Application of Blockchain Technology in Supply Alliance Chain Under Big Data Time Domain

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Abstract. The 21st century is the era of big data. Data is growing at a massive amount of time, and the value of data itself is increasing rapidly. In the era of big data, the demand for security continues to increase, and traditional methods are obviously unable to meet the increasing demand. As a trust-building machine, blockchain technology, especially the multi-center architecture and multi-institutional cooperation scenarios of the alliance chain, satisfies the needs of cross-domain authentication among regions, industries, and enterprises. The purpose of this article is to analyze and discuss the application of blockchain technology in the supply alliance chain under the time domain of big data. This article first introduces the core technology of blockchain through an overview of blockchain theory, and analyzes the status quo of supply alliance chains. Finally, it integrates big data and blockchain technology to explore the supply of blockchain technology in the time domain of big data. Experimental research shows that compared with the traditional supply alliance chain technology, the supply alliance chain that applies the blockchain technology in the big data time domain is more feasible.

Keywords: Big Data, Blockchain Technology, Supply Alliance Chain, Application Analysis

1. Introduction

With the development of informatization and networking, we have entered the era of big data. In recent years, with the government's vigorous promotion and the joint participation of enterprises, the application of big data has gradually become a boom [1-2]. The blockchain technology that has developed rapidly in recent years is called disruptive technology [3-4]. With its unique advantages, it is attracting wide participation from all walks of life, and the research enthusiasm continues to rise. Applying blockchain technology to solve the application in the supply alliance chain is a forward-looking and beneficial attempt, which will have an important impact on the supply chain [5-6].

In the research of blockchain, many scholars at home and abroad have achieved good results. For example, Peter E D. pointed out that with the increasingly fierce competition in the manufacturing industry, in order to establish a long-term competitive advantage, manufacturing companies have begun to establish customers and the strategic alliances of suppliers are part of their supply chain...
management [7]. Learning alliance is just such a way to create a strategic partnership based on reflection and learning between supply chain companies, improve the ability of production organization and learning alliance, increase customer satisfaction, and gain competitive advantage [8]. He introduced the cooperative supply chain alliance that established the learning framework of total quality management between manufacturing enterprises, and discussed the factors that influence the formation of learning alliances in the manufacturing industry [9-10]. Ray collins believes that the concept of knowledge as a corporate strategic asset consolidates learning as the source of the competitive advantage of learning organizations, and the principles of learning organizations also apply to integrated supply chains, where they show the same potential to enhance competitive advantages [11]. The product flow in the supply chain is linear, but the relationship in the supply chain is non-linear, and there may be clusters or multiple nodes because they involve more than two supply chain participants. Node companies create more possible value by strengthening mutual learning. When more value is created through collaborative learning, the value trajectory exists. The author believes that the value trajectory is the sign of the learning chain, which improves the competitiveness that is difficult to be imitated by competitors [12].

The purpose of this paper is to improve the efficiency of the supply alliance chain, with the purpose of studying the application of blockchain technology in the supply alliance chain in the time domain of big data, using the literature survey method, logical analysis method, etc. to carry out research on the theme of this article.

2. Application research of blockchain technology in supply alliance chain under big data time domain

2.1. Blockchain technology
Blockchain, as the most influential and hot technology at present, has got rid of a single application scenario in the field of digital currency, and has broad application prospects in the fields of finance, Internet of Things, and identity authentication. In academia, blockchain has also achieved some research results in non-financial fields. Blockchain technology has attracted more and more attention from all walks of life.

The basic principles of blockchain technology, in simple terms, mainly include the following three concepts: transaction, block, and chain. Transaction: In the Bitcoin system, it refers to the exchange of value with Bitcoin as the currency, which is extended to the exchange of data based on a certain key data in the system. Block: Record all transactions and status of the system within a certain period of time. Chain: represents the entire ledger, connected by blocks generated in chronological order.

Features. Under the extremely dynamic technical architecture, the blockchain has developed so far, and as a trusted machine, the following five major ones have basically formed.

Similarity:
Distributed structure. Blockchain is a network-based distributed system. The ledger is not centralized in a single node, nor is it recorded and managed by a trusted third-party authority. The blockchain system relies on rules and consensus to operate, and participates in the maintenance of block data through certain rules. Any single node failure does not affect the operation of the system. Open and transparent. The operation and data of the blockchain are open and transparent, and all nodes of each transaction are visible. The data and contracts on the chain are protected by cryptography and cannot be changed. Open and transparent operating rules have laid a solid foundation for the establishment of mutual trust between nodes.

Timing cannot be tampered with. In theory, if you want to attack the blockchain data protected by cryptography, the cracking time has reached astronomical numbers; in addition, even if a certain number of node databases are modified, the normal operation of the entire system cannot be affected.

Automatic performance. At present, most of the blockchain application systems are concentrated in the field of value exchange, while virtualized digital asset transaction contracts are programmed to execute automatically according to pre-agreed rules, showing a huge change in the trust mechanism
and forming trust in the system and code. This kind of automatic execution the performance of the contract greatly reduces the cost of the transaction.

