

# Research on Blockchain Application in Tobacco Supply Chain Management System

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**Abstract:** China's tobacco companies have a high level of informationization, and there are also problems such as centralized management and information barriers, which hinder the efficiency of tobacco supply chain management. In this paper, we use blockchain technology and combine the details of tobacco supply chain to propose a blockchain solution using main and auxiliary alliance chain form to improve the information exchange efficiency of upstream and downstream enterprises in the tobacco supply chain.

## 1. Introduction

The informationization and automation construction of the tobacco industry supply chain is constantly developing and optimizing. In the current design process of many tobacco supply chain information management systems, it has the characteristics of vertical design and functional design. These historical factors directly lead to the independence of enterprises in the tobacco supply chain and the formation of a unified whole. It directly leads to the imbalance of enterprise development, the bullwhip effect is significant, and there are problems such as repeated entry work and difficulty in traceability. Therefore, how to optimize the tobacco supply chain information system and promote the improvement of the tobacco supply chain system has become a very urgent problem [1].

After more than ten years of development, blockchain technology has developed itself in the fields of finance, law, arbitration, auditing, medical treatment, etc. due to its decentralization, transparent information, non-tamperability and traceability. According to the existing problems in the supply chain management system of the tobacco industry, according to the advantages and characteristics of the blockchain, the blockchain technology is applied to the tobacco supply chain management system to solve the problems of the current tobacco supply chain management system.

## 2. Background of Tobacco Supply Chain Development

### 2.1 Definition of supply chain management.

Supply chain refers to a core enterprise, starting from raw materials, making intermediate products and final products, and finally sending products to consumers through the sales network, connecting suppliers, manufacturers, distributors and end users into a whole. Functional network structure. Its structure is not chained in series, but is divergent in the form of a network [2]. The purpose of supply chain management is to reduce the cost of supply chain and promote the exchange of logistics and information by integrating suppliers, generators, sellers and other links in the supply chain to improve the overall efficiency of the company. The idea of supply chain management corrects the traditional ideas that emerged in the process of enterprise development, such as simply paying attention to self-productivity and neglecting market orientation; over-emphasizing competition and neglecting the cooperative relationship in competition; can not observe the situation from the perspective of

system evolution of industrial development. Lack of dynamic adjustment capabilities. With the rapid development of the economy, supply chain management plays an important role in the development of an enterprise.

Take the tobacco industry as an example. The tobacco industry is often monopolistic and stems from the government's strict regulation of tobacco. The procurement of raw materials and materials in the upstream of the supply chain is usually not liquid; the retailers downstream of the supply chain rely on the core enterprises and the government's control over tobacco. The main feature is that retailers are small and numerous. The modern circulation system of the tobacco industry is usually a top-down organizational structure, and has a tobacco distribution and supply chain information system to achieve modern information management. A typical tobacco supply chain management system is shown in Figure 1.

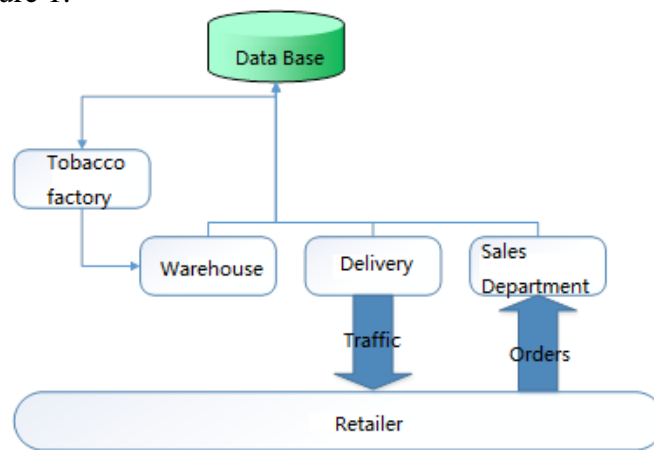


Fig. 1 Tobacco Supply Chain System

## 2.2 Problems in the current tobacco supply chain management system.

As a link in the supply chain, tobacco companies cannot separate the advantages of informationization and modernization into the entire supply chain. This has led to the following problems in the current supply chain management system:

1. Tobacco supply chain management costs are high. Based on industry characteristics, the tobacco supply chain has short and wide characteristics [3]. The tobacco supply chain mainly includes three parts: raw and auxiliary materials suppliers, cigarette manufacturers and finished tobacco retailers. As a core enterprise, cigarette manufacturers need to connect multiple raw material suppliers and a large number of widely distributed finished tobacco retailers. This brings huge management costs to the company's supply chain management.

