

# Applying Blockchain Technology to Improve Information Barriers in Fresh Cold Chain Logistics

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## Abstract

At present, there are illegitimate interests in fresh food cold chain logistics, which leads to doubts about the credibility of interactive information and information barriers. In response to this problem, this paper studies the application of blockchain technology to improve it, which has the non-tampering modification. First of all, this article analyzes the fresh food cold chain logistics market from its current situation, development environment, and development trends from the perspective of policies and laws, economics, society, technology, etc. Then, the study proposes the application of blockchain technology to improve the existing information barrier problem in fresh cold chain logistics by combining the characteristics of blockchain technology. Using the characteristics of blockchain technology of non-tamperability and traceability, the idea of information sharing module is proposed. The results of the article have some implications for the application of blockchain technology in the fresh cold chain logistics industry.

## Keywords

**Blockchain; Fresh Food; Cold Chain Logistics; Information Barrier.**

## 1. Introduction

In recent years, with the rise of fresh food e-commerce, China's fresh food retail industry has shown rapid growth. According to statistics, the transaction scale of China's fresh food market continued to expand from 2014 to 2019, of which the transaction volume of China's fresh food market reached 2.04 trillion in 2019, an increase of 6.8% over the previous year.

China's fresh cold chain logistics industry was born in the 1950s. With the further growth of demand in the fresh cold chain market, the scale of the fresh cold chain logistics industry has maintained a steady growth and the cold chain related infrastructure construction has been improved. Due to the special nature of fresh products, the fresh cold chain logistics industry generally has a large investment in fixed assets and high logistics costs.

In the upstream and downstream links of fresh food cold chain logistics, different enterprises need to interact and share information for their business, but due to different interests, it may happen that operators may modify or fabricate data in their own link database for some improper interests in the process of information interaction, thus the credibility of the interactive information is doubtful and information barriers arise. In the traceability link of cargo loss, it also leads to the inability to find the link where the problem occurs and generates disputes.

After the birth of Bitcoin, blockchain technology began to be rapidly popular and once began to be fiercely pursued in the capital market. Currently, the hype fever is gradually subsiding, but the application field of blockchain technology is further expanding. As blockchain technology is decentralized, tamper-evident and traceable, its application in the field of cold chain logistics is generally favored.

In view of the problems of information barriers such as non-sharing and doubtful credibility in the fresh cold chain logistics supply chain, this paper proposes the idea of using blockchain to improve the information barriers in fresh cold chain logistics with the help of its tamper-evident and traceable characteristics, so as to avoid cargo loss disputes, optimize supply chain management and improve logistics service quality.

The study is structured as follows: Section 2 briefly reviews studies on the application research of blockchain technology. Section 3 briefly introduces the fresh food cold chain logistics market. Section 4 presents the application concept of blockchain technology in the fresh cold chain logistics industry. Section 5 concludes the whole study.

## 2. Literature Review

Through reading and organizing the related literature at home and abroad, it is found that blockchain technology has more application fields, and there are experts and scholars involved in research in different fields, such as digital transactions, financial pledges, evidence retention, etc. Combining with the research content of this paper, we summarize the application research of blockchain technology in the field of enterprise management and logistics respectively.

Many scholars have studied different aspects of the suitability of blockchain technology for application in enterprises and the effectiveness of its application. Among them, Kamble [1] and Akyuz [2] selected 181 corporate supply chain practitioners and conducted a survey on them, which showed that corporate practitioners believed that the blockchain technology would help them gain the most benefit. They then built a model of users' perceptions of applying blockchain technology and through the model study found that blockchain technology is widely applicable and its can be applied to all types of corporate supply chains, suggesting that blockchain technicians develop more blockchain applications that can bring greater value to users.

In addition, there is a place for blockchain technology in the traceability of corporate products. Through a study by Savron [3] and Akyuz [4], it was concluded that the creation of cryptocurrency transactions using blockchain technology is fast and is a cheap and secure way of public records. At the same time, blockchain can be used for many non-financial tasks, for example, blockchain can help improve supply chain management by determining the origin of diamonds, where clothes are processed, and the winery where wine is sourced. In enterprise management, blockchain technology can also solve the problem of information asymmetry between enterprises, further improve data security and achieve accountability traceability, thus improving the trust mechanism in the enterprise supply chain. Meanwhile, Dujak [5] finds that blockchain technology can help solve the enterprise trust problem and ensure the secure and trustworthy exchange of information between upstream and downstream enterprises in the supply chain.

