Research on the Application of Blockchain Technology in Software Supply Chain Management

Xuemei Zhou[*], Wenke Cheng

59023786@qq.com[*]

Xinjiang Vocational & Technical College of Communications

Abstract: Software supply chain management is one of the important tasks in modern software product development, and whether this work is carried out well or not is directly related to the development quality of software products. Therefore, in the process of modern software product research and development, we should carry out high-quality software supply chain management, and to achieve this goal, we should pay attention to the application of blockchain technology. Based on this, this paper briefly introduces the concept and characteristics of blockchain technology, and then analyzes the requirements of software supply chain management. On this basis, this paper puts forward a software supply chain management scheme based on blockchain technology, and verifies the scheme. Through verification, it can be found that the application effect of this scheme is good, which meets the needs of all aspects and can be applied to practice.

Keywords: blockchain technology; Supply chain management; operation flow

1. Introduction

At present, influenced by the international environment, the United States has increased the restrictions on the use of software products in China, which has caused some interference to the development of software research and development in China. In this context, China's software field has started to catch up with the operating system and big data, thus strengthening the software supply chain and generating a higher degree of attention. Among them, the most important thing is the application of data block technology, which greatly improves the quality and effect of software supply chain management and lays a good foundation for the research and development of software products in China. Based on this, this paper studies the application of blockchain technology in software supply chain management, in order to provide help for better software supply chain management.

2 Overview of blockchain technology

2.1 Blockchain concept

In the development of modern society, blockchain is widely used. Blockchain first appeared in the field of bitcoin. For each block, it can be regarded as a variety of decentralized databases. According to the characteristics of time stamps, data are input into each block in turn. Every time data is input on each data node, it must compete for the right to keep accounts through a

certain mechanism. Only nodes that meet the requirements of this right to keep accounts can input data and distribute it throughout the blockchain system. In information verification, hash pointer technology is mainly used, that is, the main information in the data is extracted. In the whole blockchain, each block, as the main tool for data storage, not only stores a lot of data information, but also has a hash pointer corresponding to the previous block. Specifically, the blockchain structure is shown in Figure 1 [1].
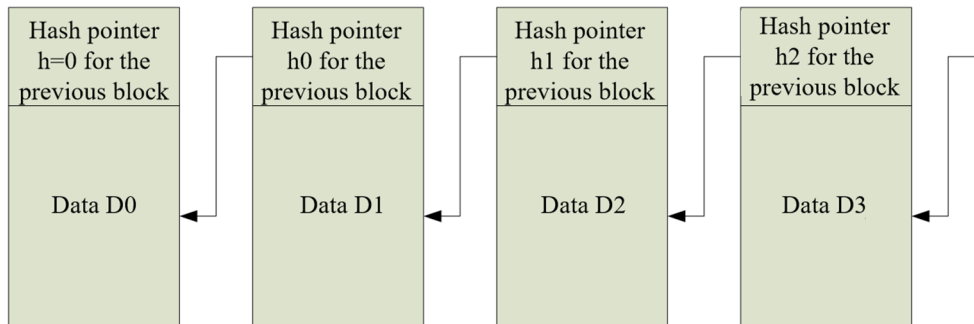

Figure 1 Blockchain structure diagram

2.2 Blockchain features

As a more advanced data storage method, blockchain has many characteristics, specifically, it mainly includes the following: (1) Distributed. There is no central node in the whole system, that is to say, any block can be regarded as a central node, and the specific location of the block has no connection. Because of this feature, when data is stored, it can be distributed to multiple nodes. When the data in one or more blocks is lost or damaged, the data can still be recovered only if there are no problems in the blocks, which greatly improves the security of data storage. (2) autonomy. On the one hand, after the blockchain is started, it will follow the pre-designed rules and there is no need for personnel to intervene. On the other hand, all the blocks are exactly the same. According to the rules set in the early stage, all the blocks can negotiate effectively. On this basis, the whole system has a high degree of trust in people by using corresponding machinery and equipment. (3) Traceability. The last block of the system contains the hash value of the previous block, and only after obtaining the hash value of the previous block can it be connected with it, which makes the whole blockchain system have strong correlation. Using this feature, the data transmission in the system can be traced back [2].

