Research on Smart Logistics Development Based on Blockchain Technology

Xinsheng Zhang*, Jing Hu

School of Computer and Information Engineering, Hubei University, Wuhan 430062, China

Corresponding author: Xinsheng Zhang, zhangxinsheng@hubu.edu.cn

Abstract: Blockchain technology has been incorporated into the field of next-generation information infrastructure in China and is experiencing rapid development. Utilizing blockchain and other emerging technologies to develop intelligent logistics is essential for logistics enterprises to reduce costs, enhance efficiency, and improve quality. By analyzing and summarizing the issues within the development of China's logistics industry, this paper discusses its growth from three perspectives: policy, technology, and industry.

Keywords: Blockchain; Development of smart logistics; Significance; Countermeasures

1. Introduction

Blockchain is a cutting-edge technology with strategic significance and a new hot spot that countries around the world are competing to master. China has elevated blockchain to the forefront of next-generation information infrastructure and identified it as a crucial development direction. Driven by national policies and market demand, China's blockchain industry has entered a rapid growth phase, with the number of blockchain companies soaring and its applications in various industrial fields expanding.

To achieve high-quality development in logistics, it is essential to reduce costs, enhance efficiency, and improve quality through new technological means such as blockchain. However, there are still many challenges in building blockchain-based intelligent logistics. Identifying the root causes of these problems and exploring corresponding countermeasures and methods is crucial. This approach will help resolve conflicts, further promote the reform of intelligent logistics, and establish a sound logistics operation mechanism. Such developments will provide strong support for advancing the high-level growth of China's logistics industry.

2. The significance of the application of blockchain technology to intelligent logistics

2.1. Multi-party cross-verification to establish trust relationships

The distributed architecture of blockchain can connect enterprises involved in logistics through consistency

protocols and incentive mechanisms, creating a multi-party cross-check system. This system allows relevant enterprises to establish mutual trust, thereby enhancing overall trust and providing financial support for small and medium-sized enterprises. Blockchain technology stores logistics information at each enterprise node participating in data sharing, forming a complete shared ledger, and achieving consensus and collaborative supervision across the blockchain. Applying blockchain technology to smart logistics allows for multi-party cross-verification via the shared ledger, enhances mutual trust between enterprises, establishes a more convenient credit record system, and supports the capital-raising efforts of small and medium-sized enterprises [1].

2.2. Timely transmission of information and full sharing of information

Information exchange and data sharing between logistics enterprises are essential for the healthy development of the logistics industry. The traditional information exchange model based on affiliated enterprises faces challenges such as potential user information leakage and difficult access. Introducing blockchain into the intelligent logistics system provides an effective way for enterprises to transmit information. Blockchain-based methods such as asymmetric cryptography and digital signatures can overcome the limitations of traditional methods and prevent the disclosure of personal information. The cryptographic and information transmission technologies in blockchain can facilitate more effective information interaction between enterprises, enabling accurate data transmission in all aspects of commodity demand, customer management, and marketing management. Applying blockchain technology to the intelligent logistics environment enables complete information sharing, connecting related enterprises, enhancing information exchange, improving enterprise information levels, and increasing operational efficiency. In a cryptography-based intelligent logistics system, the stored data cannot be altered, ensuring maximum data security and protecting the normal operation and commercial interests of the enterprise [2-4].

2.3. Monitoring the logistics process to ensure security

In a smart logistics environment, using blockchain technology along with the Internet of Things (IoT) and cloud computing can comprehensively monitor the entire logistics process and provide real-time monitoring of the data. This approach strengthens the supervision of the logistics industry and protects the rights and interests of enterprises and individuals [5]. Using blockchain to monitor logistics allows relevant departments to know the status of goods, money, and other aspects to prevent accidents. In case of a security incident, the relevant parties can clearly understand the cause and development of the incident, enabling them to devise countermeasures to avoid similar problems in the future.

3. Application analysis of blockchain technology in smart logistics
3.1. Logistics traceability

Logistics traceability involves accurately recording all aspects of product production, origin, inspection, supervision, and consumption, enabling consumers to better understand the circulation process of goods. The traditional traceability system faces numerous issues, such as insufficient information sharing, unstable information security, and unclear responsibility. In constructing intelligent logistics, applying blockchain technology to enterprise management can effectively address logistics traceability problems in supply chain management, production, processing, and transportation. This approach makes the entire circulation process of the product transparent and ensures product safety. The authenticity and immutability of information in blockchain operations provide a guarantee for the credibility of logistics traceability data. Utilizing blockchain technology for logistics traceability ensures the safety and reliability of source traceability, production

processes, quality inspection, logistics, and transportation [6].