2. The information systems in each link of the tobacco supply chain are independent of each other, and the degree of informatization is not balanced. As a core enterprise in the supply chain, tobacco companies have established a relatively complete supply chain logistics information management system based on their financial advantages. However, the supply chain information management systems between upstream and downstream enterprises are independent of each other, information is difficult to share, and product traceability is difficult. Moreover, the core enterprises have different independent supply chain information management systems for different upstream and downstream enterprises, which leads to high information communication cost between core enterprises and upstream and downstream enterprises [4]. At the same time, as a direct transaction with the final consumer, tobacco retailers located downstream of the tobacco supply chain are generally inferior in informationization, difficult to manage, and the phenomenon of stockpiling is difficult to find. At the same time, market information is difficult to feed upstream, and upstream enterprises cannot timely Inventory and logistics adjustments for market conditions.

3. The current situation of uneven development of the tobacco supply chain exists. With the influx of personal capital, enterprises will maximize the pursuit of economic benefits, blindly expand

production to increase inventory, ignore the demand for retail terminals downstream of the supply chain, ignore market demand, and will certainly bring huge impact to other companies.

4. The centralized storage of the tobacco supply chain management system has a large security risk and the risk of tampering caused by concentration of power. The current tobacco supply chain management system uses the batch management method of the production process to store the same batch of supply chain information data in the central database, and determines the product batch based on the product batch identification code. This kind of storage method is less secure. It only needs to break through the central database server to threaten the entire supply chain data. At the same time, the management authority is centralized, and the relevant organizations that control data entry have excessive information management authority, and there is a risk of tampering.

5. The traditional supply chain management model is difficult to ensure trade trust. The premise of supply chain management is mutual trust between enterprises. Without this premise, information exchange between upstream and downstream enterprises cannot be realized, information flow cannot be shared, resulting in poor coordination and cooperation between enterprises, and low supply chain integration, which seriously affects supply. Chain management efficiency.

Therefore, how to improve mutual trust between enterprises and improve the degree of integration between enterprises and supply chain is the key issue in the design process of supply chain management system.

### **3. Blockchain Development Background**

In the eleven years since 2008, when Nakamoto published "Bitcoin White Paper: A Peer-to-Peer E-Cash System", the blockchain has been widely known and widely used in the financial sector. Blockchain is a self-growth transaction record list that uses cryptographic concatenation to protect content. Its essence is to use blockchain data structure to verify and store data, use distributed node consensus algorithm to generate and update data, use cryptography to ensure the security of data transmission and access, and use intelligent contracts composed of liberalized scripts to operate data. Blockchain technology is applicable to multi-business entities, mutual distrust, and strong business linkages. Establishing a trust mechanism, based on the principles of openness and transparency, and witnessing each other, allows parties to participate and recognize transactions that have been jointly confirmed [5].

The basic protocols of the blockchain are mainly examined from five aspects: scalability and transmission technology, system security, distributed storage, regulatory compatibility, and consensus mechanism. According to the deployment environment of the blockchain, the type of docking, and the basic protocol are mainly divided into three. Species: public chain, side chain and cross chain. The public chain is a substitute product of centralization or quasi-centralization. It is completely open to the outside world and has the characteristics of including users affected by developers, low access threshold, and all data being exposed by default. The sidechain is essentially a cross-blockchain solution that moves digital assets from the public chain to the sidechain to share the pressure on the main chain. Cross-chain through a certain technology, can make the value of the chain and the chain between the obstacles, direct circulation, cross-chain will not change the total amount of assets, only the exchange of asset owners. Different basic protocols are applicable to different application scenarios. You can also create multiple chains using different blockchain protocols in the same scenario.