3 Software supply chain management needs analysis

3.1 Information deposit certificates requirements

Software supply chain is a complicated and tedious process. In many links, a large amount of fixed storage information will be used, such as contract information, faults during software debugging and operation, and suppliers' services. These storage information needs to be accurately recorded, and the recorded information has high reliability and is recognized by all participants.

3.2 Information sharing requirements

In software supply chain management, there are usually a lot of contribution data. The application of these shared data can not only reduce the difficulty of software development, but also speed up software development and save software development costs, which is of great significance to the whole software research and development work. When sharing data, all participants need to coordinate effectively, and use the trust of participants to complete all the work, especially when the scheme is revised, it is necessary to inform other participating units at the first time. If the scheme is revised, it shall be reported to the owner first, and the owner shall determine whether the scheme conforms to the important areas. If the owner has no objection, it shall inform other participating institutions related to the project. However, it should be noted that in the traditional software supply chain model, due to many factors, the communication between participants is not very smooth, the process is complex and the time is long, which is not conducive to the research and development of software products [3]. Therefore, in order to ensure the smooth development of software products, we should pay attention to the data sharing management in the supply chain.

3.3 Trust mechanism requirements

Trust is the core issue in software supply chain management. If a participant's trust is low, he may fail to complete all the work according to the previous agreement and perform his due duties, which will lead to certain potential risks in the supply chain. In severe cases, there may even be litigation problems, which seriously threaten the research and development of software products. Therefore, in the process of supply chain management, it is necessary to effectively control the trust problem.

4 Software supply chain management scheme based on blockchain technology

4.1 Software supply chain data storage and sharing model (DSSM) construction

4.1.1 Overall framework of DSSM model

In order to carry out high-quality software supply chain management, this paper constructs a data storage and sharing model (DSSM) with blockchain technology as the core. The model has six layers, as shown in Figure 2 [4], and the functions of each layer are as follows:

(1) Facility layer is used to load various devices in the system, such as data storage module, data analysis module and data communication module, and provide physical hardware support for the safe and stable operation of the whole system.

(2) Data layer is used for data storage. Because advanced technologies such as hash algorithm are set in this layer, data storage is more secure and meets the requirements of modern computer system operation.

(3) Network layer. It is the core module in the whole system, and it preserves many key elements, such as communication protocol and data verification algorithm, by encapsulation, which is used to drive all blocks to search and analyze the input data together. In networking

mode, P2P mode is usually adopted, so all blocks can be used as operation nodes for data transmission and verification.

(4) Consensus layer. In this layer, the mode of DPoS is adopted. By voting, the accurate representatives are determined, and the data is input into the block by accounting among all representatives. At the same time, after applying this mechanism, the DSSM model will be more flexible, and the block size can be modified at will according to the actual needs, so that the DSSM model can be applied to more scenes. It is the existence of this layer that makes this system achieve the purpose of decentralization.

(5) Contract layer. It is used to store codes, algorithms and various contracts. When the relevant requirements are met, the contracts will be automatically activated without personnel control, which improves the intelligence level of the whole model, reduces the usage of human resources and improves management efficiency.

