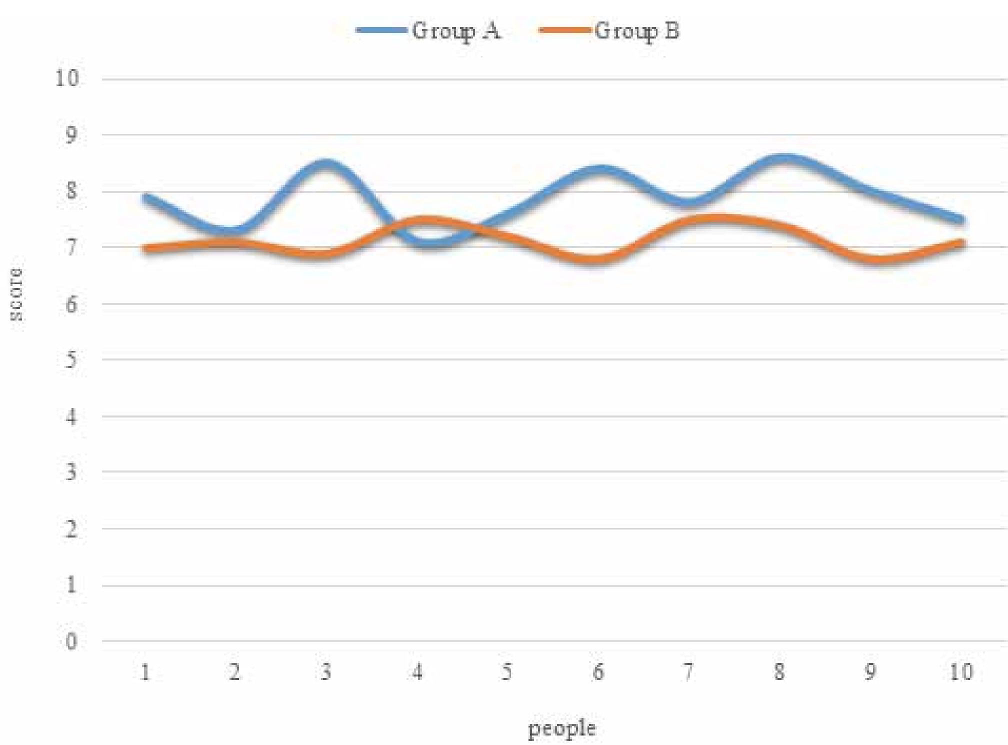
Data Analysis

Efficiency

The researchers asked the two groups to evaluate the efficiency of the enterprise's supply chain security management; they set the score to 1–10 (Figure 5).

As Figure 5 shows, the curve of Group B is distributed below Group A, indicating that Group A has higher scores and higher operation efficiency of supply chain management. However, from the perspective of details, the curve trend of Group B is flatter and more stable, indicating that employees have the same opinion on the efficiency of the enterprise's supply chain resources and economic security management. Conversely, the curve of Group A fluctuates greatly, indicating that the enterprise's supply chain management operation is more flexible and can better meet market changes and customer needs. Moreover, one employee in Group B has a higher score than that in Group A, showing that the supplier management system of Group A is still imperfect and can still be improved.

Figure 5. Comparison of the efficiency of supply chain security management between the two groups



Security

The authors asked the two groups to score the security of the enterprise's supply chain resources and economic management from three aspects: Supplier, production, and capital security. They set the score to 1–10 points. Figure 6 shows the results.

As Figure 6 shows, the data performance of Group A is better than that of Group B in the above three aspects, which indicates that Factory 1 has good supply chain management capabilities and has a certain positive role in cost control of the enterprise. In terms of supplier security, the difference between the two groups is the largest. Hence, Factory 2 should strengthen its security control over suppliers to ensure the overall operation quality of its supply chain. To sum up, the supply chain security management system based on AI and blockchain multichannel technology can effectively realize real-time monitoring and analysis of enterprise production planning, inventory, procurement, and other links, thereby providing decision support for managers. It can provide more perfect supply chain risk management scheme for enterprises to improve the level of supply chain management and reduce risks.