The blockchain has the characteristics of decentralization, difficulty in data modification, open and transparent non-confidential data, and traceability. It is applicable to multi-agent scenarios that do not require trust, exist in information islands, and have difficulty in collaboration. When a transaction is completed, the asymmetric encryption algorithm ensures that the data can be transported safely; the untrusted relationship between the subjects is avoided through the consensus mechanism, and the data is guaranteed to be authentic; the chain structure and the entities maintain the nature of the book to ensure the data. The tampering and traceability of the data guarantees the authenticity of the data and the unreliable.

According to different application scenarios of the blockchain, it can be roughly divided into three forms: public chain, private chain, and alliance chain. The decentralization of the public chain is the highest. Participants can join or withdraw arbitrarily, and operate according to their wishes. The program developer has no right to interfere, but the data is inefficient. The private chain is completely opposite to the public chain. The data read and write authority of the private chain to the participants is specified by the organizer, and the number of participating nodes is strictly limited and the number is small, and the reading and writing efficiency is high, which is suitable for the internal use of the characteristic institution. The alliance chain is between the public chain and the private chain. Each node in the chain is authorized to join the network and form a stake-related alliance to jointly maintain the operation of the blockchain. The alliance chain can be regarded as a weakly centralized private chain. Therefore, his private chain has the same high reading and writing efficiency.

#### **4. How to Solve the Problem in the Tobacco Supply Chain Using by Blockchain**

##### **4.1 Data is transparent.**

As a distributed ledger technology, blockchain allows all entities on the chain to jointly maintain a distributed shared ledger through distributed storage. All non-confidential data is stored and shared in all chain nodes, breaking the barriers between the various information systems of the enterprise, facilitating the management and coordination of the supply chain enterprises as a whole, and the upstream and downstream enterprises of the supply chain according to the transaction and logistics information of different links. Timely adjustment of its own supply strategy to facilitate enterprise risk control and core enterprise credit transfer to multi-level enterprises in the supply chain.

##### **4.2 Use smart contracts to create a trusted trading environment.**

A smart contract is a computer program of contract terms on a blockchain that is automatically executed when conditions are met. Smart contracts reduce the risk of manual operations, and rely on rules to automate performance through procedures, ensuring that two or more parties to the transaction can perform their obligations as scheduled, so that the transaction can proceed smoothly and reliably. The efficiency and reliability of machine credit greatly enhance the trust and transaction efficiency of both parties, and effectively control the performance risk.

##### **4.3 Safeguard data security and untrustworthiness.**

The centralized management method has the problem of data tampering caused by the excessive power of the data center. However, in the blockchain, since each transaction record is recorded in the block, each new block will record the previous block. The hash value, when someone privately modifies a piece of data on the blockchain, the hash value of all the blocks in the blockchain needs to be changed to ensure the data is valid, so the cost of modifying the uplink data is very high. Guarantee data authenticity through data chaining.

#### **5. Blockchain Technology Applied to the Tobacco Supply Chain**

Using the characteristics of blockchain information disclosure, decentralization, and difficult data tampering, the tobacco supply chain management system is constructed to realize the interdependence of various main business flows, information flows, logistics and capital flows in the tobacco supply chain, so that tobacco products can be fully integrated. Traceable, the management department can check the sales situation of cigarettes and the distribution of sales at any time, and adjust the market strategy in a timely manner; consumers can trace the source of cigarettes and eliminate the phenomenon of fake cigarettes and stocks.

According to the supply chain survey of some enterprises in the tobacco industry, the supply chain includes six parts: raw material origin, cigarette factory, inventory warehouse, commercial company, retailer and final consumer. The core enterprises in the supply chain are tobacco commercial companies. The upstream links include raw material production areas, cigarette factories, and

inventory warehouses. The trade links are controlled by the government system; the downstream links include retailers and end consumers, which are numerous and widely distributed. The tobacco supply chain process is shown in Figure 2.