(6) Application layer, that is, the model stores the supply chain management work, such as information flow management and capital flow management, so as to make the whole supply chain management work normally.
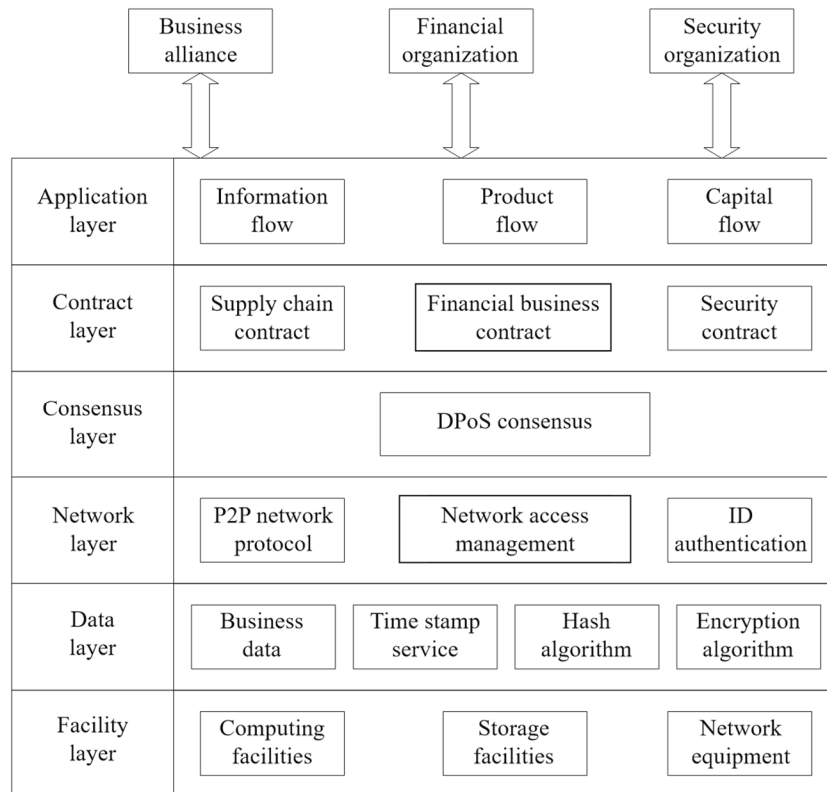
Figure 2 DSSM model structure diagram

3.1.2 Working mechanism in DSSM

When the DSSM model is running, it mainly involves three mechanisms, and each mechanism needs to adopt different working mechanisms, specifically:

(1) Business alliance. Using the port on the application layer, all kinds of data are transmitted to the DSSM model, and in this process, it needs to be signed by the corresponding private key. Other institutions can check these data to determine whether they are valid. At the same time, a credit score system is set up, through which participating institutions are evaluated, and the parties with good performance are given a certain score reward, and the branches of the parties with poor performance are deducted. If the credit score of an institution is reduced to the lowest value, it will automatically quit the institution to avoid entering invalid data. The DSSM model is used as the medium to complete the data transmission between the upstream and downstream institutions of the supply chain. Every time the data is transmitted, it is stored in the DSSM model by means of distributed storage. Each member can view and browse the transmitted data according to the agreed content in the model, so as to provide support for the development of related work. From the point of view of product flow, different products can be given different identification codes (UUID). By searching and analyzing the UUID, the information of related products can be accurately extracted, which lays a good foundation for the use of products. From the perspective of capital flow, digital RMB is adopted, which has programmable characteristics. By using the corresponding interface program, it can be transmitted to the smart contract, which can automatically complete the settlement work, simplify the transaction process, improve the payment speed, and prevent the problem that the account cannot be recovered [5].

(2) Financial institutions. In the whole software supply chain, the mode of delivery before payment is usually adopted, which leads to the need to invest a lot of money in advance when developing software, which affects the normal operation of R&D institutions to a certain extent. Therefore, on the basis of ensuring product research and development and ensuring the smooth operation of the whole enterprise, R&D institutions need to borrow a lot of money from financial institutions. In this process, financial institutions should check the information submitted by enterprises and judge whether the information is true, so as to determine whether to provide loans to R&D institutions. In response to this requirement, financial institutions can automatically collect all the information in the supply chain by using the smart contract in the DSSM model as the medium, which will help to audit the authenticity of enterprise information.

(3) Security agencies. Today, with the rapid development of modern computer technology, the problem of network security is becoming more and more serious. When using the traditional software security review mode, it can only be checked within the specified time, which is a passive inspection work and will only be dealt with after hidden dangers appear. When applying DSSM model, the software can be checked in real time based on the smart contract stored in it and combined with the relevant rules and regulations of the Internet. If problems are found, they can be reported to the R&D institution at the first time, and the other party will optimize the software.