In terms of data architecture, Liu [6] successfully constructed a blockchain technology-based system architecture, which identifies blockchain data flow through several different dimensions such as static or dynamic data attributes, and necessary or non-essential data requirements. They also proposed a reference model of data flow for supply chain stakeholders of food companies based on this architecture and successfully designed a blockchain-based food traceability system.

With the increasing maturity of blockchain technology, researchers have extended the application scenarios of blockchain to the logistics field. Through their research, Dobrovnik [7] proposed scenarios of using blockchain technology in the logistics field. By proposing an analytical framework and the theory of four transformation stages for enterprises to use blockchain technology, scholars argue that different enterprises can choose different blockchain application scenarios and models according to their own organizational structures as well as business processes.

In terms of logistics specific operations, a study by Tijan [8] finds that blockchain technology has advantages in streamlining logistics tasks, tracking purchase orders, changing orders, generating shipping documents, and helping to share information about manufacturing processes and deliveries. With its ability to ensure data invariance and public accessibility of data flows, blockchain technology can improve the efficiency, reliability, and transparency of logistics and optimize the inbound process [9].

In a practical case, the German logistics company DHL and Accenture, a global technology consultant, have developed a blockchain-based work process that aims to track the entire transportation of goods from the place of shipment to the end consumer, guaranteeing the authenticity of the origin of the goods. The technology is currently used mainly in pharmaceutical products to avoid counterfeit medicines [10].

From the current research on the application scenarios of blockchain technology at home and abroad, scholars at home and abroad have studied the application scenarios of blockchain technology in various fields. Through the above studies, it is easy to find that blockchain technology has the characteristics of openness and transparency, non-tamperability, etc. Scholars have reached a consensus on the functions that blockchain can help reshape the credit system, complete product traceability and improve business efficiency. Some scholars also proposed the application model of blockchain technology in the logistics industry. At the same time, scholars believe that blockchain technology is not yet mature, and blockchain development suffers from the lack of a single basic standard, difficulty in grasping application concepts, and lack of regulation.

However, the current problems of information barriers such as arbitrary data tampering and doubtful credibility of information in the fresh cold chain industry, such problems not only make it impossible to find the link where the problem occurs and generate disputes when cargo damage occurs, but also expose the business operation to great risks. In view of the above problems, scholars have not conducted a more in-depth study, so this paper hopes to conduct a relevant study on how to improve the information barriers in the fresh cold chain logistics industry.

### 3. Fresh Cold Chain Logistics Market Analysis

In recent years, due to the rapid development of the Internet and the birth of the new retail model, the fresh food e-commerce industry has developed relatively quickly, further promoting the development of the fresh food cold chain logistics industry. According to China's cold chain logistics market size statistics from 2014 to 2019 show that the cold chain logistics market size is continuing to grow, with China's cold chain market size reaching 339.1 billion yuan in 2019, up 12% year-on-year from 303.5 billion yuan in 2018.

At present, fresh cold chain logistics has a better development environment in terms of policies and regulations, economy, society and technology. In terms of policies and regulations, in recent years, the central government and relevant ministries and commissions have been supporting the development of cold chain logistics, and the state has introduced many policies to further strengthen the construction of China's cold chain logistics system. At the same time, the implementation of the "One Belt and One Road" strategy is conducive to expanding the cross-border export of domestic high-quality agricultural products, aquatic products and other cold chain food, and further strengthen the development of the emerging trade model of cross-border cold chain food e-commerce, which provides new opportunities for the development of cold chain logistics and promotes the development of the cold chain logistics industry.

In terms of the economic environment, since 2012, the per capita disposable income of urban residents in China has been rising, and the people's need for a better life has become stronger, and the demand for fresh food, fruits and dairy products has been rising. According to statistics,

the total demand for fresh food cold chain logistics in China reached 235.2 million tons in 2019, up 24.65% year on year, which will further promote the development of the fresh cold chain logistics industry. In recent years, with China's rapid development of information technology at the same time, the consumption pattern of residents is also undergoing a transformation, fresh food sales have seen rapid growth. Among them, with the addition of e-commerce platforms such as Tmall, Jingdong and Boxma Fresh, the transaction volume of fresh food has gained greater growth. This provides a huge development space for cold chain logistics, especially cold chain home delivery.