3.2. Logistics finance

As China's logistics industry continues to develop, the logistics supply chain has evolved from a single supply and demand model to a cooperative mode involving multiple parties. During this transition, issues such as an imperfect credit system, low work efficiency, and financing difficulties for small and medium-sized enterprises have become significant barriers to the development of intelligent logistics. By applying blockchain technology to logistics finance, blockchain can be linked with the logistics finance database to establish a more secure and credible financial ecosystem through real-time recording of enterprise information [7-9]. Blockchain technology's characteristics of information immutability and extensive information sharing ensure the authenticity and reliability of financial transactions, thus helping small and medium-sized enterprises overcome financing challenges.

3.3. Logistics credit information

Currently, various logistics industries in China have certain shortcomings. For instance, the proportion of online transactions in the logistics industry is very low, and general enterprise reputation evaluations rely heavily on big data, which hinders the development of China's logistics industry and restricts its financing and growth. In the logistics information system, blockchain can link suppliers, logistics enterprises, and warehouse management enterprises while connecting relevant supervision departments, guarantee agencies, and government regulatory bodies. Intelligent credit evaluation algorithms can integrate enterprise credit evaluations with actual enterprise records, enabling enterprise credit evaluation. This information is displayed on the blockchain to improve the credit of intelligent logistics enterprises.

4. Development strategy of smart logistics based on blockchain
4.1. Policy level

(1) Build the top-level design of smart logistics: Building on the achievements, foundational ideas, and main practices of China's logistics informatization during the "13th Five-Year Plan" period, we propose objectives, ideas, and specific measures for the "14th Five-Year Plan." This includes supporting major manufacturing enterprises and innovative industries. Each province should tailor its smart logistics development system and plan to its regional and socio-economic characteristics, serving the overall national strategy. Advanced logistics provinces and cities should lead by example, developing smart logistics demonstration bases and enterprises to guide national development.

(2) Build a team of intelligent logistics talents: Improve the training mechanism for smart logistics, focusing on talent cultivation. Strengthen leadership and team building for smart logistics through comprehensive selection, training, and evaluation at all levels. Enhance training for grassroots personnel, integrating online and offline methods to elevate training standards. Engage with universities and vocational colleges to provide professional knowledge, facilitating quicker job placement for graduates. Collaborate with countries and regions with mature smart logistics systems to organize senior personnel training programs, learning from foreign experiences to enhance China's smart logistics management capabilities [10].

(3) Promote the standardization of smart logistics: Enhance the implementation of current logistics standards and improve standardized operations. Accelerate the development of smart logistics standards across all professional fields, establishing a regional logistics standard system with significant

influence. Encourage major logistics enterprises to participate in formulating logistics technology and management standards, building an enterprise-specific standard system to achieve standardized management and services, thus improving the informatization of modern logistics enterprises in China [11].

4.2. Technical level

(1) Strengthen technical support for smart logistics: Promote the application of modern logistics technology and equipment, guiding enterprises towards low-carbon, green, and intelligent development. Address the needs of "Internet + high-efficiency logistics" by advancing intelligent logistics and enhancing enterprise capabilities. Foster the development of big data, cloud computing, and the Internet of Things, incorporating mobile Internet and Beidou vehicle positioning into logistics to achieve informatization, networking, visualization, automation, and controllability. Promote modern logistics equipment, such as multimodal transportation and pallet sharing, and advance the green and low-carbon development of the logistics industry [12]. Establish intelligent logistics platforms and public information platforms for industrial logistics, facilitating efficient and low-cost logistics operations. Strengthen logistics park construction to form a low-cost, high-efficiency logistics network.

(2) Leverage innovation in smart logistics: Implement scientific and technological innovations to build a smart logistics system. Execute national development plans, such as the National Medium-and Long-Term Development Plan for Logistics, to promote the logistics industry. Conduct research on smart logistics development strategies, with pilot projects in key regions and industries to demonstrate and support national manufacturing industries in independent R&D.

4.3. Industrial level

(1) Optimize the spatial layout of smart logistics: Align with national development strategies like the "Belt and Road" initiative, the Guangdong-Hong Kong-Macao Greater Bay Area, and the Yangtze River Economic Belt [13]. Enhance logistics hubs, open logistics corridors, and improve port logistics functions. Coordinate regional customs clearance and logistics infrastructure interconnection, focusing on combined transportation modes. Strengthen logistics facilities, resource sharing, and information sharing, supporting key logistics bases and modern logistics demonstration enterprises. Promote advanced distribution methods in cities and improve logistics and distribution systems in rural and urban areas for coordinated development.

