

Research Article

Design of Enterprise Financial Information Management System Based on Blockchain Technology

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According to the development of information technology, a large amount of data information has been increasing, especially financial information. There are many acts of fraud, which makes it impossible to trace the data sources of enterprise financial information and relevant personnel. According to the fact that most staff are unable to complete accurate queries on the required financial statements, there are serious problems of nonstandard behavior and lack of key information in the financial statements of these enterprises. Because many comparable challenges have not been handled adequately, it has always made financial information management more complex for businesses, posed a threat to the whole industry's ecosystem, and harmed the interest of many stakeholders, among other things. Due to the qualities of blockchain, such as centralization, anonymity, trustworthiness, and willfulness, which make information difficult to forecast and tamper with, blockchain has gotten a lot of attention in recent years, and bitcoin and other digital currencies have grown popular. Because these characteristics are related to the information storage security and information transmission speed required by enterprise financial information management, blockchain has become a new idea to solve problems related to enterprise financial information management, according to current application and exploration. The overall management system incorporating blockchain technology is created in detail with the financial management system architecture and data processing scheme provided by blockchain technology in order to build an open and secure transmission mechanism for blockchain data. Moreover, it also integrates the encryption technology of the combination of symmetric key and asymmetric key and fast and secure data access control.

1. Introduction

In recent years, with the sharp increase in the number and dimension of big data of financial information, the risk of destruction and tampering of financial information of Chinese enterprises has gradually increased, and the problem of financial information fraud is still emerging [1, 2]. From 2015 to 2017, Shandong Molong Co., Ltd. "turned losses into profits" in quarterly and semi-annual reports for two consecutive years by falsely increasing the selling price and underestimating the cost. In 2017, the related parties of Zhejiang Chenlong Sawing Machine Co., Ltd. illegally occupied 120 million yuan of Chenlong Sawing Machine funds through 111 related capital transactions. The inability to assure the veracity of financial information, examine the source of financial information, and investigate

responsibility is the primary cause for business financial information fraud [3]. Furthermore, many businesses' financial statements suffer from nonstandard preparation and a lack of crucial topic data. Financial statements are a critical foundation for businesses to represent their financial situation and analyze their performance, which has a significant impact on how financial statement data are used by relevant staff. This demonstrates the urgent need for organizations to improve the accuracy of financial statement data location and storage, as well as standardize the storage granularity of financial statement data [4]. These issues with financial information management not only complicate business financial information management and jeopardize the interests of essential stakeholders, but also jeopardize the industry's environment. Decentralization, anonymity, trustworthiness, and willfulness are all properties of

blockchain, and information cannot be falsified or tampered with [5]. These features are inextricably linked to corporate financial information management's need for secure and dependable data storage, low-cost and efficient data transfer, and information traceability. As a result, academics and business are focusing on the use of blockchain in the administration of corporate financial data [3].

From the perspective of the relationship between blockchain and financial information management, Chen et al. believed that blockchain can be used in financial information management and meets the requirements of stakeholders for the accuracy, authenticity, and integrity of financial data [4]. Zheng et al. believed that the technical architecture of blockchain is an effective way to realize the innovation of financial data management and reduce security risks, and provides new solutions and methods for enterprises to solve financial information management [5]. Wang et al. believed that the application of blockchain technology will help to achieve global integrated control in financial information management in view of the financial sharing of e-commerce enterprises [6]. Li et al. successively analyzed the strengths, weaknesses, opportunities, and threats in the transition from traditional accounting to blockchain accounting through the SWOT matrix [7]. Liu et al. proposed that blockchain can promote the innovation of financial information management mode, improve the operation efficiency of enterprises, reduce operation costs, improve data security, and enhance the antirisk ability of enterprises [8]. Bons et al. proposed that the scalability, flexibility, appropriate architecture, and network security of blockchain are the key to determine whether blockchain can be well applied to financial information management [9].

From the perspective of financial information storage of blockchain, Nadine proposed a blockchain-based distributed storage mode of financial information within the listed companies for one of the core issues of accounting (i.e., MAF) and pointed out the limitations of pow consensus mechanism in solving 34 MAF [10]. Nam proposed that financial information can be safely stored and transmitted through blockchain technology, and the blockchain framework can be managed through smart contracts [11]. Karamchandani et al. analyzed the role of new technologies such as big data, blockchain, and artificial intelligence in a cloud-based financial information storage system through structural equation modeling [12]. For the storage of financial statement data, Tapscott and Tapscott believed that with the help of blockchain, the form of financial statements will evolve from a brief introduction of the enterprise at one time point to a three-dimensional view of the whole enterprise, and shareholders and regulators can create credit ratings based on facts [13]. Wang et al. proposed to provide credibility guarantee for transaction information through blockchain, and then, enterprises will summarize and obtain financial statements according to actual needs [14].

Based on the findings of the previous research, this study creates a detailed design of an enterprise financial management system that incorporates blockchain technology, as well as the overall architecture and underlying data processing scheme of a financial management system that

incorporates blockchain technology. On this foundation, a set of blockchain data transmission mechanisms based on openness and security are developed, using encryption technology that combines symmetric and asymmetric keys to provide highly secure data access control.

