Audit research of large engineering projects based on blockchain technology

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Abstract: Large-scale projects have the characteristics of huge investment, long construction period, resource consumption and many project participants. The audit work is very important but the difficulty is often very high. Blockchain technology has gradually entered the mainstream application with its characteristics of decentralization, openness and transparency, and data is difficult to tamper, which also brings new opportunities to engineering audit. This paper studies the application of blockchain technology in large-scale engineering audit, and explores the implementation method of large-scale engineering audit based on blockchain technology from the aspects of blockchain technology selection, platform framework construction, smart contract design, etc., to solve the problems of difficulty in obtaining evidence, poor reliability of evidence and low efficiency.

Key words: engineering audit; Blockchain; Decentralization; Smart contracts

1. Research status of engineering audit and blockchain technology

In recent years, China has developed into a large engineering construction country. The scale, complexity and diversification of infrastructure are increasing day by day, and many large-scale projects with a huge scale, complex environment, and long construction and life cycle emerge in response to the needs of The Times. These large-scale projects are an important part of government financial investment projects, and have become an important measure to promote our country's economic development, promote social progress, and realize national strategy. However, large projects have the characteristics of large investment, long construction period, large resource consumption and many project participants, which makes the conditions of project audit limited, frequent problems such as incomplete project archives and insufficient audit evidence, which affect audit judgment and ultimately lead to the inability to effectively play the audit functions of economic supervision, visa and evaluation. With the development of information technology, it is possible to solve these problems.

Blockchain, also known as distributed ledger technology (DLT), can create mutual trust in cooperation. Essentially, a blockchain is a simple database that stores information. What is more, the decentralized and transparent nature of the blockchain system enables an irrefutable record of data and real-time information sharing among the various participants (Lucchi et al., 2022). In a blockchain system, engineering participants can access information written through a consensus mechanism without relying on any central administrator, and no one can control the data (Wu Ting, 2022). Therefore, this paper mainly puts forward the framework of large-scale project audit platform of blockchain technology, studies the realization method of large-scale project audit on this basis, promotes the informatization and intelligent construction of large-scale project audit in China, and hopes to promote the innovation in the means, norms and methods of project audit.

The development history of blockchain technology can be divided into three stages: blockchain 1.0, 2.0 and 3.0 (Swan, 2015). Taking Bitcoin as a typical application, blockchain 1.0 is mainly used in cryptocurrencies as a model for securely verifying and storing transaction information. The Blockchain 2.0 era began with the adoption of smart contracts, and its applications are mainly focused on economics, markets and finance. A smart contract is defined as a computer transaction protocol that executes the terms of a contract, encoded by a computational programming language, automatically deployed and executed in the blockchain, which enables more complex transactions and strengthens mutual trust among users (Xu Wensi, 2022). The Blockchain 3.0 era extends the application of blockchain to other industries, aiming to provide a new paradigm with less friction and high efficiency for organizing social activities (Wang et al., 2017). Blockchain 3.0 has the potential to promote the transformation and upgrading of many industries, including auditing, in the direction of digitalization and intelligence.

In this context, some scholars have specifically discussed the impact of blockchain technology on the audit industry, as well as blockchain-based audit methods. Xu Chao and Chen Yong (2020) respectively explained the logical application of blockchain technology in audit work from four aspects: audit data quality, audit organization management, audit process and risk control in the audit process. Zheng Shiqiao (2021) put forward a theoretical framework on the impact of blockchain on audit forensics, and analyzed the changes of audit forensics methods, audit forensics models and audit forensics methods.

In general, large engineering audit systems are born with the attributes and characteristics of complex systems, and the difficulties of engineering audit will be magnified invisibly, but the blockchain technology brings new opportunities, and the blockchain technology provides a creative method to effectively examine the authenticity and compliance of economic activities by providing transparent, immutable and traceable accounting information records. Smart contracts can also help improve the efficiency of financial information processing and even enable automated authenticity and compliance reviews. Based on blockchain technology, the pain points of large-scale project audit can be effectively solved, and tracking audit and real-time audit have a foundation for implementation.

2. The audit framework of large-scale engineering projects based on blockchain technology

(I) Blockchain selection

In order to establish a large-scale project audit platform based on blockchain technology, it is necessary to first determine the appropriate blockchain type to store project financial information. At present, according to the degree of open access, the blockchain system is divided into three types: public chain, private chain and alliance chain (Morabito, 2017). All three blockchains are based on consensus mechanisms to ensure the security and reliability of information management, traceability and immolability, but they also differ significantly in meeting the needs of different types of applications (Zhong et al., 2020). Consortium chains balance the two aspects of "decentralization" and "high efficiency", with the ability to control data and maintain privacy. On a federated chain, read and write access is determined by a consensus process controlled by pre-selected nodes, and information is only available to authorized participants. In addition, the alliance chain can also provide a series of complete authentication, authorization, audit and other functions for participating members, which can meet the needs of business cooperation.