(2) Develop backbone enterprises for smart logistics: Prioritize cultivating backbone enterprises with significant scale, promoting logistics operation carrier platforms, and guiding enterprises to smart logistics parks. Identify key logistics enterprises and technology centers, supporting important logistics projects with a focus on smart logistics construction and multi-industry integration. Utilize industrial transformation and upgrading funds to enhance the overall logistics industry level [14].

(3) Promote industry integration in smart logistics: Strengthen cross-industry, cross-departmental, and cross-regional development. The logistics industry's high permeability facilitates resource integration and industrial synergy, promoting coordinated development with manufacturing, finance, and other sectors. Encourage traditional manufacturing enterprises to integrate smart logistics concepts and supply chains, transitioning towards service-oriented operations. Enhance logistics and e-commerce integration, elevating comprehensive service levels in sales, information, warehousing, and distribution. Address urban development needs by advancing express delivery, cold chain, pharmaceutical logistics,

rural logistics, and community logistics. Promote logistics finance integration through pilot projects and strengthen regional coordination, encouraging enterprises to expand internationally and form large-scale logistics resources [15].

5. Conclusion

Blockchain is a public database based on credit and collaboration mechanisms, which can reliably track and disclose stored data. As a breakthrough in China's critical technology sector, blockchain has great application potential and can be divided into three development periods. Although the development path of intelligent logistics based on blockchain is not smooth, it is essential to focus on key areas and critical links with thorough planning and steady progress. The reform of "smart logistics" will be effectively implemented in practice. It is believed that with technological advancements, smart logistics featuring wisdom sharing, safety, and efficiency will eventually play a fundamental, strategic, and leading role in the development of the national economy.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Feng Z, 2024, Exploration of Statistics Teaching Mode of Logistics Management Major from the Perspective of Big Data. Logistics Engineering and Management, 2024(2): 126–128 + 80.

[2] Song G, Xiang A, 2024, Research on the Idea of Promoting the High-Quality Development of China's Modern Logistics Industry. Price in China, 2024(2): 5–8.

[3] Zhang R, 2024, Analysis of Smart Logistics Performance and Influencing Factors in Shandong Province. Straits Technology and Industry, 2024(1): 17–22.

[4] Fu X, Bai X, Li J, 2023, Application Analysis of Internet of Things in Intelligent Logistics Management. China Logistics and Procurement, 2023(24): 93–94.

[5] Liu X, 2023, The Impact and Mechanism of Smart Logistics on Regional Green Economy Development: An Empirical Study Based on the Yangtze River Economic Belt. Commercial Economics Research, 2023(22): 97–100.

[6] Yue Y, 2023, Research on Combination Efficiency Measurement and Spatial Differentiation of Smart Logistics Industry Under the Background of Digitalization. Business Economics Research, 2023(21): 93–96.

[7] Pan W, Chen Y, 2023, Research on the Application of Smart Logistics Technology in Cross-Border E-Commerce Logistics. Logistics Technology, 2023(21): 27–30.

[8] Liu W, Lu C, Long S, 2023, Research on Urban Spatial Logistics Network Layout Method for Smart Logistics. Engineering Management Technology Frontier, 2023(5): 10–18.

[9] Xu G, 2023, Strategic Analysis of Port Logistics Finance Supporting Port Economic Development. China Shipping Weekly, 2023(39): 44–46.

[10] Xu Y, Yu L, 2023, Application of Blockchain Technology in Feed Industry Supply Chain Management. Modern Business, 2023(15): 27–30.

[11] Yan H, Wang J, 2021, Big Data Collection: Exchange and Sharing Model of Smart Supply Chain Based on Intelligent Manufacturing. Logistics Science and Technology, 2021(10): 22–28.

[12] Xu Z, 2021, Research on the Development of Smart Logistics Under the Background of New Infrastructure. Logistics Engineering and Management, 2021(1): 41–44.

[13] Yang L, 2020, Development Analysis of Guangxi Smart Logistics Based on the SOT-PEST Model under the "Belt and Road". Journal of Nanning College of Technology, 2020(1): 64–70.

[14] Yang L, 2020, Synergetic Research on Policy Measures and Objectives of China's Logistics Industry, thesis, Xidian University.

[15] Xu N, Chen S, 2023, The Trend and Practice of the Integration of Intelligent Logistics and Supply Chain Management. Journal of Wuhu Polytechnic, 25(2): 40–43.