

Research on the Development Direction of Smart Logistics Based on Blockchain Technology

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Abstract: Blockchain was only applied into underlying technology of Bitcoin system in the past. After years of development, its applications have been expanded to fields such as logistics, supply chain, finance, medical health, and public affairs. E-commerce expands globally, which brings opportunities and challenges caused by blockchain technology to logistics industry, a critical hub for online e-commerce and offline users. However, in China, logistics industry faces problems namely high costs, inefficient information exchange, and poor performance. Therefore, future intelligent logistics transformation depends on multi-party collaboration. With aid of deep integration of blockchain technology, it is able to trace source, cut down intermediate links, ensure secure goods delivery, and improve logistics efficiency.

1. Introduction

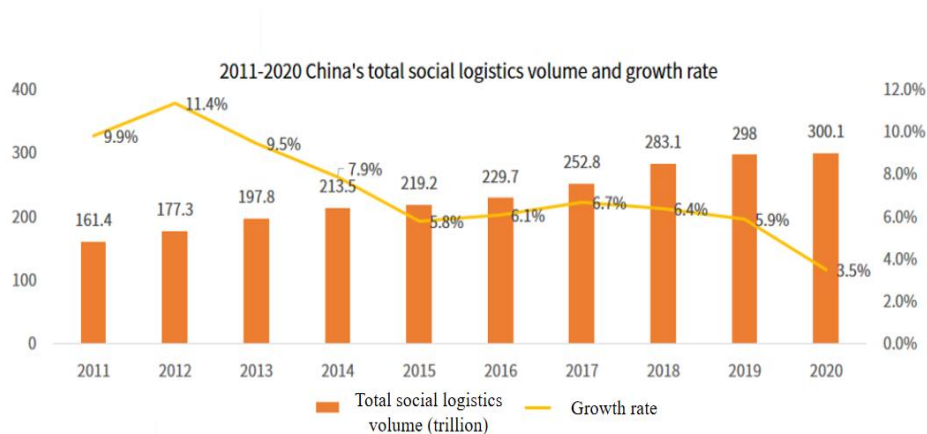


Figure 1: 2011-2020 China's total social logistics volume and growth rate (Data source: China Federation of Logistics & Purchasing)

Logistics, as a pillar industry of national economy, is increasingly demanded in market with fast economic development. Especially in recent years, online economy is booming and online consumption models upgrade, which continuously expands market demand of logistics industry. According to data from China Federation of Logistics & Purchasing (CFLP), China's total social

logistics reached RMB 300.1 trillion in 2020 (As shown in figure1)[1], marking a record high. China has become the world's largest logistics market with strong demand. At the same time, the standing problems remain to be solved in logistics industry, such as low delivery efficiency, loss of delivery, wrong or mistaken picking, information leakage, long business chain, and waste of resources. With development of the Internet, big data, cloud computing, and artificial intelligence technology, advanced information technology further integrates with logistics industry, showing development trend of intelligent logistics. Among them, supply chain and logistics are considered to be mostly improved by blockchain technology. Under the background, this study focuses on analyzing application of blockchain technology in future intelligent logistics.

2. Blockchain Technology and Intelligent Logistics

2.1 Definition of Blockchain Technology

Blockchain originally serves as underlying technology to support Bitcoin. It allows Bitcoin digital assets to circulate in a decentralized network via distributed shared ledger and point-to-point transmission technology. After development for several years, blockchain evolves into a comprehensive system based on P2P network, asymmetric encryption, hash function, Merkle tree, chain structure, timestamp, consensus mechanism and other key technologies. Generally, blockchain is a distributed ledger technology that supplies decentralized trust mechanisms in a non-trust environment, so that multi-party participants can conduct secure trust transactions without intermediary agencies. Particularly, in logistics field that requires multi-party cooperation, blockchain is expected to reduce transaction costs, optimize business models, and be applied in countless fields.[2]

2.2 Characteristics of Blockchain Technology

2.2.1 Decentralization

Distributed ledger technology helps achieve decentralization of blockchain network data transmission and storage. Each node can maintain a copy of ledger. Blockchain technology no longer relies on central network node when transmitting data. Instead, it keeps overall system in which multiple nodes participate working well through consensus open source protocol, and ensures information is transmitted in block network. In order to ensure equal rights and obligations, distributed nodes in system build a trust mechanism through mathematical methods rather than centralized regulatory agencies.

