Research on the Secure Financial Surveillance Blockchain Systems

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Abstract

Supply chain finance refers to banks or loan institutions that can provide financial services to industries in which the core enterprise's supply chain industry is located. Blockchain with confidentiality, accountability, non-repudiation, and reliability can be effectively used in supply chain finance. Transactions and individuals can be stored in a distributed ledger, copying copies to each node of the blockchain to prevent data corruption and collapse. In addition, sensitive data stored in the blockchain is never afraid of being stolen, and always maintains its privacy. In this proposal, we intend to raise three research questions to design a mechanism that can not only help with credit checks but also be used for loan ledger management: 1) Research on the preservation and supervision of credit information on the blockchain; 2) Research on the blockchain in post-loan management; 3) Research on the financial supervision chain based on a time sequence.

Keywords: Blockchain; Distributed Ledger; Financial Surveillance Blockchain Systems; Peer-to-Peer Networks

1 Introduction

Supply chain means a unit consisting of a series of upstream suppliers, buyers, retailers, and distributors to the final downstream consumers [26]. From the initial purchaser to purchase raw materials from the supplier to the intermediate manufacturing, design, completion of the final product, and finally deliver the product to the consumer. The network formed by these series of actions and processes is a simple supply chain. In terms of manufacturing, the manufacturing supply chain is roughly composed of three parts: supply, manufacturing, and distribution. Supply is the process by which the purchaser must purchase raw materials from the supplier and strictly supervise its quality before manufacturing the goods; After the manufacturing makes up the raw materials for the purchaser, the raw materials are made or improved into the final product; Distribution is the use of retail, shipping, and orders to deliver the final product to the customer. However, in the real environment, the supply chain is more complicated, and each process of the upstream, middle, and downstream units can supply each other. The supply model is also quite complicated, including issues such as sales methods, efficiency assessment, and payment methods [2]. So not only the manufacturing supply chain that everyone is familiar with, this concept can be used in various fields. This paper mainly focuses on the financial supply chain.

In the traditional financing and lending model of financial institutions, the pre-operation is to collect credit from enterprises or individuals. The content of the credit report is that a third party department other than the bank sorts out its financial status, credit report, and the nature of the department's work, and then delivers it to a credit institution such as a bank as a reference condition for a loan or information. Therefore, traditional financial institutions are more willing to provide financial support than competitive core enterprises. However, smaller companies or upstream and downstream suppliers have higher operational risk and are more resistant to economic fluctuations than core companies. Coupled with the information asymmetry factors of banks and SMEs and the high cost of credit reporting, financial institutions are re-

luctant to provide loans to these suppliers. The result is an imbalance in the supply chain due to difficulties in capital turnover. Because of this, in recent years, various financial institutions have also actively responded to this phenomenon, and supply chain finance came into being.

In short, Supply Chain Finance (SCF) is a bank or lender that seeks and targets specific core companies, uses it as a starting point, and integrates and connects with upstream and downstream companies to provide a financing model of flexible financial products and services [2]. It is effectively investing funds in upstream and downstream of small and medium-sized enterprises (SMEs) can make capital flow flexibly in the supply chain and solve problems such as financing difficulties and supply chain imbalances for SMEs. Therefore, supply chain financing also has another name, called supply chain financing. The biggest difference between supply chain finance and the above-mentioned traditional financial credit industry is that through the evaluation of the credit and capabilities of specific core companies, financial institutions share information asymmetry between upstream and downstream SMEs [27]. So that upstream and downstream SMEs can obtain sufficient financial support to maintain the balanced development of the supply chain, as shown in Figure 1.

There are already international success stories, the most widely known being the Mexican National Financial Development Bank (NAFIN). The bank obtains information about large European and American channel providers and establishes contacts with domestic SME. The bank used the high credit of European and American core enterprises to reduce the default risk or other risks of SMEs. It successfully established a multinational supply chain financial platform between core enterprises and suppliers. However, due to the development of traditional supply chain finance, it only provides services for about 15% of suppliers. 85% of SMEs still suffer from cash flow.