Satisfaction

The authors investigated the satisfaction of the two groups of employees; Figure 7 shows the results.

The satisfaction distribution of the two groups of employees in Figure 7 is quite different. The satisfaction of Group A is basically more than 95%, which is at a high level, as a whole, whereas the satisfaction of Group B hovers around 90%, which is far lower than that of Group A. The reason for this difference may be the company's poor internal management or external competition. Therefore, under the influence of AI and BT, the enterprise's internal management system may have undergone major changes, which can create a better working environment for employees. After calculation, the

Figure 6. Comparison of the security of the supply chain between the two groups

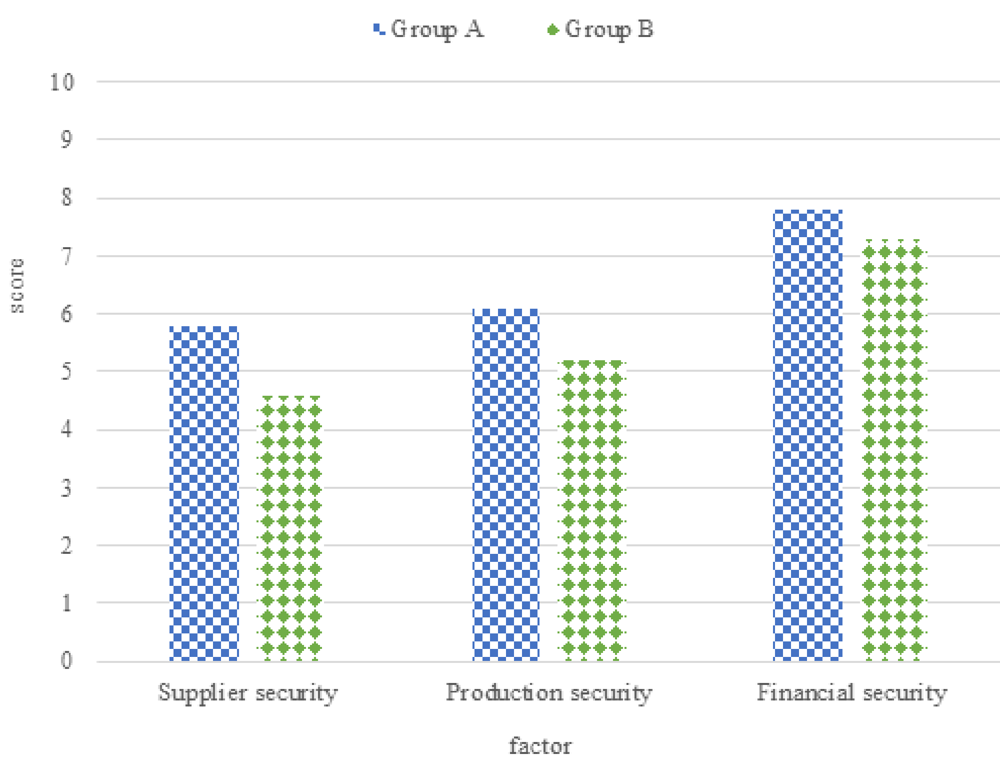
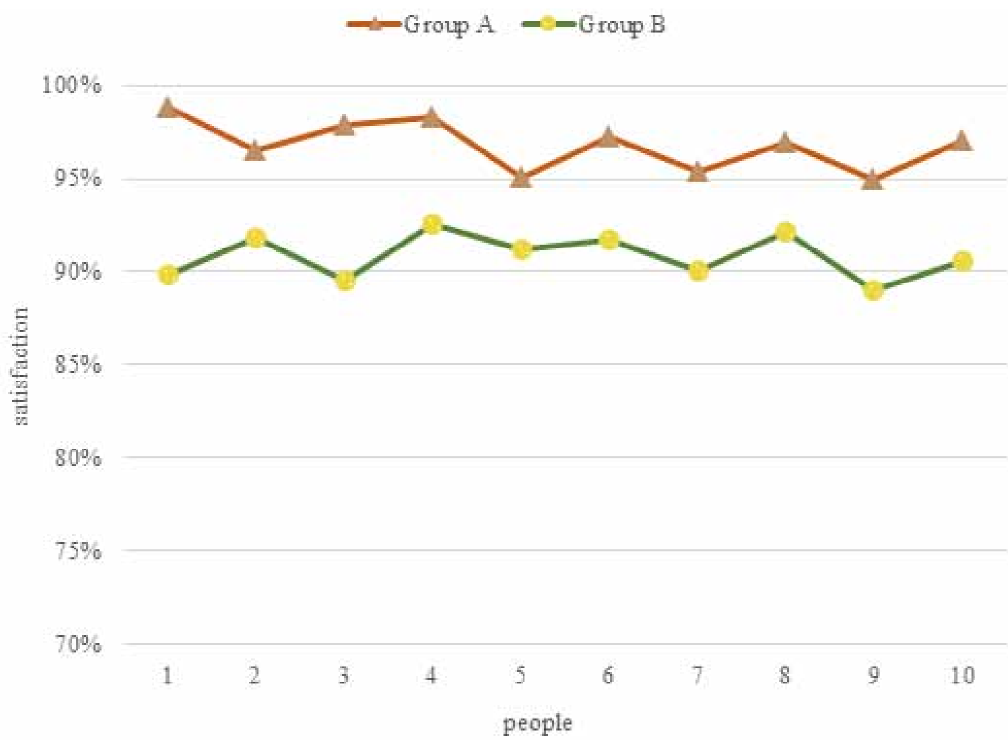