3.2 Business process based on blockchain technology

3.2.1 Demand business process

In the past, when researching and developing software, it was necessary to investigate the market first to accurately understand the actual needs of customers, so as to provide a basis for the research and development of software products. However, the market of the whole industry is large, and in order to obtain accurate demand survey results, it is necessary to arrange a large number of survey resources, which is costly and inefficient, and will affect the accuracy of the survey results, which is not conducive to the subsequent software research and development work. Therefore, in order to get better demand information, all demanders should be regarded as a chain on a demand node, so as to improve the above problems. Through the application of blockchain technology, using its non-tamperable characteristics, strengthening the storage of data information is conducive to the management of demand changes, and at the same time, it can also visually display the demand changes and provide support for the exchanges and communication of all participants [6]. As for the demand result, it is completely transparent at the demander. By observing the result, we can determine whether the demand has been adopted. If it has been adopted, we can query the demand plan scheme and grasp the progress of the plan. Specifically, the demand business process is shown in Figure 3.
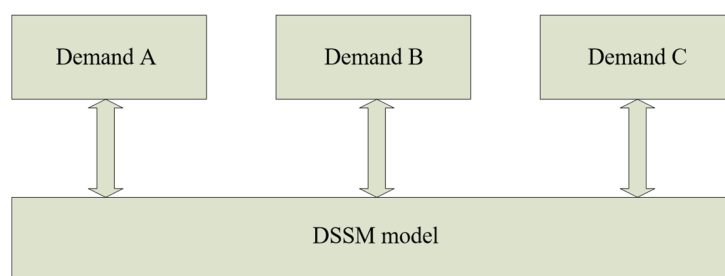

Figure 3 Demand business process in DSSM model

3.2.2 Financial business process

In the past, there was usually a serious information asymmetry problem in the material procurement mode. Affected by this problem, both sides could not make an accurate evaluation of the other side, which caused serious interference in the cooperation between the two sides. At the same time, when purchasing materials, we should reduce the cost on the basis of ensuring that the product performance meets the requirements of relevant regulations. To achieve this goal, we should improve the transparency of the whole procurement process. Among the existing common procurement modes, the main partners provide information independently, so it is difficult to sort out the data, the process is complicated, and the transparency of the whole work is not very high [7]. For example, in 2021, there were many incidents of procurement personnel engaging in malpractices for personal gain in the Internet industry, which seriously restricted the development of the whole industry. After the blockchain technology is integrated into the procurement management, the transparency of this work can be greatly improved, and it can be effectively connected with other links such as production to prepare for software research and development. After applying DSSM, the

information related to material procurement is stored in the smart contract, so as to control the whole procurement work and automatically store the whole transaction process in the blockchain. First, the enterprise transmits the purchase information to the chain according to its actual demand, and then processes it through the DSSM module, and transmits the information to the supplier according to the smart contract standard stored in it. The supplier places an order according to the actual demand of the enterprise, and at the same time, automatically locks the money to be paid, and does not directly submit it to the supplier, generating a corresponding purchase agreement, submitting it to the supplier, and generating a second smart contract. After the supplier determines that there is no problem with the agreement, it returns it to the enterprise, which shows that the agreement is officially effective and the supplier arranges the delivery according to the requirements of the enterprise. After the materials are delivered to the enterprise, the enterprise will inspect the materials and transmit the acceptance information to the blockchain, so as to drive the execution of the smart contract, unlock the account and pay it to the supplier. Specifically, the whole process is shown in Figure 4.
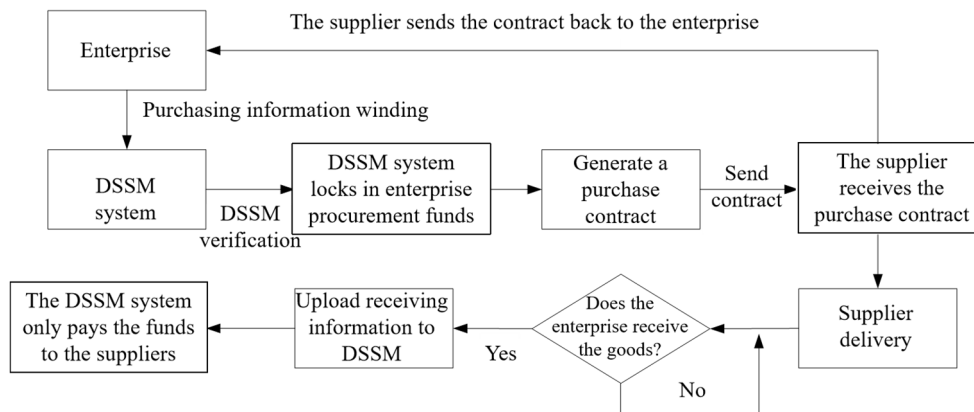

