Research on Trust Influence of Building Supply Chain Members Based on Blockchain Technology

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Abstract. The trust of construction supply chain has become an obstacle to its development. The emergence of blockchain technology provides a new way to solve the trust problem of construction supply chain. However, the impact of blockchain technology is complex. Only by grasping the characteristics of blockchain impact can the government help the transformation and upgrading of construction supply chain. Firstly, the system relationship and correlation between blockchain technology and construction supply chain are analyzed. On this basis, this paper analyzes the influence of different levels and characteristics of blockchain on trust by using AHP, and puts forward policy suggestions.

1. Introduction

The characteristics of non repeated games and temporary contract organizations in the construction industry have led to a large number of opportunistic behaviors and hostile relationships in the construction supply chain, presenting a dilemma that fragmentation cannot break [1]. Bad "consensus" such as peripheral collusion operation, low-cost bid winning secondary operation, black contract validity period, project payment default seriously affect the integrity status and productivity development of the construction industry [2]. The trust among members of construction supply chain can solve opportunism. The decentralization of blockchain technology provides new opportunities and ideas for solving the trust crisis of supply chain system. Using blockchain for collaborative design and establishment of operation alliance is a possible way to solve the trust problem, and the trust mechanism can be rebuilt [3]. Therefore, the emergence of blockchain technology brings new opportunities to solve the trust problem of construction supply chain.

The influence of blockchain technology on construction supply chain is complex. Only by fully grasping its influence can we improve the trust level of the main nodes of the construction supply chain and complete the transformation and upgrading.

2. Theoretical logic of blockchain and its trust relationship

Blockchain technology was originally a special database technology designed for electronic currency. This is a decentralized system design based on elliptic curve digital signature algorithm and P2P [4]. The complete blockchain is divided into two parts, as shown in Figure 1.
Blockchain can be said to be data structure, database technology or network protocol. Blockchain technology can disperse the construction supply chain. However, this model not only affects the trust of supply chain subject, but also affects the behavior of nodes, and changes the unified communication paradigm of subject.

3. The mechanism of the influence of blockchain technology on building supply chain trust

3.1. Analysis of the impact of blockchain technology on building supply chain trust based on AHP

Using the method of brainstorming and questionnaire to sort out the index factors, the index is divided into six first level indexes. B1 randomness, B2 dynamic, B3 multiplicity, B4 contractual, B5 reward and punishment and B6 unity. In these six aspects, the paper analyzes the influence of factor weight on the construction supply chain. The content of this paper is to improve the efficiency of the construction supply chain. Therefore, if this problem is objectively analyzed, the sample data may be too large and not representative, which is not conducive to the calculation of the weight. Therefore, the method of combining expert investigation with AHP is adopted.

According to the selected index system, this article uses the 1-5 scale method and uses a judgment matrix to compare the importance of each index. As shown in Table 1, the average geometric number of each level of indicators obtained by the questionnaire as a whole.

| index       | Randomness | Dynamic | Multiplicity | Contractual | Reward and punishment | Unity |
|-------------|------------|---------|--------------|-------------|-----------------------|-------|
| Arithmetic mean | 3.91       | 4.13    | 4.13         | 4.22        | 4.22                  | 4.2   |

Table 2 shows the indicator judgment matrix of blockchain technology element system through the comparison of the above two indicators.

| B  | B1  | B2  | B3  | B4  | B5  | B6  |
|----|-----|-----|-----|-----|-----|-----|
| B1 | 1.000 | 0.947 | 0.947 | 0.927 | 0.927 | 0.931 |
| B2 | 1.056 | 1.000 | 1.000 | 0.979 | 0.979 | 0.983 |
| B3 | 1.056 | 1.000 | 1.000 | 0.979 | 0.979 | 0.983 |
| B4 | 1.079 | 1.022 | 1.022 | 1.000 | 1.000 | 1.005 |
| B5 | 1.079 | 1.022 | 1.022 | 1.000 | 1.000 | 1.005 |
| B6 | 1.074 | 1.017 | 1.017 | 0.995 | 0.9954 | 1.000 |

