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Discussion on Using Blockchain Technology to Improve Audit Efficiency and Financial Transparency

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Abstract: With the acceleration of enterprise informatization, traditional audit methods face many challenges in verifying the authenticity of enterprise information, real-time control, and transparency of audit information. The blockchain technology, with its decentralized control, traceability, and tamper proof features, provides new ideas to enhance audit efficiency and financial transparency. This article summarizes the relationship between blockchain technology and financial auditing, and constructs a blockchain based auditing application framework. Specific implementation paths are proposed from three aspects: referencing blockchain real-time auditing systems, automated auditing processes, and real-time multi node data sharing. Specific measures are also proposed to enhance financial transparency through the use of blockchain based financial records, hierarchical control information authorization, and unified standardized disclosure principles. This article analyzes that the application of blockchain will shift financial auditing from traditional "post verification" to "real-time monitoring", thereby achieving a win-win situation of real-time auditing and transparency before, during, and after the event.

Keywords: blockchain technology; audit efficiency; financial transparency

1. Introduction

With the efficient development of the Internet and financial technology, the company's financial situation has become increasingly complex. The traditional audit model takes a long time, and data lag and information closure cannot meet the high requirements for timeliness, transparency and legitimacy. Therefore, achieving the optimization of financial audit effect and the real guarantee of financial information with a more efficient and effective audit method has become an urgent need for current financial management and financial supervision. As a new distributed accounting model, blockchain has the advantages of decentralization, immutability, and full traceability, and is expected to drive a technological revolution in financial auditing. On the one hand, it can build a real-time shared accounting system and break down data audit barriers; On the other hand, the automatic control mechanism of smart contracts can significantly enhance audit response speed and accuracy. At present, some countries and industries have begun to explore the use of blockchain technology to conduct audit experiments, demonstrating its potential to enhance efficiency and transparency. In this context, this article establishes an audit application architecture driven by blockchain based on its basic definition, and analyzes the key influencing factors and specific implementation strategies for improving audit efficiency and increasing financial information transparency. It attempts to provide some theoretical support and practical guidance for the emerging era of intelligent auditing [1].

2. Overview of Blockchain Technology and Basic Theory of Financial Audit

As a decentralized distributed ledger platform, blockchain technology has core features such as tamper proof information, full traceability, and node consensus verification,

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gradually entering multiple fields such as finance, logistics, and healthcare. In financial auditing, traditional enterprises often use internal information and receipts as the basis, which may cause phenomena such as data lag, easy tampering of information, and slow verification and evidence collection. However, blockchain technology provides us with new solutions [2].

With the help of blockchain technology, information related to enterprise operations can be directly written onto the chain, which can avoid auditors waiting for reports to obtain original and complete data sources, greatly ensuring the authenticity of information; Smart contracts can also establish audit rules to achieve automatic inspection and abnormal prompts at key stages, which can promote the transformation of the audit process towards automation and intelligence. In theory, blockchain auditing combines various disciplines, including information system auditing, risk control, and accounting transparency. It provides strong technical support to improve financial audit efficiency and to rebuild trust mechanisms. It is an important foundation for achieving smart auditing [3].

3. Construction of Financial Audit Framework Driven by Blockchain

3.1. Restructuring of Audit Process Empowered by Blockchain

The traditional audit process mainly relies on post-event sampling inspection, which involves manual verification of financial statements and other methods, resulting in problems such as information lag, tampering risks, and low efficiency; Blockchain technology reconstructs the audit process with "data on chain, automatic review, and full traceability". Relevant financial data generated by enterprise business (such as contract signing, proofs of bill payment and invoices) is instantly written into the blockchain. Each transaction is mutually reviewed by multiple nodes, permanently saved on the chain, and forms a traceable audit chain. At the same time, the use of blockchain can embed smart contracts to define audit rules and trigger conditions, achieve automated auditing of abnormal behavior alarms, and transform auditing from "post audit" to "in-process supervision" [4]. Auditors can call on chain data to directly verify the entire process without repeated evidence collection and manual comparison, greatly improving audit efficiency and data accuracy, and providing technical support for the operation of intelligent and transparent audit systems **(**Figure 1).