Core technology. Decentralized structure. The district-centralized architecture is different from the current centralized deployment of large databases, using multi-node, distributed deployment. At the same time, through mathematical and cryptographic methods, a trust relationship is established between business scenarios and data that require manual operations. When the record of a node is calculated first, the data will be synchronized to other nodes to ensure that the data of each node is consistent, and the data can be automatically executed in accordance with the established procedures during data exchange. While ensuring information security, it also reduces the possibility of data tampering.

Data information cannot be tampered with. The composition of the data information adopts the method of adding a time stamp to the data block. The block contains the buyer and seller of the transaction, as well as the time, amount, and address of the transaction. After each block is confirmed, it will be marked by a timestamp. The newly generated block contains the ID of the previous block and the newly generated ID of this block, forming a series of electronic transaction proofs that establish connections through the network. The nodes all store data copies and can exchange each other to ensure that the data cannot be tampered with.

Distributed accounting and storage. The accounting process of the blockchain is a process in which data passes through distributed accounting and distributed storage, and each participating node will store the same information. After the block completes accounting, it will broadcast the data to other nodes in the network. In addition, the advantage of distributed deployment is that even if some nodes in the network are abnormal, it will not affect the accounting and storage of other nodes. The architecture that the blockchain relies on is distributed, and its corresponding record storage will also be scattered on each node. Data access between nodes is encrypted by algorithms, so it can ensure that the communication between nodes is safe and reliable.

Smart contracts can be flexibly programmed. Smart contracts can enable people to embody the terms that need to be promised or fulfilled in the business in the form of codes in the program according to the established business form. Even if it is a business between multiple transaction parties and multiple business models, the corresponding terms can be automatically executed in accordance with the content of the procedural constraints. For example, in the field of charity, people process donations and limit the funds to be used to purchase charitable facilities. In this scenario, the funds raised can be transferred to the other party’s account exclusively through the program, and the support of the funds can be tracked through blockchain technology. The joint application of smart contracts based on blockchain technology and computer programs has laid a solid foundation for people to build a platform of mutual trust.

Anonymity protection from cryptography. The cryptographic mechanism of the blockchain uses a hash algorithm, also known as hash hashing. In this algorithm, a set of strings with a fixed length of information can be calculated, and a timestamp at the time of the transaction is added at the same time. To form a unique information record, through this method, the operation process between the system and the system can be highly transparent.

2.2. Supply chain alliance
In theory, the supply chain alliance combines the advantages of the two organizational forms of supply chain and strategic alliance. Its most prominent feature is that it breaks the tangible boundaries of traditional organizations, establishes a closer cooperative relationship within the alliance, and effectively integrates the alliance. The overall resources promote the ultimate realization of corporate goals. This process enables the supply chain member companies to be more closely linked together, to achieve rapid response to the requirements of the end customers, to maximize the value created by the supply chain, and to make the supply chain more competitive.
2.3. Application analysis of blockchain technology in supply alliance chain under big data time domain

(1) Identity verification mechanism.

Use asymmetric encryption to verify the identity of the node. In the external blockchain alliance chain system, the enterprise and the transporter will generate their own corresponding private and public keys respectively, and mark them in the blockchain, so that identity authentication can also be realized in the public network to prevent impersonation information from interfering with the blockchain system. The customer can select the private key and public key by himself when placing an order for the first time, and other nodes can mark the corresponding public key after the order is completed. The private key and public key of each node in the internal blockchain system can be selected by itself, or specified by the management node. Personnel changes in each node may result in the disclosure of the private key of the corresponding node. The public key of the corresponding node needs to be changed. The change of the node public key needs to be uploaded to the system and added to the blockchain after being digitally signed by the enterprise management node. In this way, it is ensured that all nodes can be notified in time, and the public keys of other nodes will not be tampered with by malicious attacks. In addition, multiple functions such as query authority control, accounting rights distribution, and division of labor storage in the blockchain system all require the realization of identity authentication. It can be said that identity authentication under asymmetric encryption is the basis of the supply alliance chain system.

(2) Consensus mechanism.

One of the most important technologies of blockchain is its consensus mechanism. The previous article has explained many consensus mechanisms and analyzed the pros and cons of various consensus mechanisms. After research, it is found that the existing large-scale blockchain consensus mechanism is actually not suitable for small-scale blockchain application scenarios. First, the relationship between the small-scale blockchain scenes is clear. All nodes are joined by real names. The scenes that are completely anonymous and cannot guarantee the creditworthiness of the nodes will not appear. Therefore, the consensus mechanism with high cost and high energy consumption is for small-scale blocks. For chain applications, the cost is too high and unnecessary. Secondly, the consensus mechanism of traditional large-scale blockchains, such as POS and DPOS, use the number of tokens as the basis for obtaining accounting rights. However, in small-scale blockchains, the issuance of tokens is unnecessary and unlawful. Therefore, in small-scale blockchain application scenarios, appropriate new consensus mechanisms should be innovated.