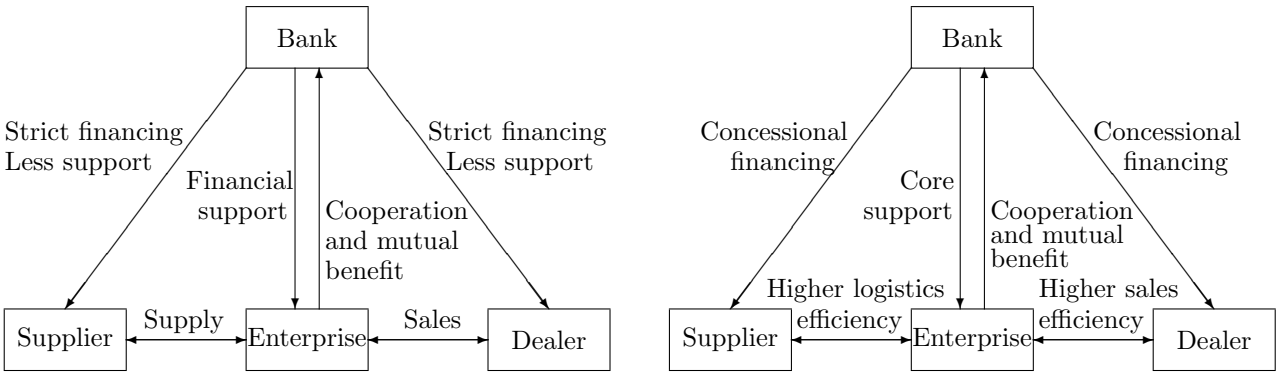
In order to solve this financial problem,blockchain is an opportunity for commercial financing. Blockchain is a decentralized database in the form of a peer-to-peer network, also known as a decentralized ledger [6, 14–16]. It has the characteristics of decentralized, permanent storage of data, and no tampering of data. Initially, it was mainly used for virtual encrypted electronic money. When it comes to blockchain cryptocurrency, one must mention the representative work of blockchain technology-Bitcoin. Satoshi Nakamoto released the Bitcoin white paper (Bitcoin: a peer-to-peer electronic cash system) in 2008, and officially released Bitcoin in 2009 [19, 24]. It is a virtual currency composed of point-to-point, proof of work, encryption and decryption technology, and electronic signature [4]. It is also the most famous cryptocurrency with the highest market value and unit value. According to official bitcoin information, as of 2017/12/05, the official exchange rate was 11726.03 US dollars. Compared with about 300 US dollars in 2016/12, it has increased by more than 30 times, and also let us know the infinite potential and possibilities of blockchain technology.

Satoshi Nakamoto issued the first Bitcoin block in 2009, which we call the Genius block. The field of the block contains the hash value function, timestamp, transaction number and content of the block, block index, difficulty calculation, etc. The value in the blockchain field is a hash function composed of multiple bits, which is a hexadecimal hash function generated after calculation by the encryption algorithm SHA-256 (secure hash algorithm) [7,8,10]. It is easy to verify, but difficult to reverse. This algorithm calculates the public wallet address and hash value function of each transaction. The reason why the blockchain is called "chain" is that the hash function of each new block is derived from the hash function of the previous block, and then calculated by an algorithm. With such infinite expansion, there will be a feeling of putting each block "chain" together. When a malicious attack changes the contents of a block, the block hash function will become completely different. It is why the blockchain has the characteristics of non-tampering. Because as long as the hash function can be easily compared, you can know whether the block is correct. Blockchain is not only used for cryptocurrencies but also widely used in IoT (Internet of Things) [1], DRM (Digital Rights Management), healthcare, and stock debt. The term smart contract also appeared, often referred to as blockchain 2.0, and then evolved into blockchain 3.0 again. Many companies in the world develop blockchain technology, such as IBM, R3 Alliance, and Ripple.