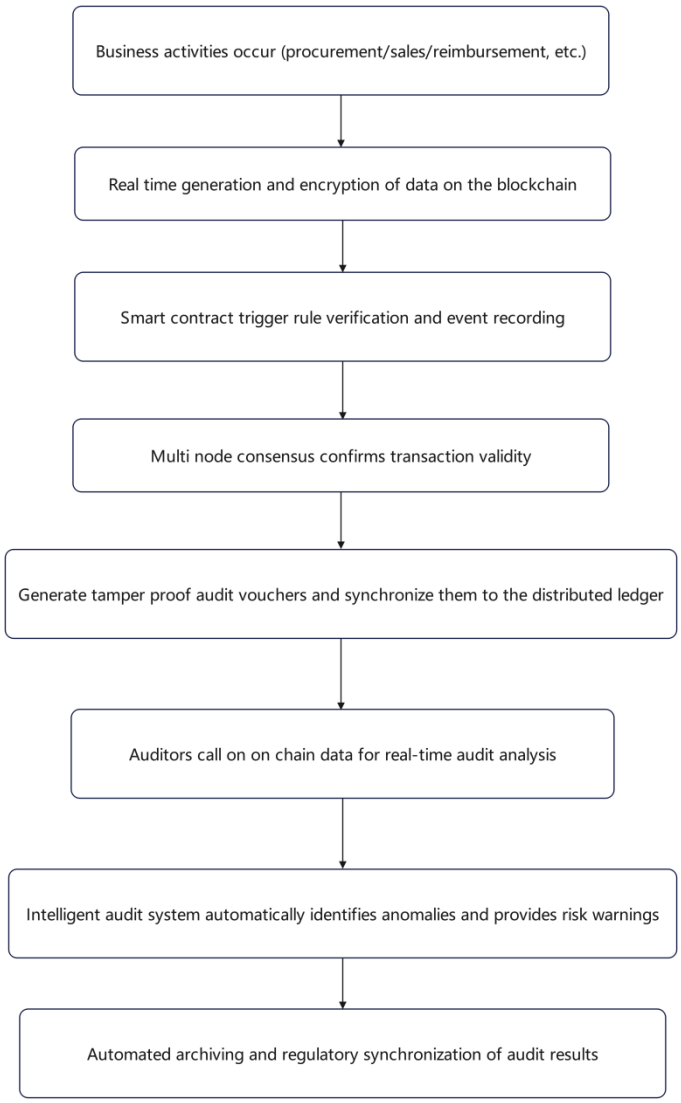

Figure 1. Restructuring Process of Audit Process Empowered by Blockchain.

3.2. Mechanism for Enhancing Financial Information Transparency.

Financial information transparency is a core requirement for enterprises to operate with integrity and market supervision. Traditional financial information disclosure has problems such as untimely updates, strong data controllability, and difficulty in verifying external entities, which affect the credibility and availability of financial data. The immutability and full traceability of blockchain technology provide a new solution for enterprises to solve this problem. Enterprises can incorporate important financial statements, transaction records, tax records, and other financial information into the blockchain to ensure their solidification and encrypted storage at the time of generation, ensuring information security and achieving "data as evidence". Through permission management and smart contract technology, different data access levels for various roles are established to enable regulatory agencies, auditors, or investors to obtain authentic and comprehensive financial information based on their permissions, enhancing the legality and pertinence of disclosed information. This approach transforms financial information from a "static display" to a dynamic and transparent state, not only improving the company's financial management system but also increasing the trust of investors in the target company's financial information in the financial market [5].

3.3. Construction of Data Sharing and Regulatory Linkage Platform

In traditional audit monitoring mechanisms, there are information barriers between institutions, slow frequency of data sharing and low update efficiency, which seriously affect the progress and accuracy of audit monitoring. The construction of a multi-agent collaborative data sharing and regulatory linkage platform using blockchain technology provides a feasible path. This article proposes a solution based on the consortium chain model, which enables enterprises, audit institutions, tax authorities, and financial regulatory departments to act as nodes in the network, realizing synchronous real-time confirmation and sharing of multi perspective audit information, eliminating information silos, and constructing a mechanism of "same origin data, hierarchical sharing". The platform integrates smart contract functions that can preset risk identification rules and disclosure trigger conditions. It can automatically identify illegal and irregular behaviors and send warning information to regulatory nodes, achieving 'intelligent supervision'. At the same time, the platform has permission management functions, which can ensure the legality of authorized access to core data in the security level domain and protect the integrity of privacy information, thereby improving audit efficiency, enhancing the real-time, systematic, and credible supervision, and providing support for building an intelligent and collaborative financial monitoring ecosystem [6].