2.4. Asymmetric encryption

The security of the elliptic curve encryption algorithm (ECC) used in blockchain applications is also based on the elliptic curve discrete logarithm problem (ECDLP). Bitcoin uses a special elliptic curve and a series of mathematical constants defined by the secp256k1 standard. The secp256k1 curve is defined by the following function:

\[ Y \equiv (x^3 + 7) \mod p \]  \hspace{1cm} (1)

Among them \( P = 2^{256} - 2^{253} - 2^{252} + 2^{64} - 1 \):

\[ Y = (x^3 + 7) \text{ over } F \]  \hspace{1cm} (2)

3. Experimental research of blockchain technology in supply alliance chain under big data time domain

3.1. Subjects

In order to make the research results of this article more scientific and effective, this experiment will investigate the supply alliance. This time, we will explore the profit ratio of the supply chain alliance. This time, the supply alliance chain applied by blockchain technology under the big data time domain is compared with the traditional supply alliance chain system, and the supplier is investigated in the
form of questionnaire survey. All the subjects of this survey have worked for more than three years to ensure the reliability of the experimental data.

In order to further study the application of blockchain technology based on big data in the supply alliance chain, this experiment interviewed relevant experts to further investigate the core technology and application functions of the blockchain. A total of 50 relevant personnel were interviewed this time, among which the ratio of men to women was equal to ensure that the experimental data were more scientific and effective. This survey uses a ten-point scoring system, where 1 means disagree, 10 means agree, and the collected data is analyzed using the analytic hierarchy process.

3.2. Research methods

Questionnaire survey method. This article sets up a targeted questionnaire through interviews with experts. This questionnaire survey adopted a semi-closed method, the purpose of which is to promote the survey staff to fill in correctly.

Logic analysis method. This article explores the basic concepts, core technologies, and application approaches of blockchain technology to make the article clearer and the full text more rigorous.

Field research method. This article goes deep into the supply alliance, conducts face-to-face interviews with suppliers, and organizes and analyzes the collected data. These data not only provide theoretical support for the topic selection of this article, but also provide a reliable reference for the final research results of this article.

AHP. Use relevant software to conduct statistics and analysis on research data.

4. Experimental analysis of blockchain technology in supply alliance chain under big data time domain

4.1. Application analysis of blockchain technology in supply alliance chain

In order to explore the interest rate of the supply alliance chain using blockchain technology, this experiment will compare the supply alliance chain using blockchain technology and the traditional supply alliance chain based on the time domain of big data. The data obtained is shown in Table 1.

| Table 1. Application analysis of blockchain technology in supply alliance chain |
|-----------------|---------------|---------------|-----------------|------------------|
|                  | Sales growth | Market share  | Reduce costs    | Return on investment |
| Blockchain       | 64%          | 75%           | 66%            | 58%              |
| Traditional      | 43%          | 52%           | 49%            | 38%              |

![Figure 1. Application analysis of blockchain technology in supply alliance chain](image-url)
It can be seen from Figure 1 that compared to the traditional supply alliance chain, the supply alliance chain that applies the blockchain technology in the big data time domain is better than the traditional supply alliance chain in all aspects, and the sales growth rate has increased by about 20%. From this, we can see the feasibility of applying blockchain technology in the supply alliance chain.

4.2. Performance analysis of blockchain technology application

In order to further study and analyze the good performance of the blockchain in the supply alliance chain, this experiment conducted a test investigation and analysis on the core technology of the blockchain, and the results obtained are shown in Table 2.

|                  | Decentralization | Information cannot be changed | Distributed storage | Flexible programming |
|------------------|------------------|-------------------------------|--------------------|---------------------|
| Man              | 7                | 8                             | 5                  | 9                   |
| Woman            | 6                | 5                             | 6                  | 8                   |

**Figure 2.** Blockchain technology application performance analysis

It can be seen from Figure 2 that the application of blockchain technology in the supply alliance chain under the big data time domain is highly recognized, especially the smart contract can be flexibly programmed, and the feasibility is very high. This reflects the good use of blockchain technology in the supply alliance from the side.

5. Conclusion

The rapid development of technologies such as Internet+ and big data has brought a huge impact on the collaborative management model of supply chain information. How supply chain companies can screen out information management technologies that fit their own needs, quickly tap the hidden value of massive amounts of data, and make full use of and coordinate various resources have become an important means for companies to flexibly respond to and quickly respond to customer needs. As the development trend of the supply chain, information collaboration management is an effective means for the supply chain to adapt to the changes of the times and achieve synergistic benefits by improving the data processing process and accelerating the seamless connection of all links by using the existing information collaboration technology. In this paper, through literature analysis, questionnaire surveys and other methods, with blockchain as the innovation point, the traditional supply chain information collaboration system has been analyzed and discussed in depth, and a blockchain-based supply chain information collaboration system has been constructed to further demonstrate the region.
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