2 Related Works

In the past, experts and scholars have conducted research on financial lending and supervision, focusing on risk management and risk prediction [3, 11, 20] and its efficiency [9]. Through analysis to reduce risks [5, 21], improve financial stability [13]. Tao analyzed the relationship between companies through game theory [22]. Luo and Zhang used game theory analysis and provided recommendations to participants and regulators to solve financial risks, reduce regulatory costs, and improve the effectiveness of financial regulation [17]. Huang proposed data analysis to improve the effectiveness and safety of financial control [9]. Zhang proposed that the module structure is based on the financial supervision system, and it will immediately issue a warning signal when it encounters economic conditions [29].

In order to meet these requirements, many corresponding systems have also been proposed, and scholars such as Ye *et al.* proposed a web-based information system [28]. The system can analyze and predict financial risks. However, today's financial commodities are becoming more and more diverse, and trading systems are becoming more and more complex. To adapt to a more variable trading system, Tsai proposed to apply intelligent blockchain technology to financial supervision [23]. They use corpo-



(a) Traditional financial model (b) Supply chain financial model

Figure 1: The financial mode

rate bonds as an application area and design more complex and variable trading systems for commodities. Use the decentralized advantages of blockchain to eliminate the need for direct peer-to-peer transactions for intermediaries. Make transactions transparent, safe, and anonymous. However, this method does not consider loans to SMEs because the loan amount is not high, but the audit cost is too high.

Mainelli & Smith proposed a qualitative multi-attribute model to identify the situation where the price of a single stock is affected by fraudsters who will actively promote stocks to support decisions in the field of financial market monitoring [18]. And provide data based on a large number of abnormal conditions. Lee *et al.* proposed the forward and backward analysis methods of the FDB Miner (FDBM) Information Extraction system [12]. This method aims to detect potential illegal Pump and Dump comments on the FDB by integrating the stock price per minute during the detection process to reduce false positives during the detection process. Wang *et al.* proposed a blockchain loan (LoC) in 2019 [25]. It is an intelligent financial loan management system based on smart contracts. They designed a digital account model for transferring assets between centralized and decentralized ledgers and introduced digital signatures to protect data privacy.

This article will propose three research directions:

1) Use blockchain traceability and transparency to integrate supply chain finance. In addition to making each transaction in the supply chain more comfortable to manage, it also allows financial institutions to easily view past import, export, or transaction data for SMEs. And under the protection of the security mechanism that cannot be tampered with or forged by the blockchain, the cost of bank credit and audit operations is significantly reduced. It makes the short-term capital turnover of SMEs easier and maintains the stability of the supply chain.

2) Tracking problems after loan. Post-loan tracking of traditional financial institutions is an important issue. In the past, few studies have proposed methods to solve the problem of severe difficulty and high cost of post-loan tracking.

3) Although personal privacy information is protected, it has resulted in a large number of financial institutions (such as banks, securities, insurance, trusts, and funds) signing a large number of personal data consent applications, resulting in reduced financial supervision efficiency.

Therefore, the financial system needs more effective and safer post-loan management and economic supervision methods.

3 Research Issues

In the blockchain environment architecture proposed in this article, the blockchain functions and architecture can be used in the industrial supply chain to improve user safety and performance. We apply various record keeping and encryption protection technologies to the blockchain environment. In this section, we propose three research topics: (1) Research on the preservation and supervision of credit information on the blockchain; (2) Research on the blockchain in post-loan management; (3) Research on the financial supervision chain based on a time sequence. Figure 2 shows the research architecture and describe it as follows.

3.1 Research on the Preservation and Supervision of Credit Information on the Blockchain

The traditional supply chain system is called the B2B (Business to Business) model. Because any node in the supply chain is only connected to its upstream or upstream, it does not fully understand the upward or downward supply chain relationship. However, in the era of