Figure 4 Financial business flow chart

3.2.3 Delivery business process

After the software development, it needs to be delivered to the owner. As for software, it is an intangible commercial product, and it needs to be tested by professional technical means. However, during testing, the results may be tampered with, and the performance level of the software cannot be truly and accurately displayed, which affects the judgment of the owner. Therefore, in software delivery inspection, it is necessary to improve the credibility and traceability of software information through corresponding technical means. After applying blockchain technology, this goal can be achieved. After the enterprise completes the research and development of software products, it directly transmits information such as feature codes to the blockchain, and the owner uses the comparison of feature codes to judge whether the detected products are delivered products. The main flow is as follows: within the DSSM model, the development organization applies for delivery and enters the feature code; At the same time, upload the software to the corresponding security agency, and the other party will test the software. After the test is completed, the security organization will enter the evaluation

feature code and submit the two feature codes to the owner through the channels outside the chain. After that, the owner compares the two feature codes to judge whether they match. If they don't match, they don't agree to the delivery application. If it matches, it shows that the software meets the requirements, and the other party can be arranged to enter the site for deployment. After the deployment is completed, the whole product shall be accepted to judge whether the on-site deployment meets the requirements. Specifically, the whole process is shown in Figure 5.
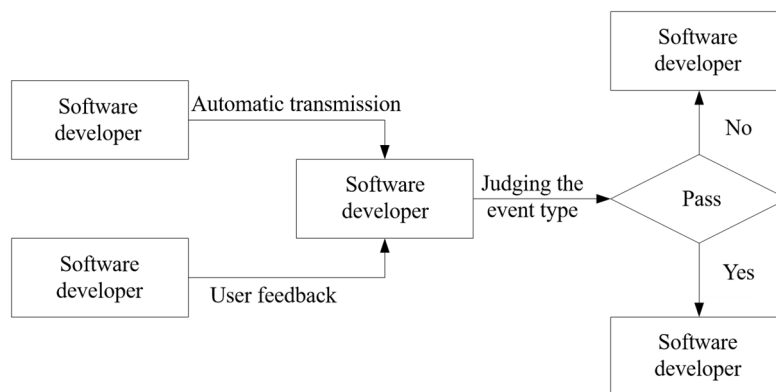

Figure 5 Delivery flow chart

3.2.4 Operation and maintenance business process

In the past, when software was operated and maintained, it was usually necessary to set up an operation and maintenance service center. After users needed operation and maintenance services, they made requests to the center. According to the request information transmitted by users, they classified the requests and arranged them for the corresponding engineers, who completed the software operation and maintenance work. After the problem is solved, the engineer reports it to the operation and maintenance center and transfers it to the user. It can be found that there are many intermediate links, and if there is a problem in the service center, it will affect the whole operation and maintenance business [8]. After applying the blockchain technology, this problem can be solved. In the process of software operation, according to the smart contract stored in it, the software operation situation is automatically detected, the existing problems are automatically found, and the problems are uploaded to the chain, and information is sent to the operation and maintenance personnel. After obtaining this information, the operation and maintenance personnel can enter the site for maintenance, and the whole maintenance process will be automatically entered into the blockchain. After the problem is solved, report to the user. Specifically, the main process is shown in Figure 6.
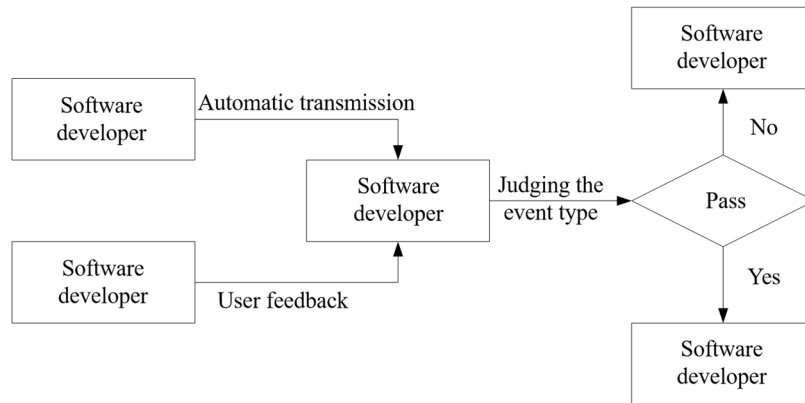
Figure 6 Flow chart of operation and maintenance business