As to the social environment, with the continuous improvement of China's social security system over the past 30 years, it has given consumers greater confidence in consumption. The increase in the level of consumption inevitably leads to an increase in the quality of consumption. Inevitably, this will lead to higher requirements for food freshness. In addition, in recent years, food safety incidents have occurred from time to time, which has focused public attention on food safety once again. As the economic and educational levels of the population continue to grow, so does the awareness of social responsibility. In addition, after the problem of food and clothing has been solved, the public's needs have risen to the level of seeking safety according to Maslow's theory of needs, so food safety concerns are on the rise. An important way to ensure food safety is to provide a suitable storage environment and monitoring mechanism, which coincides with the purpose of cold chain logistics.

For the technical environment, through measures such as improving the market environment, developing cold chain technology and upgrading logistics organization, China's fresh cold chain logistics is developing by leaps and bounds, and it shows the development trend of informatization, integration, transparency, capitalization and customization.

#### **4. Blockchain Technology Application in Fresh Cold Chain Logistics**

In view of the information barrier in fresh cold chain logistics, this section will focus on ensuring the authenticity of information data and design the information sharing module through blockchain technology to ensure the authenticity of fresh product logistics information. The information sharing module is implemented on two levels. One is the information collection layer, which mainly includes sufficient information perception and reception, and real-time data transmission; the other is the information recording layer, which mainly uses blockchain technology for data storage and provides open data query methods. The above methods provide a recognized and real information flow to achieve traceability and traceability throughout the supply chain and improve the trust barriers in fresh cold chain logistics.

The information collection layer includes the sensing and receiving system of information, which mainly consists of client browsers and sensing terminals, including sensors in production bases, temperature and humidity measurement devices in transportation and storage equipment, as well as computers, cell phones and mobile terminals; the transmission layer of data, which is mainly responsible for uploading and publishing data. To ensure reliable data and product quality, fresh cold chain product source suppliers are required to upload product-related data. Product manufacturing or growth information is automatically collected through sensors or monitoring equipment and depending on the information infrastructure environment of the specific information collection location, the raw data collected is transmitted in real time to trusted nodes with Internet access using the HTTP protocol, XML protocol, Wireless or WAP wireless transmission protocol, etc. Cold chain logistics enterprises have been equipped with relatively complete temperature and humidity monitoring and testing equipment in their refrigerated trucks or cold storage, and for such data, enterprises only need to cooperate with RFID or WMS/TMS system to upload cargo information to the block, that is, they can obtain real-time commodity status and information. Blockchain technology can

transfer real-time logistics and storage information to the node responsible for data processing for the next step.

The information recording layer is mainly responsible for processing data, packaging and compressing data and creating storage addresses and interacting with data on third-party blockchain platforms, as well as providing methods and approaches for reading data and providing open access to information. The interaction between the sensing and receiving layers and the database relies on nodes for implementation. Unlike the traditional architecture that requires a connection through a centralized server, the nodes of blockchain technology are polycentric, and the nodes can be set up as long as they meet the requirements of trustworthiness. With the polycentric structure, the moral risk of a single center and the security risk of the system are effectively avoided. The sensing and receiving layer transmits the real-time logistics data to the node responsible for information recording after the node through HTTP protocol, XML protocol, Wireless or WAP wireless transmission protocol, etc. Using the IP address of the socket, and the internal ID number in the received packet, the node first identifies the source of the data and the type of data. According to the type of information source, the data is divided into production real-time data, transportation real-time data, etc. Different methods are invoked to process the original data and structure the unstructured data respectively.

## 5. Summary and Conclusion

At present, with the continuous development of the social economy and the improvement of people's quality of life, the demand for domestic fresh cold chain food is expanding rapidly, which brings a huge market for cold chain logistics. At the same time, the fresh cold chain logistics industry is also facing the problem of information barriers. Blockchain technology, with its decentralized, open and transparent, and tamper-evident characteristics, fully meets the demand for improving the information barrier of fresh cold chain logistics.

In this paper, we propose the application of blockchain technology to improve the existing information barrier problem in fresh cold chain logistics by combining the characteristics of blockchain technology. Using the characteristics of blockchain technology of non-tamperability and traceability, the idea of an information sharing module is proposed. The results of the article have some implications for the application of blockchain technology in the fresh cold chain logistics industry.

Due to the limitations of the research content and depth of this paper, there are still shortcomings that need further research. For example, blockchain technology is currently at an early stage, the number of underlying platforms in blockchain technology is large, and there is a lack of uniform standards for platform construction. This paper does not select a specific underlying platform for application construction and form application products to be put into use. Second, the object of blockchain application is limited. The application of blockchain technology in this paper faces fresh cold chain logistics enterprises and their customers, aiming to improve the problem of information barriers, which can be extended to upstream and downstream enterprises in the supply chain in the future to further improve the problem of information sharing.

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