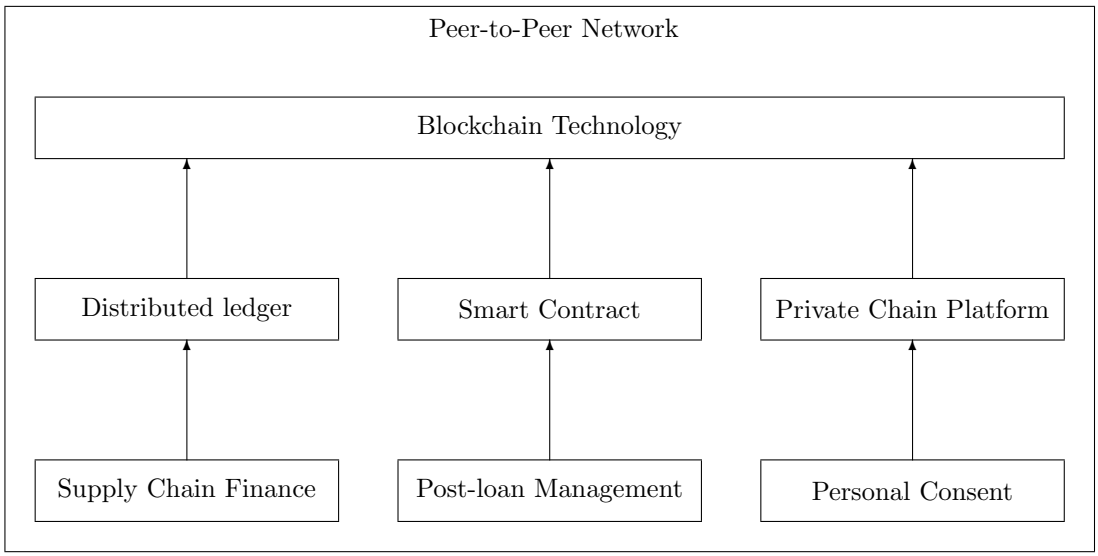


Figure 2: The research architecture

economic globalization, the product design from the initial raw material purchase to the final product model sales can be regarded as a long-chain single-chain system. However, the information currently understood by most nodes is limited to the units directly related to it, which is also one of the factors that cause asymmetric information in the supply chain.

In the absence of information, it is difficult for SMEs in the supply chain to verify whether they are one of the core business partners. Besides, the small size of the enterprise will also lead to a small amount of borrowing. When the audit costs of traditional financial institutions are too high, they will naturally resist the financing activities of SMEs. If we integrate the traceability and transparency of the blockchain into the supply chain finance, in addition to making each transaction in the supply chain more comfortable to manage, it also allows financial institutions to quickly check the past imports and exports of SMEs And transaction data. And under the protection of the security mechanism that cannot be tampered with or forged by the blockchain, the cost of bank credit and audit operations is significantly reduced. It makes the short-term capital turnover of SMEs easier and maintains the stability of the supply chain.

In the research theme, the use of blockchain transparency and unforgeable features will solve the problem of supply chain information asymmetry. The research topic will focus on necessary blockchain technology, including consensus algorithms, cryptographic hash functions, etc. And design a set of decentralized ledger platform for blockchain. For traditional records and supervision, we finally introduced the process from the supply chain to the downstream.

Due to the non-tampering, traceability, and high privacy functions of the private blockchain, a blockchain platform was developed. It can enable banks or other financial institutions to conduct credit investigations on enterprises or individual units faster and save more costs. First, a decentralized ledger must be created to allow units that need to borrow from the bank to retain their supply chain transactions, expenditure income, and other accounting materials. It will enable financial institutions to collect credit information faster and more efficiently. Figure 3 and Figure 4 are the flow charts of this platform.

In Figure 3, as long as any unit initiates a transaction, whether upstream of the supplier or upstream of the manufacturer's supplier, as long as both parties agree to initiate the transaction, the transaction will be stored in the temporary storage pool for confirmation. Then through Figure 4, all pending transaction items are broadcast to each unit in the supply chain. After designing the consensus mechanism of the algorithm, it is finally broadcast to the database system of each unit. Each unit in the supply chain can have the same ledger, which is the last decentralized ledger in Figure 4. In the security mechanism, to avoid tampering, it will lead to the situation of the bank's credit information is untrue, and eventually, cause unnecessary misunderstandings, and even cause credit bankruptcy. We introduced a multi-node authentication mechanism on the public chain. Even if a unit wants to tamper with the content arbitrarily, as long as it is not more than half, each node can compare the old and new data in real-time. According to the principles of our design, the data will never tamper successfully, so in addition to permanent storage, the possibility of tampering is also very low.