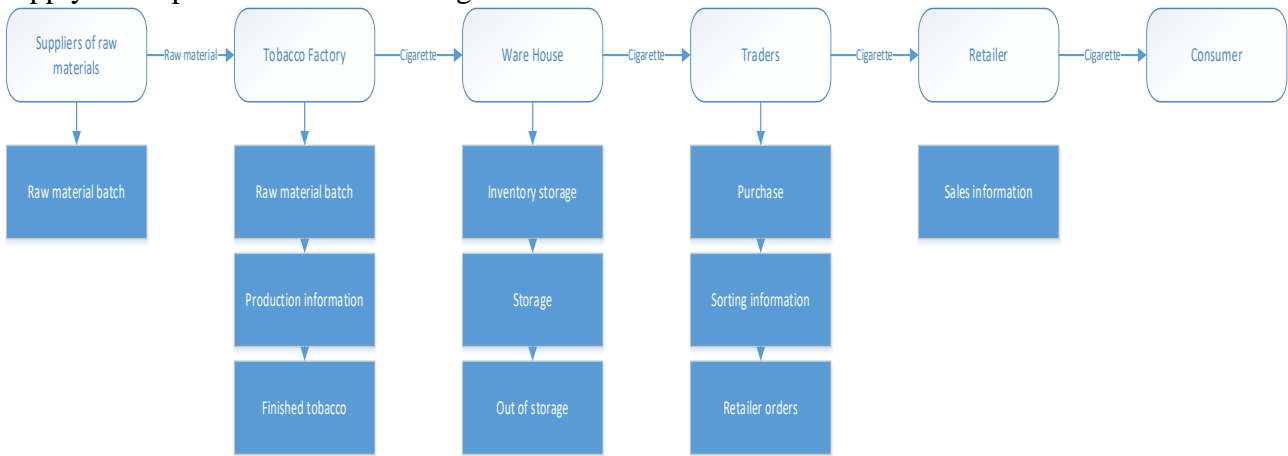


Fig. 2 Tobacco Supply Chain Process

For the upstream enterprises in the supply chain, the enterprises mainly deal with bulk materials. For example, the raw materials are produced in batches to transport the raw materials to the cigarette factory, and the inventory warehouse manages the cigarette storage on a piece-by-piece basis. The purpose of information recording is mainly the traceability of goods and the exchange of trade. The participating entities correspond to different enterprises, and the number is relatively fixed. For retailers downstream of the supply chain, they have frequent transactions, a large number of participants, and need to apply for cigarette sales qualifications. Therefore, it is necessary to implement a tobacco supply chain management system by using a coalition chain with high information reading and writing efficiency and a controlled number of subjects.

According to the characteristics of tobacco supply chain, a tobacco supply chain management system based on the main and auxiliary alliance chain is proposed, as shown in Figure 3. The supply chain is divided into two layers horizontally, and the main chain and the auxiliary chain are separately deployed. Raw material origin, cigarette factory, inventory warehouse, commercial company, retailer as the main chain member, used for logistics management, contract storage, intelligent performance; internal procurement department, warehousing department, management department, marketing department, sales department, etc. As an auxiliary chain, the department is used for internal production management, procurement and sales coordination; through the specific interface, the auxiliary chain will disclose information that does not involve trade secrets, as well as contract deposit, bill deposit, receipt and payment certificates. The main chain stores information such as trade secrets and contract details in the enterprise on the auxiliary chain within the enterprise. Therefore, for the main chain, there is no need to store specific data, and only the address of the publicly available data and the relevant block are stored. The column value can access related information [6], realize information sharing between enterprises in the main chain alliance chain, data confidentiality and data security in the enterprise auxiliary chain alliance chain.