4 Application effect analysis

In order to verify the application effect of the above DSSM model in practice, this paper verifies it through case analysis. Among them, when the information is stored and verified, the authorized and unauthorized users are used to input or extract data information respectively. Through verification, it can be found that users with authority can input data into the model or extract data from the model, while users without authority cannot input or extract data, which ensures the accuracy of data within the system. When verifying data sharing, on the one hand, we should observe whether all participants can browse the data in the system accurately, and on the other hand, we should deliberately attack the system to judge whether external attacks have an impact on data sharing. Through verification, it can be found that all participants can browse the information stored in the system, and can effectively resist external attacks, which is conducive to improving the security of system operation. When verifying the trust mechanism, the system can automatically extract a large number of relevant information, and through the analysis of these information, accurate trust results can be obtained, which is beneficial to the cooperation between various institutions.

5 Conclusion

To sum up, the application of blockchain technology in modern software supply chain management can more effectively improve the management effect of demand, procurement, delivery, operation and maintenance, and meet the needs of supply chain management for information storage, information sharing and trust mechanism, so as to provide strong support for software research and development.

References

[1]Zhang Jiayi, Zhou Liya, Wu Xiongying, et al. Application of Blockchain Technology in Tracing and Accounting of Carbon Footprint of Textile and Clothing Products[J]. Journal of Silk, 2023, 60(02): 14-23.

[2]Hu Yang, Kuang Yuanpei, Zhu Zili. Application of Blockchain Technology in National Audit — Based on the Perspective of Technical Trust[J]. Auditing Research, 2023, 08(01): 39-47.

[3]Li Hongtao, Qin Shanchun. Research on the Development Strategy of Applying Blockchain Technology to Carry out Chronic Disease Management under the Mode of Regional Medical Association[J]. China Digital Medicine, 2023, 18(01): 112-118.

[4]Shi Qin. Research on the Application of Blockchain Technology in the Field of Digital Trade — Based on the Perspective of the Whole Process of International Trade[J]. China Journal of Commerce, 2023, 24(01): 45-49.DOI.

[5]Liu Wanni, Wang Bin, Zhang Fengzhi, et al. Research and Analysis on the Application of Blockchain Technology in China's Insurance Industry — Taking the Auto Insurance Products of Insurance Companies as an Example[J]. Chinese & Foreign Corporate Culture, 2022, 07(12): 91-93.

[6]Liu Wen. Practical Evaluation and Future Prospect of the Application of Blockchain Technology "Three Chains" in Smart Libraries[J]. The Library Journal of Henan, 2022, 42(12): 116-119.

[7]Chen Qiaojian. Research on Reconstruction and Transformation Strategy of Library Information Business System Based on Blockchain Technology[J]. Jiangsu Science & Technology Information, 2022, 39(33): 49-51+66.

[8]Lu Xiaoli, Wang Chaoxian. Exploring the Economic Logic of Blockchain Technology Application Scenarios — Analysis from the Perspective of Information Economics[J]. Journal of Tianjin University (Social Sciences), 2022, 24(05): 428-434.