The research topic needs to overcome the following potential problems: Although units in the supply chain can use blockchain technology to record at any time, however, data leakage between groups is undesirable, which leads to leakage of business opportunities. When financial institutions ask for credit, will they have too much

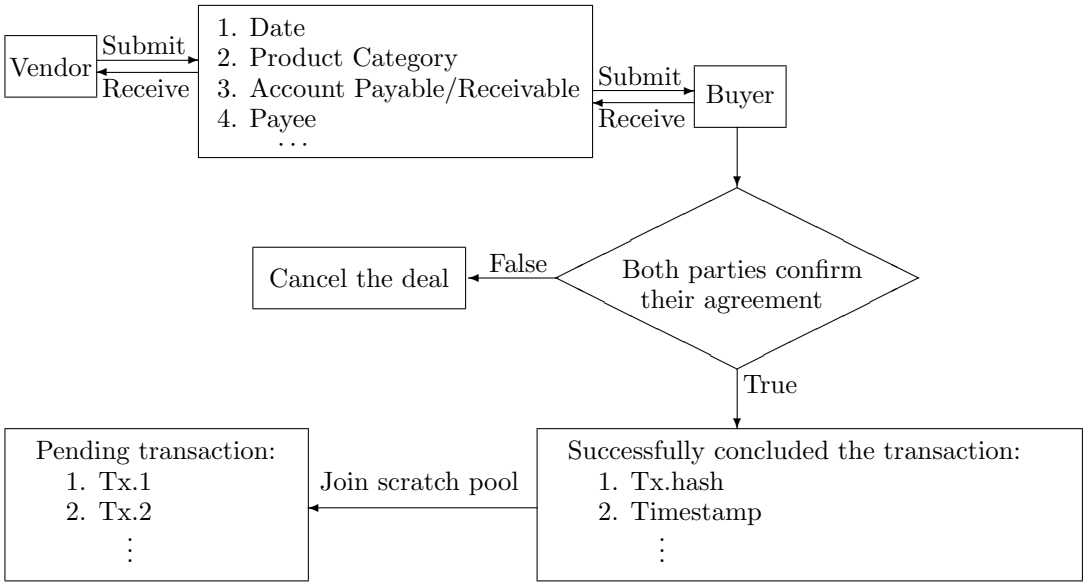


Figure 3: Supplier and buyer forming transaction phase

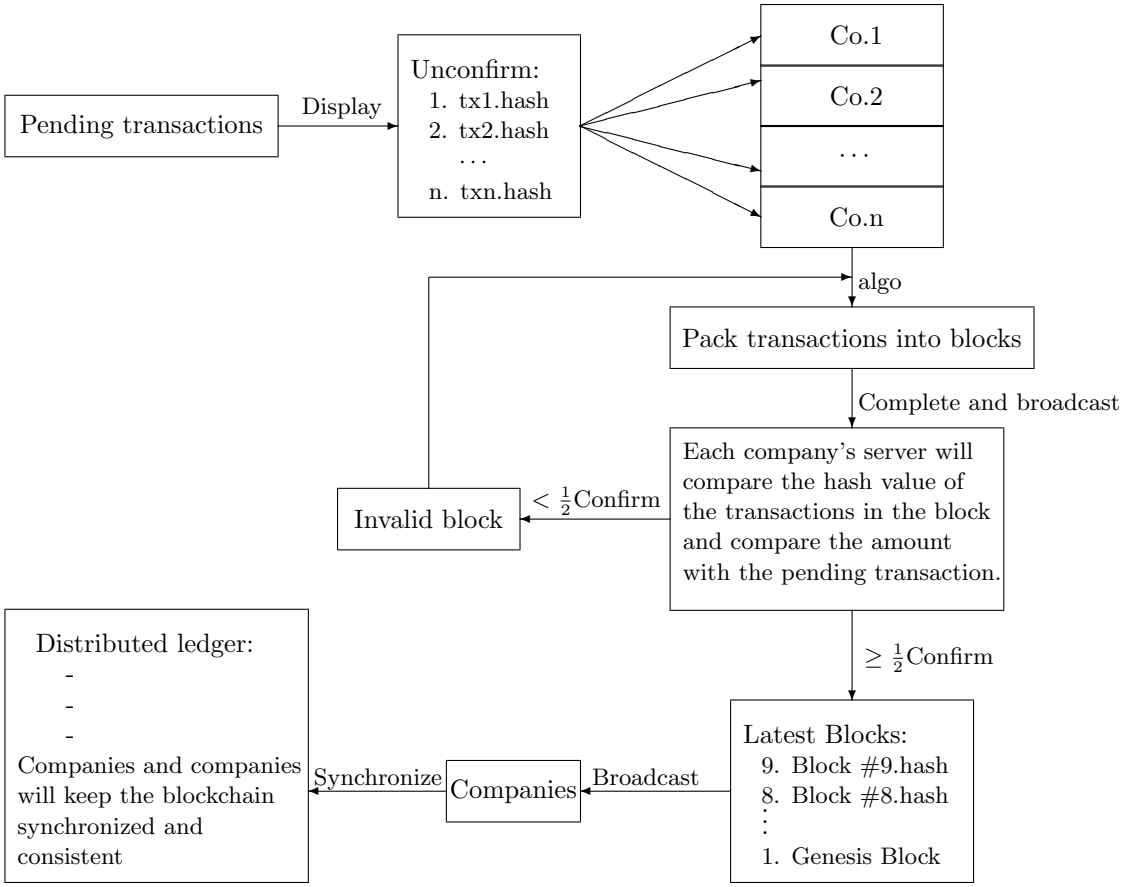


Figure 4: The synchronization to decentralized ledger process

essential data themselves? The specific situation must be considered according to the actual situation, and a more comprehensive overview and analysis are required.

3.2 Research on the Blockchain in Post-loan Management

Post-loan management is the process from financial institution loan issuance to loan recovery. This intermediate link or other aspects of the management process is also the final link after completing the credit work. Contents include loan tracking and review, credit risk management, and daily credit management. The primary purpose is to confirm the customer's repayment willingness and repayment ability and other factors so that financial institutions can ensure loan security and case prevention and control issues, prevent loan overruns, and more effectively control loan risks. Generally speaking, the post-loan management part of financial institutions' credit management is always weak and unreliable.

There are many problems with post-loan management. The client's business and financial situation is usually constantly changing. The client's financial status may be good at the initial credit. Still, later due to environmental prices, economic downturn, investment failure, commercial interference, poor management of the company, or bad policies may be weak. The customer's operating financial situation has an adverse effect. Therefore, post-loan management not only supervises the pure financial operation of customers, but also oversees upstream and downstream manufacturers starting from the customer