Figure 7. Comparison of satisfaction between the two groups



average satisfaction of Group A is about 96.81% and that of Group B is about 90.83%. Group A is about 5.98% higher than Group B. Therefore, in the AI era, how to effectively improve the work efficiency and achieve higher performance has become a problem that every enterprise must face.

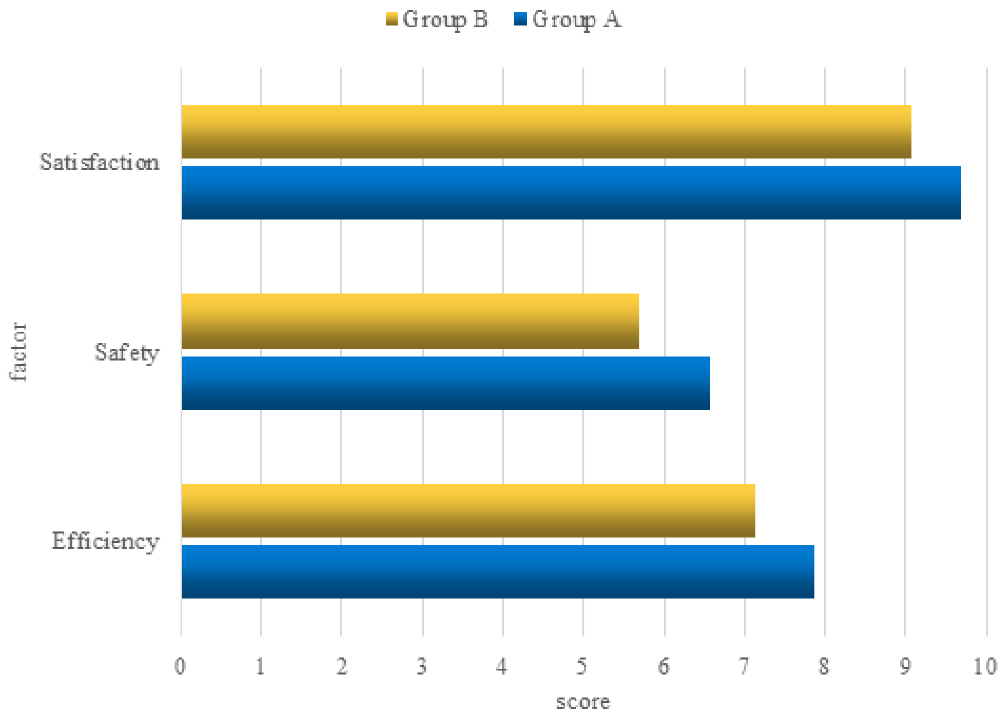
On the basis of the above three aspects, the authors compared the efficiency, security, and satisfaction of the supply chain management of the two factories. To facilitate the comparison, they converted the satisfaction data to a number within 10; the data in Group A is about 9.68, and those in Group B is about 9.08. Figure 8 presents the results.