The sum of index columns of geometric average judgment matrix is shown in Table 3.
Table 3. Columns of first-level indicators of arithmetic mean

| First-level indicators | Randomness | Dynamic | Multiplicity | Contractual | Reward and punishment | Unity |
|------------------------|------------|---------|--------------|-------------|-----------------------|-------|
| Columns                | 6.344      | 6.008   | 6.008        | 5.88        | 5.8804                | 5.907 |

Divide the values of each column of the geometric average judgment matrix by the values listed in the above table to get a new matrix, and then sum each row, as shown in Table 4.

Table 4. The value of each column divided by the value of the column sum and the sum of each row

| B     | B1     | B2     | B3     | B4     | B5     | B6     | SUM   |
|-------|--------|--------|--------|--------|--------|--------|-------|
| B1    | 0.158  | 0.158  | 0.158  | 0.158  | 0.158  | 0.158  | 0.946 |
| B2    | 0.166  | 0.166  | 0.166  | 0.166  | 0.166  | 0.166  | 0.999 |
| B3    | 0.166  | 0.166  | 0.166  | 0.166  | 0.166  | 0.166  | 0.999 |
| B4    | 0.170  | 0.170  | 0.170  | 0.170  | 0.170  | 0.170  | 1.021 |
| B5    | 0.170  | 0.170  | 0.170  | 0.170  | 0.170  | 0.170  | 1.021 |
| B6    | 0.169  | 0.169  | 0.169  | 0.169  | 0.169  | 0.169  | 1.016 |

Then, the weight of each indicator is determined according to the average value of each row, as shown in Table 5.

Table 5. Level 1 indicator weights

| First-level indicators | Randomness | Dynamic | Multiplicity | Contractual | Reward and punishment | Unity |
|------------------------|------------|---------|--------------|-------------|-----------------------|-------|
| Columns                | 0.158      | 0.166   | 0.166        | 0.170       | 0.170                 | 0.169 |

The weight vector of the obtained index is as follows.

\[ \omega = [0.158, 0.166, 0.166, 0.170, 0.170, 0.169]^T \]

The maximum feature root of the feature vector is calculated as follows.

\[
\lambda_{\text{max}} = \frac{1}{6} \left( \sum_{i=1}^{6} b_{ij} w_i + \sum_{i=1}^{6} b_{ij} w_i + \sum_{i=1}^{6} b_{ij} w_i + \sum_{i=1}^{6} b_{ij} w_i + \sum_{i=1}^{6} b_{ij} w_i + \sum_{i=1}^{6} b_{ij} w_i \right)
\]

=6.434

Indicators to determine the consistency of the matrix: R.I. can be found to be 1.26 according to the specification.

\[
C.I. = \frac{1}{n} (\lambda_{\text{max}} - n)
\]

=0.0868

The consistency index is calculated by the following formula.

\[
C.R. = \frac{C.I.}{R.I.}
\]

=0.0689<0.1

Finally, the weight and consistency test results of the first level indicators are shown in Table 6.

Table 6. First-level index weights and consistency test results

| index | Feature vector | Weight limit | Consistency check |
|-------|----------------|--------------|-------------------|
| B1    | 0.945          | 0.158        | \( \lambda_{\text{max}} = 6.434 \) |
| B2    | 0.998          | 0.166        | C.I.=0.0868       |
| B3    | 0.998          | 0.166        | R.I.=1.26         |
| B4    | 1.020          | 0.17         | C.R.=0.086<0.1    |
| B5    | 1.020          | 0.17         | Pass the consistency test |
| B6    | 1.015          | 0.169        |                   |

Therefore, their importance is B4 = B5> B6> B2 = B3> B1
3.2. Blockchain core technology improves the trust level of building supply chain

Dividing the type of trust is the key to integrating blockchain into construction supply chain governance. As shown in Figure 2, the impact of blockchain technology on trust can be better explained based on computational trust and emotional trust.