industry, and even partners and business credits of partners. It is also the information that financial institutions must pay attention to and track. We can only find problems that are not conducive to loan repayment in time and propose appropriate solutions. The blockchain ledger technology is transparent and traceable and cannot be tampered. In addition to checking and sorting the ledger records, it also saves time and effort and also ensures the accuracy of customer data. It is very suitable for recording various matters of post-loan management, effectively reducing costs and improving operational efficiency.

In the research topic, the transparency of using blockchain will improve the efficiency of post-loan management. This topic requires an understanding of the loan process between domestic and foreign financial institutions and companies. For example, a letter of credit guaranteed by a third party, an ERP system (Enterprise Resource Planning) for enterprise resource planning, a continuous loan after the initial investment is completed, and a post-loan management part before full repayment. And research and integrate smart contract deployment on the Ethereum platform to save a lot of time and labor costs.

From the initial loan to the final repayment, the traditional financial post-loan management is the weakest and most inefficient part. The main reason is that tracking is more difficult and costly. Imagine that if a financial institution lends tens of thousands of individual units or enterprises, it will be an extensive project to track the financial status after a loan. To build a blockchain platform, use the blockchain to store all data, and even use the blockchain 3.0 smart contract for many applications. Financial institutions create their smart contracts for each unit or enterprise, allowing lenders to perform operations such as automatic repayment or transaction deferral. Banks will save the time and cost of collecting payments regularly, and can even keep banks from requesting money from units that cannot repay loans.