4. Measures to improve audit efficiency using blockchain technology

4.1. Building a Real time Audit System Based on Blockchain

Traditional financial auditing mainly relies on regular and post audit processes, heavily relying on paper vouchers or electronic account statements provided by enterprises, which has the drawbacks of information lag and possible manual alterations of written vouchers. Building a real-time audit system based on blockchain technology can achieve a "full process, traceable, and automated" audit data flow, promoting the transformation of auditing from static inspection to dynamic monitoring. The system is driven by smart contracts and records important events (such as payments, contract signing, invoice issuance, etc.) in real-time on the blockchain, completing the real-time recording of audit evidence. In addition, the real-time audit system can be connected to the company's ERP system to automatically collect raw transaction data and use a multi-node consensus mechanism to synchronize the ledger, which has the function of 'recording and auditing at once', expanding the audit scope and responding quickly. This system reduces labor costs and improves the immediacy and accuracy of risk warnings (Table 1).

Table 1. Core Comparative Analysis Based on Blockchain and Traditional Audit Systems.

Indicator items	Traditional auditing system	Real time audit system based on blockchain
Audit method	Sampling, regular, and post review	Full scale, real-time, and in-process supervision
data acquisition	Manually retrieve internal information of the enterprise	Automatic system collection and real-time synchronization on the chain
Data reliability	There is a risk of forgery or omission	Non tamper proof and traceable throughout the entire process
Audit response speed	Long cycle and strong lag	High speed response and real-time anomaly recognition
Audit and evidence collection efficiency	Multi stage manual verification	Single point on chain verification, automatic certificate storage

4.2. Introducing Automated Audit Processes and Smart Contract Mechanisms

In traditional auditing, due to the existence of a large number of links and processes, it often relies on manual operations and the application of certain rules for analysis, which makes it inefficient and prone to bias when dealing with a series of tasks. Therefore, by leveraging smart contracts in blockchain technology, automated mechanisms can be set up to respond to major stages of audit processes, ensuring the standardization, automation, and transparency of audit work. As an embedded program on the blockchain, smart contracts can automatically trigger audit events according to predetermined rules, verify transaction compliance, flag anomalies, and synchronize with the blockchain to ensure efficient auditing and improve risk management [7]. Automated audit services based on enterprises can be applied to some aspects of enterprise business, such as budget execution monitoring, invoice reimbursement comparison, contract performance verification, etc., automatically recording data and verifying it in real-time with on-chain vouchers to reduce human factors. Auditors can focus their energy on identifying business risks, making decisions, and achieving efficient collaboration between machine execution and manual decision-making (Table 2).

Table 2. Examples of Smart Contract Automation Applications for Common Financial Audit Processes.

Audit process	Trigger conditions for smart contracts	Automation function
Invoice compliance verification	Invoice uploaded and matched successfully with order information	Automatically complete validity verification and record on chain
Reimbursement approval process	The comparison result between the reimbursement amount and the budget limit is true	Automatically generate approval opinions and file them on the chain
Contract Execution Audit	Contract milestones completed and accepted	Automatically confirm performance status and generate audit records
Payment authorization verification	The transaction amount is below the authorized limit and the invoice is compliant	Automatically complete payment instructions and generate on chain vouchers

4.3. Establish a Multi Node Collaborative Audit Data Sharing Platform

In cross-departmental and cross-organizational audit collaboration, traditional methods suffer from data redundancy, duplicated evidence collection, and low communication efficiency due to data silos and system fragmentation. By leveraging blockchain to form a consortium structure, data from related audit entities (such as companies, audit institutions, tax bureaus, supervisory agencies, etc.) can be shared and synchronized, achieving a multi-party joint audit model of timely disclosure and real-time auditing of data from all parties on this platform. Real-time recording of data through a reconciliation mechanism ensures that each financial record is stored consistently across multiple nodes, avoiding single point of failure issues and improving the efficiency of multi-party auditing.

In platform design, based on the multi node consensus mechanism, the formula can be expressed as:

$$C = \frac{\sum_{i=1}^{n} V_i}{n} \geq T \quad (1)$$

Among them, C is the consensus verification value, Vi represents the validity judgment of the i-th node on a certain transaction (1 is valid, 0 is invalid), n is the total number of nodes, and T is the set trust threshold (such as 0.75). When the consensus value C is greater than or equal to the threshold T, the transaction is confirmed by the platform and

recorded on the chain. This scheme ensures the objectivity and tamper-proof capability of the multi-party data synchronization process. Auditors can quickly verify the evidence material information and behavior traces of important nodes within the blockchain through this platform, thereby shortening the time for transmitting and inspecting a large amount of information and achieving the transformation of "efficient, intelligent, and trustworthy" collaborative auditing among multiple institutions.