3.2.1. Data layer

The data layer includes Merkle tree, hash algorithm, asymmetric encryption and other technologies. Each node can record complete information and form non-modifiable data after authentication by other nodes. Therefore, the possibility of information modification is reduced. Asymmetric encryption technology can be used to give the node permission to ensure the security of data. The foundation of establishing supply chain trust mechanism is objective and fair data information [5]. At the same time, the new accounting model changes the cognitive basis of supply chain members. This new cognitive model is conducive to the unity of members' values. However, supply chain nodes may maliciously carry out bypass attacks and steal a certain amount of information, which will have a certain impact on emotional trust. B6 occupies a medium position in the factors, which is the key to change the values of members of the construction supply chain.

3.2.2. Consensus layer

Consensus algorithm is the core technology of consensus layer. Here we refer to the consensus mechanism of stochastic dynamic sdpos [4]. According to the multi center characteristics of supply chain, it is suitable for alliance chain. In sdpos, the system votes every u to select the entrusted bookkeeper of the supply chain network. After the node initiates the transaction, the system will randomly assign two trustees to conduct two-way verification of the transaction, and one of them will execute the transaction record and generate a new block. Based on the consistency of traditional sdpos, this mechanism increases the randomness and has the characteristics of dynamic and multi verification. Dynamic means that the trustee is not fixed and needs to vote again after a period of time. In this way, the problem trustee can be eliminated, and the accounting right of small and medium-sized enterprises with better development of supply chain can be eliminated. At the same time, every voter participates in the system voting, which solves the problem of indifference. This randomness is reflected in the generation mechanism of bookkeepers, which prevents bookkeepers from cheating in advance because they do not follow the agreed order. Multiple checks changed the single check method to two or three
bookkeepers at the same time, which improved the reliability of transaction information. The characteristics of the algorithm determine that the voters and Bookkeepers who can effectively eliminate the differences in the supply chain can enhance the emotional trust in the construction of the supply chain, and the cooperation between nodes is more active. The multiple verification characteristics of the consistency algorithm effectively improve the reliability of the data. From this we can see that B1, B2 and B3 have an important impact on trust.

3.2.3. Contract layer
The contract layer consists of various script codes, algorithm mechanisms and intelligent contracts. Among them, the smart contract is the core of the contract layer, which is implemented by the contract code embedded in the blockchain [6]. Smart contract is an agreement signed by all participants of the project to realize the blockchain ledger recording function, which is finally attached to the blockchain in the form of code. Participants draft the contract content and trigger mechanism in advance, and embed the system in the form of code. Once the trigger conditions are met, the contract is generated and external interference is not allowed. When the nodes participating in the interest relationship can reach a resource transaction smart contract, the contract code is embedded in the blockchain. After the transaction data is uploaded, the system will automatically determine whether the conditions are met. When all requirements are met, the amount will be automatically divided into node accounts to solve economic disputes such as contract price default in the field of construction engineering. Members of the construction supply chain must achieve transactions through contracts. Secondly, every contract is incomplete and has certain defects. In the process of writing smart contracts, punitive incentives with incentives can be encapsulated into the smart contract system, so that nodes can better fulfill the contract, so as to improve the emotional trust between members. Due to the incompleteness of contracts, supply chain members may make new opportunistic behaviors. The side chain technology of contract layer forms the channel between alliance chain and alliance chain, which effectively promotes the communication and cooperation between enterprises. Government departments can participate in management properly. B4 and B5 play a leading role in the construction of supply trust management.

4. Concluding remarks
Blockchain technology has the characteristics of solving the trust problem of construction supply chain, and the integration of blockchain technology and construction supply chain is an inevitable trend. This paper considers the development of construction supply chain from the perspective of the government, and integrates the blockchain technology into the construction supply chain model. Use AHP to get the influence of different characteristics of blockchain on trust. Finally, in order to better promote the management of building supply chain trust, we need to pay attention to the following two points: (1) the most important thing is not the blockchain itself, but the spirit behind it. (2) Fully understand the impact of blockchain technology on different types of trust in the construction supply chain.

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