The following are the blockchain post-loan management process of the research topics:

1) Overseas companies sign contracts and place orders with domestic manufacturers.

2) Overseas companies open individual accounts in the international bank.

3) Overseas companies remit 30% of the first part to the individual account of the international bank.

4) The international bank writes letters of credit in the form of smart contracts and places the deals on the blockchain.

5) The local bank remit 30% of the first part of funds to domestic manufacturers by smart contracts.

6) The domestic manufacturer's ERP system records the warehousing, logistics, and capital usage, and connects the blockchain system to update smart contracts in real-time.

7) The local bank performs post-loan management by updating smart contracts.

8) The local bank gradually issues loans based on the contract performance on smart contracts.

For smart contracts, the most extensive and standards-compliant platform is the Ethereum platform.

The research topic needs to overcome the following potential problems: The use of smart contracts to supervise and control the loan process, replacing traditional letters of credit, etc., are all built on the Ethereum platform. But Ethereum is currently only a transaction between numbers. If you need other functions, you need to develop different platforms and add a smart contract compiler. More research is needed in this area.

3.3 Research on the Financial Supervision Chain Based on a Time Sequence

In financial institutions, no matter what services are used, including foreign currency economic commodity financial management and insurance departments. The first task must be to confirm the identity of the customer and comply with the Personal Data Protection Law. The

purpose of the law is to regulate the collection and application of personal data by relevant units to avoid infringement of personality rights. To promote the cognitive processing and utilization of personal data, the objects of supervision of the Personal Data Protection Law include various institutions and individual units as well as financial banking institutions. But financial institutions include many different departments, and usually, the system of each department is independent. When customers sign the use of the law, different departments of financial institutions also need to repeat the operation once. Traditionally using paper records, in addition to being time-consuming, the process is inefficient. Reduce customer service perception and service willingness. If we use the blockchain to record customer's consent in a financial institution's proprietary account, not only can the information exchange of various departments be integrated, but the customer can also change the personal asset law for the first time when driving the power of the financial institution and solve the time cost of traditional paper records.

In the research topic, the time sequence of using blockchain can help financial institutions to track and monitor customers' wishes. This topic will focus on personal data protection law issues. Under the financial institution system, a private chain combined with a decentralized ledger platform is established. The consumer's privacy law application is stored on the blockchain, and the chronological order is used as the final basis. It does not affect the independent database between the various departments of the bank so that the information can be circulated among the different departments, and it also replaces the traditional paper, causing problems of waste of resources and difficult to save.

Because of this, the subject of this study is to build a proprietary private chain system platform for financial institutions. The system is specifically designed to store consumers' use of personal data, including the current signature time and whether they agree with the use of financial institutions. After using blockchain technology to form a record book, this information will be broadcast to each department's independent database system under the same financial institution. The data content of each unit is the same, and financial institutions can also set up other database systems or cloud systems to store these data. When more nodes have this account, both security and accuracy can be guaranteed.

This topic needs to consider many details, such as how to verify that the consumer's current signature is a real person, and whether to give consumers the right to query their signature status. There is also the speed and difficulty of each node verification and so on. It also involves the design of functions and algorithms in the system.

4 Conclusions

In this article, we have proposed three research topics: 1) Research on the preservation and supervision of credit information on the blockchain; 2) Research on the blockchain in post-loan management; 3) Research on the financial supervision chain based on a time sequence. The purposes of these topics are 1) Credit check and management using blockchain can help banks find it easier Industry transaction data, thereby reducing cost audits and investigations; 2) Loan management using blockchain to track loan repayment ability; 3) Financial monitoring period helps protect user's data.

The research topic needs to overcome the following potential problems: When a customer signs, the traditional method of verifying identity is double certificates, signatures, stamps, or handwriting. However, using blockchain technology, how to provide user-oriented proof when reading data in the future is the biggest challenge currently facing the system.

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Biography

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