5. Strategies for optimizing financial transparency using blockchain technology

5.1. Establishing an immutable financial information recording mechanism

The authenticity and integrity of financial information are the core elements to ensure the compliant operation of enterprises and market trust, while traditional financial systems generally have defects such as being prone to modifications and difficulty in tracing records. Blockchain technology constructs an "immutable" financial information storage mechanism through hash encryption, timestamp mechanism, and distributed ledger structure. Every financial transaction in the entire financial process is encoded as a unique hash value and linked to the previous transaction data to form a chain. In this way, any attempt to tamper with a certain link will directly damage the overall connection and crash, ensuring the credibility and authenticity of the data. Under this mechanism, enterprises can upload important financial information such as procurement, payment, and contract completion in real-time on the chain, forming on-chain vouchers verified by consensus nodes to eliminate traditional fraudulent methods such as duplicate declarations and fake invoices. Regulatory authorities and auditors can audit the entire process of financial behavior by querying chain data (Table 3).

Table 3. Comparison of Anti tampering Mechanisms and Functions for Blockchain Financial Information.

technology mechanism	Implementation method	Anti tampering Function Description
Hash encryption	Generate a unique hash value for each transaction	Once the data changes, the hash becomes invalid and difficult to forge
Timestamp mechanism	Label each transaction with precise time stamps	Clearly define the order of data generation to prevent tampering and insertion
Blockchain structure	The current block is associated with the hash value of the previous block	Tampering with any block requires synchronously tampering with the entire chain, which is almost impossible
Distributed ledger	Multi node joint storage and verification of data	High data consistency, difficult to control or change at a single point

5.2. Building a multi-level financial data disclosure authorization system

How to reasonably control the access permissions of sensitive data while ensuring financial transparency is one of the difficulties in blockchain implementation. It is necessary to establish a multi-level data authorization system for data security protection and compliance disclosure. This is especially important for multiple stakeholders involved in the disclosure of quarterly reports, shareholder relationship management, and tax supervision of listed companies.

Taking a large manufacturing enterprise as an example, the enterprise connects core financial data such as procurement expenses, sales revenue, and contract fulfillment through blockchain, and sets up three main bodies: internal financial management, external audit units, and regulatory agencies. By introducing a permission control model based on access level, setting an access threshold Ai for different data types, and using the smart contract's requester access level U to determine whether the authorization conditions are met:

$$U \geq A_i \quad (2)$$

Among them, Ai represents the minimum access level of the i-th type of data, and U is the current identity level of the user. When U meets the conditions, the system automatically authorizes access and records logs; Otherwise, reject the request and trigger an audit alert. This mechanism not only achieves the "layered opening" of sensitive financial data, but also avoids the risks of data abuse and illegal crawling, providing strong support for enterprises to build a compliant, secure, and controllable data transparency architecture.

5.3. Promote the standardization of financial disclosure standards and on chain formats

At present, there are problems with the display of financial information in companies, such as inconsistent content, inconsistent display methods, and inconsistent data granularity, which are not conducive to the effectiveness of information comparison, data analysis, and supervision. The use of blockchain technology can provide a trustworthy information display platform and also help promote the standardization of information display content and data models. By developing on chain financial statement format templates, unifying field structures and disclosure cycles, companies can follow standards to independently construct and publish audit reports, fund flow information, tax information, etc., ultimately achieving a "structured, templated, and automated" form of information presentation. By using the smart contract system, companies can automatically check whether the structure and key features of financial statements meet the disclosure requirements after they are completed. Information that does not meet the requirements will be automatically rejected and prompted for correction, improving submission quality and reducing subjective bias (Table 4).

Table 4. Standardized elements of on chain financial information disclosure.

Element category	Specific content examples	Standardization goals
Disclosure format	JSON structures, XBRL templates, etc	Realize consistent data structure and easy parsing
Disclosure Fields	Operating revenue, net profit, asset liability ratio, etc	Ensure the completeness of core indicators and comparability of data
Disclosure cycle	Quarterly, annual, ad hoc disclosures, etc	Standardize disclosure time points and improve timeliness
Review mechanism	Smart contract field verification and node consensus confirmation	Automatically screen for errors and improve disclosure compliance

6. Conclusion

With the booming development of the digital economy, enterprises' requirements for audit efficiency and financial transparency are gradually increasing. Blockchain technology, with its decentralized, tamper proof, and traceable features, is gradually becoming an important technological force driving innovation in financial auditing. This article starts with the foundation of blockchain and constructs an application framework for auditing and financial governance. From the two key links of audit efficiency and financial transparency, it elaborates in detail on the key mechanisms and specific implementation plans to improve audit efficiency and financial transparency. Through the use of smart contracts, real-time on chain, and information sharing methods, auditing has achieved automation, preset processing, and financial disclosure has become more equal and trustworthy. In the long run, we should continuously improve the standard system of blockchain auditing, achieve the integration and implementation of technology and blockchain auditing, and form an efficient, convenient, transparent, and AI-based advanced financial management audit model.

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