2.2.2 Security and reliability

Blockchain realizes secure and reliable network information through principle of asymmetric encryption. Blockchain system encrypts and decrypts data via public key and private key created by encryption algorithm. In addition, the blockchain adopts technical design such as timestamp certification and consensus mechanism to ensure data is not manipulated.[3]

2.2.3 Expansibility

Based on blockchain, the underlying open source technology, developers can build decentralized and de-trusted applications to serve various application scenarios including e-commerce logistics. Smart contracts automatically judge conditions for each node to execute contract and obligations to be fulfilled, as well as automatically implement contract matters that meet conditions. In the

absence of supervision of central institutions, blockchain can ensure orderly execution of contract, raise execution efficiency, and reduce waste of resources.[4]

2.2.4 Traceability

Relying on timestamp technology, blockchain system records time dimension during data information expansion. After new block containing data information on P2P network is produced, it will be imprinted by time stamp, and connected in chronological order to form blockchain. Blockchain data cannot be forged and tampered, so people can trace source of any data information through such chain structure.[5]

2.3 Connection Point between Blockchain Technology and Intelligent Logistics

China’s intelligent logistics industry has experienced primary development. In operation, it relies heavily on data and algorithms to allocate resources in various operation links of intelligent logistics, namely transportation, storage, packaging, loading & unloading, and distribution. Unfortunately, between different logistics industry chains and logistics enterprises, logistics data cannot be interconnected due to universality and barriers of information, which leads to dispersive upstream and downstream in logistics industry, lack of mutual trust, and information asymmetry. Therefore, costs become high and more resources are wasted. In this way, there are many similarities between blockchain technology and reform of future intelligent logistics industry (As shown in table 1).

Table 1: Connection Point between Blockchain Technology and Intelligent Logistics

Blockchain technology	Intelligent logistics reform direction
(1)Decentralization; (2)Smart contract;	Introduce smart contracts to solve disputes in some links of logistics industry chain. When it meets rules, the system will be automatically executed to protect rights and interests of both parties in transaction
(1)Time stamp; (2)Distributed storage; (3)Asymmetric encryption;	Modern logistics should form tamper-resistant records of all aspects of commodity production and circulation. Consumers can compare full-link logistics information, in order to trace source and inspect anti -counterfeiting of products
(1)Transparent trading mechanism; (2)Break information asymmetry;	In order to achieve development, intelligent logistics needs to break information barriers of upstream and downstream industries of logistics, and realize resource sharing. Meanwhile, data security is higher, that is more transparent and safe, which is conducive to coping with information isolated islands of logistics industry.

3. Application of Blockchain Technology in Intelligent Logistics

Currently, logistics is not traditional cargo transportation, but means modern business service that relies on modern information system skills to integrate goods flow, capital flow, information flow, and business flow as one. Blockchain technology is a key application in intelligent logistics. Based on characteristics, it accesses buyer and seller, transportation, warehousing, transport, finance, supervision and other participants on the entire long logistics chain. This is helpful to solve issues such as scattered information, uniformity, lack of mutual trust, and information asymmetry; reconstruct business and optimize business scenarios.

3.1 Blockchain Solves Logistics Trust Issue

In terms of logistics tracking, blockchain technology combines with modern Internet of Things to transparently trace entire process from production, processing, transportation, to sales. The former guarantees data stored is true and reliable, and the latter ensures real and credible collection process of data. Based on blockchain, it can optimize logistics information traceability. What plagues consumers all the time is fraudulent courier logistics information. In this case, blockchain is bale to form tamper-resistant records of products production and circulation through timestamp, distributed storage, and asymmetric encryption technologies. Data is ensured technically true and effective. Managers and terminal consumers can compare full-link logistics information, so as to effectively prevent illegal and false logistics records, thereby realizing functions of traceability and anti-counterfeiting.

Aiming to prevent production and sale of counterfeit products and improve goods quality, cross-border e-commerce companies have begun to adopt blockchain technology to upload, track, and verify full-link information of cross-border imported goods. Data covers information such as production, transportation, packaging, customs clearance, and third-party inspection, as well as full process information such as country of origin, sponsor nation, loading ports, transportation methods, imported ports, bonded warehouse inspection and quarantine orders, customs declaration orders, etc. Specifically, Alibaba's Koala shopping platform introduces blockchain technology of Ant Financial. Users can scan blockchain QR code through Alipay, to browse information of products filing, customs clearance and logistics. On the basis of full-link traceability system of products, products sold by e-commerce platforms are labeled unique through blockchain, which makes it easier and faster for consumers to query true source of products through traceability system.