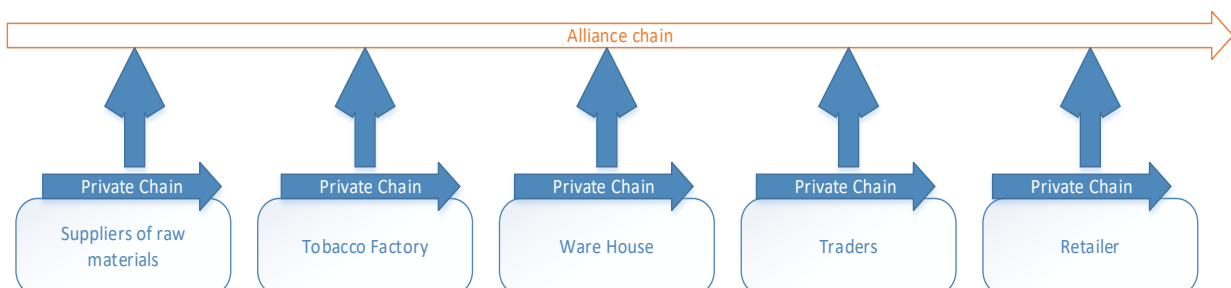


Fig. 3 Tobacco Supply Chain System Base on the Main and Auxiliary Alliance Chain

When the consumer or the enterprise needs to trace the source of the cigarette product, the source of the cigarette product is inquired through the logistics information, batch management, distribution information, etc. in the main chain, thereby achieving the purpose of eliminating the circulation of the fake cigarette and preventing the real cigarette. Such a design method can reduce the risk of confidential leakage and ensure data security. At the same time, the use of the deposit certificate system can guarantee that the contract cannot be falsified or untrustworthy. At the same time, according to the downstream consumers' tracing of cigarette products and the sales situation of retailers, tobacco companies and cigarette factories can adjust sales and production strategies according to the feedback from the retail market, analyze sales trends, customer preferences, and customer distribution. Information, so as to achieve personalized, differentiated, customized services, deepen the level of services, improve the efficiency of information utilization, and provide decision-making assistance for procurement, production, logistics, etc., and respond to market changes in a timely manner.

## 6. Conclusion

This paper analyzes the current situation of tobacco industry supply chain development, proposes the current tobacco supply chain management system, and combines the development of blockchain technology to propose the problem of solving the current tobacco supply chain management system through blockchain technology, and according to the tobacco supply chain enterprise. In detail, a tobacco supply chain management system model based on the main and auxiliary alliance chain was proposed, which formed a tobacco supply chain management system with information disclosure, high information security and full chain traceability between supply chain entities. It can provide strong evidence for illegal activities such as inquiring counterfeit cigarettes and tracing goods. At the same time, enterprises in the supply chain use chain data to adjust their business strategies in a timely manner, providing data support for improving capital turnover efficiency, reducing logistics costs and reducing default risks.

At the same time, in the development process of blockchain technology, there are still some problems. For example, the authenticity of the blockchain technology cannot be guaranteed before, and the data uplink is difficult to tamper with and the loss caused by the mistake of entry is very large. How to ensure the authenticity and accuracy of the uplink data is a problem that the blockchain technology needs to solve in the practice of the tobacco supply chain management system.

## References

- [1] CAI Jinhua. Application of block chain in Construction of cigarette supply chain system[J]. LOGISTICS ENGINEERING AND MANAGEMENT, 2017, 39(6): 89-90.
- [2] LI Xiaohua. Design and Implementation of Supply Chain Management System Based on Guangdong China Tobacco Group[D]. Changsha: Hunan University, 2017.
- [3] WANG Yanni. Research on the Construction of Lean Management System of YLYC Company from the Perspective of Supply Chain Management[D]. XiAn: Northwest University, 2018.
- Iyio. 2018 blockchain industry application research report[R]. Beijing: Iyio, 2018.
- [4] ZHANG Nan. Tobacco supply chain logistics construction and development[J]. Technology application and innovation, 2017, 7: 280-280.
- [5] ZHANG Lu. Research on Financial Innovation of Blockchain Driven Supply Chain from the Perspective of Game Theory[J]. On Economic Problems, 2019, 4: 48-54.
- [6] DING Qingyang, ZHU Jianming, ZHANG Jin, etc. Traceability permissioned chain consensus mechanism based on double-layer architecture[J]. Chinese Journal of Network and Information Security, 2019, 5(2): 1-12.