As Figure 8 shows, in the above three aspects, the data performance of Group A is significantly better than that of Group B, with the largest difference in security. Therefore, AI and BT have a high application value in the supply chain financial management. Through real-time tracking and recording of transactions, funds, and assets in the core business process of the enterprise, the automatic processing of the entire business process can be completed, and the risk management early warning function can be realized, thereby providing customers with timely and effective financing services.

CONCLUSION

Supply chain is one of the most core links in finance, and its operation efficiency is closely related to capital cost and resource allocation. As the development direction of new technologies, AI and BT can help enterprises solve the problems existing in the traditional supply chain financial business model and promote the transformation and upgrading of supply chain financial services to refinement, diversification, and other aspects. In this paper, the authors initially reviewed the theory of supply chain management, and then analyzed the opportunities and challenges enterprises face under the supply chain environment, on this basis. Subsequently, the authors discussed the effective ways to improve the

Figure 8. Comparison of the overall effect of the supply chain between the two groups



level of supply chain security management from the aspects of establishing and improving the supply chain security management system, and strengthening supplier risk identification and evaluation. Finally, the authors discussed the establishment of a systematic supply chain management system to ensure the efficiency and security of enterprise operations, making it more suitable for the long-term development of enterprises. The edge computing of the Internet of things has rich application scenarios, which can provide powerful data transmission, data processing, and business collaboration services for the supply chain. It can be widely applied to all links of logistics transportation and capital, business, and information flows. At the same time, it is also the basis for efficient supply chain operation.

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REFERENCES

Bechtsis, D., Tsolakis, N., Iakovou, E., & Vlachos, D. (2022). Data-driven secure, resilient and sustainable supply chains: Gaps, opportunities, and a new generalised data sharing and data monetisation framework. *International Journal of Production Research*, *60*(14), 4397–4417. doi:10.1080/00207543.2021.1957506

Hassija, V., Chamola, V., Gupta, V., Jain, S., & Guizani, N. (2020). A survey on supply chain security: Application areas, security threats, and solution architectures. *IEEE Internet of Things Journal*, *8*(8), 6222–6246. doi:10.1109/JIOT.2020.3025775

He, G. (2021). Enterprise e-commerce marketing system based on big data methods of maintaining social relations in the process of e-commerce environmental commodity. *Journal of Organizational and End User Computing*, *33*(6), 1–16. doi:10.4018/JOEUC.20211101.oa16

Hu, F., Xi, X., & Zhang, Y. (2021). Influencing mechanism of reverse knowledge spillover on investment enterprises' technological progress: An empirical examination of Chinese firms. *Technological Forecasting and Social Change*, *169*, 120797. doi:10.1016/j.techfore.2021.120797

Hwang, Y., Kim, S., Rouibah, K., & Shin, D. (2021). The moderating effects of leader-member exchange for technology acceptance: An empirical study within organizations. *Journal of Organizational and End User Computing*, *33*(4), 1–27. doi:10.4018/JOEUC.20210701.oa1

Jha, D. N., Alwasel, K., Alshoshan, A., Huang, X., Naha, R. K., Battula, S. K., Garg, S., Puthal, D., James, P., Zomaya, A., Dustdar, S., & Ranjan, R. (2020). IoTSim-Edge: A simulation framework for modeling the behavior of Internet of things and edge computing environments. *Software, Practice & Experience*, *50*(6), 844–867. doi:10.1002/spe.2787

Kolesnikov, A. V. (2020). Agriculture export supply chain management in Belgorod region. *International Journal of Supply Chain Management*, *9*(1), 702–706.