Large engineering audits involve different organizations, and only authorized members of the project can join the blockchain network. Different members may have different requirements for control of information and privacy during the collaboration process. Subsets of the organization may have their own communication channels and provide private information only for themselves. For example, a contractor can establish separate business cooperation channels with different subcontractors, which can ensure the confidentiality of information. Therefore, this article recommends choosing alliance chain for large project audit.

(2) Platform framework

In a specific engineering project, participants such as the government, owners (usually representatives of the project Management Authority), contractors, subcontractors, suppliers, supervisors, etc., can establish one or more decentralized peer-to-peer networks according to business needs, and upload the transaction information between them to the blockchain network system through the client. It is worth noting that different project participants have different lifecycles on the blockchain. Specifically, subcontractors exit the blockchain system after completing their contracted tasks. The government node and the Project Authority node are always on the chain and can query and update the ledger of the engineering project at any time. When economic disputes and violations still occur after the subcontractor exits the blockchain system, the government and project Management Authority counterparts can query and confirm the relevant information records in the ledger.

In a large-scale project audit platform, nodes such as the government, project authority, contractors, subcontractors, suppliers and supervisors are all connected on a flat topology with no hierarchical structure and a central manager, making the peer-to-peer network completely decentralized. The consensus algorithm approves and confirms the transactions in the distributed environment through a series of processes, that is, after all the transaction information is converted into a transaction proposal, it needs to reach a consensus agreement through various nodes before it is added to the ledger. Once transactions are added to the distributed ledger in blocks, all the ledgers reflect this change, i.e. all nodes share a copy of the ledger. At the same time, the hash algorithm guarantees the security of the information stored in the blocks by converting traditional transaction information into a hash value. In general, the hash value is unique. If you make any changes to a block in the chain, then it will immediately change its hash value. If an attacker tries to change a hash, the hash values of all chains located between that block and the last block would need to change, which is almost impossible in a distributed environment.

(3) Smart contract-based automated auditing

Smart contracts are an important technology of blockchain. Essentially, smart contracts are written as computer code that represents specific business logic and can automatically execute the terms of the contract if certain conditions are met, enabling the digitization and automation of executing business workflows. In this context, smart contracts make the blockchain system a decentralized application (Dapp) for large-scale engineering audits, with the following advantages: (1) Large-scale engineering audits can be conducted autonomously without the assistance of a third party, increasing efficiency. When the amount of funds, information flow and business flow information between the participating units are uploaded to the blockchain system, the corresponding smart contract will be called and the audit procedure will be carried out, and no one can interfere. (2) The audit results are recorded in the blockchain system and are easily traceable, as all operations are digitally signed by the person in charge. These results are immutable and have a high level of transparency.

3. Conclusions and Prospects

As an emerging technology, blockchain has been widely used in the fields of digital currency, supply chain management, information security, certificate and anti-counterfeiting data services. For the audit industry, blockchain technology can also be targeted to solve the current pain points and difficulties. Based on this, this paper studies the application of blockchain technology in large-scale engineering design, including blockchain selection, framework construction, smart contract design and other aspects. The relevant work shows the feasibility of applying blockchain technology in large-scale engineering audit, and shows the changes brought by blockchain technology to large-scale engineering audit. First of all, ensure the audit accuracy. Although the contract documents involved in the project are complicated, they are deployed on the chain, which can effectively solve the problem of data tampering, ensure the reliability of data acquisition, and avoid the phenomenon of "false accounts true audit". Secondly, improve the audit efficiency. Through the deployment of smart contracts, the relevant audit work can be automatically completed, without the need for staff to manually consult and check information, which greatly improves the audit efficiency. Finally, the whole process audit can be realized. From project feasibility paper, project initiation, survey and

design, construction to delivery and operation, the whole process and all-round monitoring of project funds can be realized through smart contracts, real-time detection and analysis of abnormal situations, and early discovery and solution of audit doubts.

Future research needs to assess the key challenges impeding the practical implementation of blockchain systems from the perspectives of different engineering and construction stakeholders, and further explore the efficient integration of iot, artificial intelligence technology and blockchain. For example, the data of people, machines and materials in the process of engineering construction can be collected and uploaded to the chain through the Internet of Things for audit work; The use of artificial intelligence technology to process and analyze the data on the chain, providing the ability to mine audit clues and audit doubts.

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