3.2 Blockchain Changes Future Logistics Contract Rules

With the rise of artificial intelligence and the Internet of Things, AI society will establish a new set of trading rules to adapt to intelligent trading. The blockchain technology just builds a new computer protocol main structure, to help AI society achieve contract management. Blockchain is characterized by high degree of transparency, decentralization, de-trust, collective maintenance, anonymous. It is essentially a decentralized distributed accounting database. In fact, due to asymmetric information, it is necessary to solve trust of both parties by virtue of an intermediary agency. Fortunately, Internet has greatly reduced information asymmetry to some extent, so that various devices can access open concentrated clouds. In the future, decentralization and mediation will be point-to-point connected directly.(As shown in figure 2)



Figure 2: Blockchain changes future logistics contract rules

Transportation process of cargo can also be clearly recorded on the chain. Whole process is apparently visible from loading, transportation to pickups. It can optimize resource utilization and reduce intermediate links, to improve overall efficiency. When blockchain is used to record all steps from issuing to receiving, it ensures information traceability, which avoids packet loss and mistaken claiming. Users check the blockchain to inspect package signing. This eliminates problem that deliveryman fakes his signature to claim the package, and also promotes implementation of real-name system of logistics. Moreover, enterprises can master logistics direction of products through blockchain to prevent commodities fleeing.

3.3 Logistics Finance Based on Blockchain Technology

With transformation and upgrading of logistics industry, and improvement of service capabilities, logistics enterprises closely connect buyers, sellers and financial institutions in trade to offer more advanced logistics finance. Logistics industry tends to be complex, original simple supply and demand relationship evolves into a long chain and multi-party cooperation model, and accounting period prolongs. Financial institutions, relying on “property rights”, begin to apply and develop various financial products, including supply chain finance, asset securitization, digital pledge by warehouse receipts for financing, etc.[6]

In practice, if logistics financial system is constructed by traditional technologies, all parties involved shall handle relevant businesses in their own systems. In order to ensure business rationality, data consistency and accuracy, all parties need to invest financial resources to build their systems, and achieve data interaction and reconciliation between systems. As business expands gradually, reconciliation has been a normal for all parties to ensure rational business. Even so, each party also doubts about data in the other party’s system. The distrust seriously harms enthusiasm and initiative of all parties in the platform. Blockchain technology adopts distributed weak center technology architecture to enable suppliers, purchasers, logistics enterprises and financial institutions in supply chain to participate equally in system construction and business operations. In addition, it contributes innovative solutions for logistics financial system by introducing high-intensity cryptography, unique chain storage mechanism and distributed ledger technology.

Due to application of blockchain technology in logistics industry, logistics commodities are turned into assets. Such technology values and capitalizes information-based commodities, which is mainly because assets recorded by blockchain technology cannot be changed or forged. When sole ownership of goods is fixed, all goods in logistics chain become traceable, falsifiable and tamper-resistant; logistics goods are turned into assets. Through basic platform of blockchain, funds can be effectively and promptly accessed to logistics industry, improving financing environment of logistics industry thereby.[7]

4. Conclusion

As an advanced business model of future logistics industry, intelligent logistics refers to a new logistics that reshapes traditional logistics models and processes based on integrated intelligent technology, and that realizes automatic identification, traceability, intelligent optimization & decision-making and real-time response of entire logistics industry chain. Blockchain technology empowerment helps reshape logistics operation service mode, effectively deal with trust problem of logistics communication, change future logistics contract rules, and supply an innovative solution for logistics financial system.

Policy Proposal. Application of blockchain should be designed as a whole at policy level. On the basis of full understanding of national policies and blockchain technology, blockchain technology must be matched with China’s economic development strategies in the future. Focus should be

placed on building intelligent and information-based technology applications in logistics industry. What's more, it is urgent to develop blockchain logistics research under support of 5G technology, in order to enhance resource integration capability of logistics industry.

Technical Proposal and blockchain technology needs to be further improved in terms of data storage architecture, consensus mechanism, smart contract, privacy security and other technical links, so as to cater to development trend of supply chain continuously expanded by intelligent logistics. Furthermore, more work should be done to establish unified industry standards; strengthen interaction of blockchain technology and its system; accelerate interconnection of different smart modules; fully release advantages of network value of platform development; integrate multiple resources; innovate in new functions and models of intelligent logistics.

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