Li, L., & Zhang, J. (2021). Research and analysis of an enterprise e-commerce marketing system under the big data environment. *Journal of Organizational and End User Computing*, *33*(6), 1–19. doi:10.4018/JOEUC.20211101.oa15

Liu, M., Yang, L. W., & Liu, T. S. (2021). Analysis on the structure of influencing factors of sustainable supply chain implementation of water diversion project. *Journal of Geoscience and Environment Protection*, *9*(8), 140–150. doi:10.4236/gep.2021.98009

Markina, I. (2018). Defining the dimensions of national security, financial security, and food supply chain in Ukraine. *International Journal of Supply Chain Management*, *7*(6), 608–620.

Martin, R. A., Barsoum, Y., & Aisenberg, M. A. (2021). Defining a system of trust (SOT) as a keystone tool for supply chain security. *Scitech Lawyer*, *17*(2), 20–28.

Miller, H. E., & Engemann, K. J. (2019). Business continuity management in data center environments. *International Journal of Information Technologies and Systems Approach*, *12*(1), 52–72. doi:10.4018/IJITSA.2019010104

Ryabchuk, P. (2020). Supply chain management of industrial enterprise based on the participation in network architecture holdings (case study: SPV*). International Journal of Supply Chain Management*, *9*(3), 1243–1250.

Seyedghorban, Z., Tahernejad, H., Meriton, R., & Graham, G. (2020). Supply chain digitalization: Past, present and future. *Production Planning and Control*, *31*(2-3), 96–114. doi:10.1080/09537287.2019.1631461

Shamsi, K., Li, M., Plaks, K., Fazzari, S., Pan, D. Z., & Jin, Y. (2019). IP protection and supply chain security through logic obfuscation: A systematic overview. *ACM Transactions on Design Automation of Electronic Systems*, *24*(6), 1–36. doi:10.1145/3342099

Smith, R., Palin, D., Ioulianou, P. P., Vassilakis, V. G., & Shahandashti, S. F. (2020). Battery draining attacks against edge computing nodes in IoT networks. *Cyber-Physical Systems*, *6*(2), 96–116. doi:10.1080/23335777.2020.1716268

Swanson, D., & Suzuki, Y. (2020). COVID-19 carves new facets of supply chain disruption. *Transportation Journal*, *59*(4), 325–334. doi:10.5325/transportationj.59.4.0325

Vlasov, M. P., Modenov, A. K., & Harchenko, O. V. (2020). Modelling of the supply chain planning for the business and economic security. *International Journal of Supply Chain Management*, *9*(3), 750–756.

Wang, P., & Han, W. (2021). Construction of a new financial e-commerce model for small and medium-sized enterprise financing based on multiple linear logistic regression. *Journal of Organizational and End User Computing*, *33*(6), 1–18. doi:10.4018/JOEUC.286808

Wen, Y., Wang, Y., & Shi, M. (2020). Competition in the multichannel supply chain with a self-logistics-type E-platform. *International Journal of Information Systems and Supply Chain Management*, *13*(1), 32–72. doi:10.4018/IJISSCM.2020010103

Yang, X., Li, H., Ni, L., & Li, T. (2021). Application of artificial intelligence in precision marketing. *Journal of Organizational and End User Computing*, *33*(4), 209–219. doi:10.4018/JOEUC.20210701.oa10

Zalozhnev, A. Y., & Peremezhko, D. V. (2022). IT project management: Supply chain optimization for service operations. *IFAC-PapersOnLine*, *55*(10), 2505–2508. doi:10.1016/j.ifacol.2022.10.085

Zhou, X., Liang, X., Du, X., & Zhao, J. (2018). Structure based user identification across social networks. *IEEE Transactions on Knowledge and Data Engineering*, *30*(6), 1178–1191. doi:10.1109/TKDE.2017.2784430

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