2. Foundation and Feasibility of Blockchain Technology Application

2.1. Foundation of Blockchain Technology Application

2.1.1. Enterprise Financial Management Mode. At present, enterprise financial management has entered the information stage. With the help of computer programs, the traditional paper-based process has been changed, and all business work is completed manually through the centralized financial management system [15]. Based on the traditional financial management module, the enterprise financial information system divides the business into revenue and expenditure, accounting, budget management, and other main modules, and each module includes sub-businesses related to salary, reimbursement, query, and scientific research management. Enterprise financial informatization has laid a solid foundation for the intelligent financial management system based on blockchain [16, 17]. According to the development status of enterprise financial informatization, completely abandon the original information system and reconstruct a new intelligent financial management system. The cost is huge. Based on the original information system, the intelligent financial system can integrate blockchain and artificial intelligence. New technologies such as big data are deployed in the system. They are used to optimize the original process, change the original data management mode, improve work efficiency, and save development costs.

2.1.2. Foundation of Enterprise Financial Management Talents. Staff with good financial management understanding and specific blockchain technical abilities are required for the intelligent financial management system based on blockchain. The financial management department's employees have a lot of higher education experience, some have master's or doctorate degrees, and they have a lot of learning capacity. They can adjust to the new technological needs following professional training on the basis of their previous financial management knowledge [21]. At the same time, the staff has some scientific research ability and can work on relevant topics and projects, conduct more in-depth research on fields related to blockchain intelligent finance, solve difficult system problems in practical work, and study and solve problems in the intersection of finance and computer technology.

2.2. Feasibility of Blockchain Technology Application

2.2.1. Decentralized Distributed Structure. The traditional enterprise financial management is based on the centralized financial management system and works through various

business modules. The centralized financial management belongs to the pyramid management mode, and each business node belongs to the centralized management system, which depends on the top instructions of the financial management system. In the business model, the data are submitted by the business node and finally summarized to the central server of financial management after the managers of each layer agree according to their own permissions. In terms of data management, each node of the centralized financial management system has different permissions [18]. High permission nodes have higher data permissions and can approve and adjust the data of low permission nodes. The financial management system based on blockchain belongs to a decentralized distributed structure. Each node no longer allocates authority according to the pyramid structure, but forms a flat distributed authority allocation. Each node has the same data management authority and is not dominated by the central node. Each business work requires the unanimous consent of all nodes, and the business data will be backed up at each node. It will no longer be uploaded to the server according to the traditional business model. No node can modify and adjust the data without authorization, so as to ensure the authenticity of financial management and prevent internal control risks [19].

2.2.2. Data Consensus. Enterprise finance financial management encompasses a broad variety of activities. It encompasses business management on the inside, such as staff, scientific research, materials, procurement, equipment, and real estate, as well as commercial work on the outside, such as entertainment and business travel. Revenue and spending, accounting, and budget management are all covered by the business node [18, 22]. The conventional business paradigm necessitates each node initiating and approving enterprises at each level. Nodes at all levels are unable to conduct business in real time due to varying business permissions. They must wait for the previous level's permission before moving on to the next step, which adds to the business's time cost. The blockchain-based financial management mode offers each node the same business management and data management authority. Each node may perform real-time business assessment and processing once each business is started. The system will automatically back up the data at each node when each node agrees on the business and data, and the business processing will be done.

2.2.3. Data Encryption. The financial management system based on blockchain technology uses hash function to convert enterprise financial data into a hash function value. Hash function conversion has the characteristics of timing and fixed length. No matter how long the original data are, it can convert financial data into data of the same length at the same time, with high efficiency. The conversion process is unidirectional, and the original data cannot be deduced through the hash function value to ensure the data security. Based on the asymmetric encryption principle, the financial management system of blockchain technology generates the

public key and private key required for encryption and decryption. The public key and private key cannot be calculated from each other. Each node can use the public key to encrypt the data. Only by mastering the corresponding private key can it decrypt and view the data to prevent data risk [20].

3. Overall Design of Financial Management System

In order to give full play to the characteristics of blockchain in traceability, trusted database, openness, transparency, and decentralization, this study has specially established an overall blockchain architecture that can be applied to enterprise financial management. The architecture is composed of application layer, contract layer, incentive layer, consensus layer, network layer, and data layer. The specific structure is shown in Figure 1.

3.1. Data Layer. The data layer mainly covers the data of annual budget, fund use plan, risk management, etc. and is saved in the distributed ledger. Each node in the financial management system holds a data backup, which can not only maintain the robustness of the system, but also realize data sharing. In the case of a node failure, it will not lead to the collapse of the whole system.

3.2. Network Layer. The blockchain network uses a peer-to-peer lending (P2P) network as its networking method. This technique allows block and transaction data to be sent between nodes. The qualities of the networking mode include dispersion, autonomy, and equality. The data-based verification and dissemination mechanisms allow each node to contribute to the blockchain network's stability. This research separates all nodes into light nodes and complete nodes in terms of system needs. The light nodes are responsible for data inquiry, verification, and distribution, while the full nodes are in charge of data storage.

3.3. Consensus Layer. The consensus layer maintains the data consistency of each node in the blockchain network through the consensus mechanism. Each device in the blockchain will write a common protocol, so each node in the whole network needs the same authorization verification. From the perspective of system performance requirements and application environment, this study uses EFT, PBFT, and other algorithms to verify the network nodes, which can realize no bifurcation, high throughput, and millisecond data transaction.

3.4. Incentive Layer. In order to improve the efficiency of enterprise financial management and strengthen the synergy and enthusiasm of financial workers, this study also sets up to for the financial management system Ken reward and issuance mechanism. The system will issue a token to the financial worker and evaluate the financial worker's performance based on it. To the rewards, punishment and

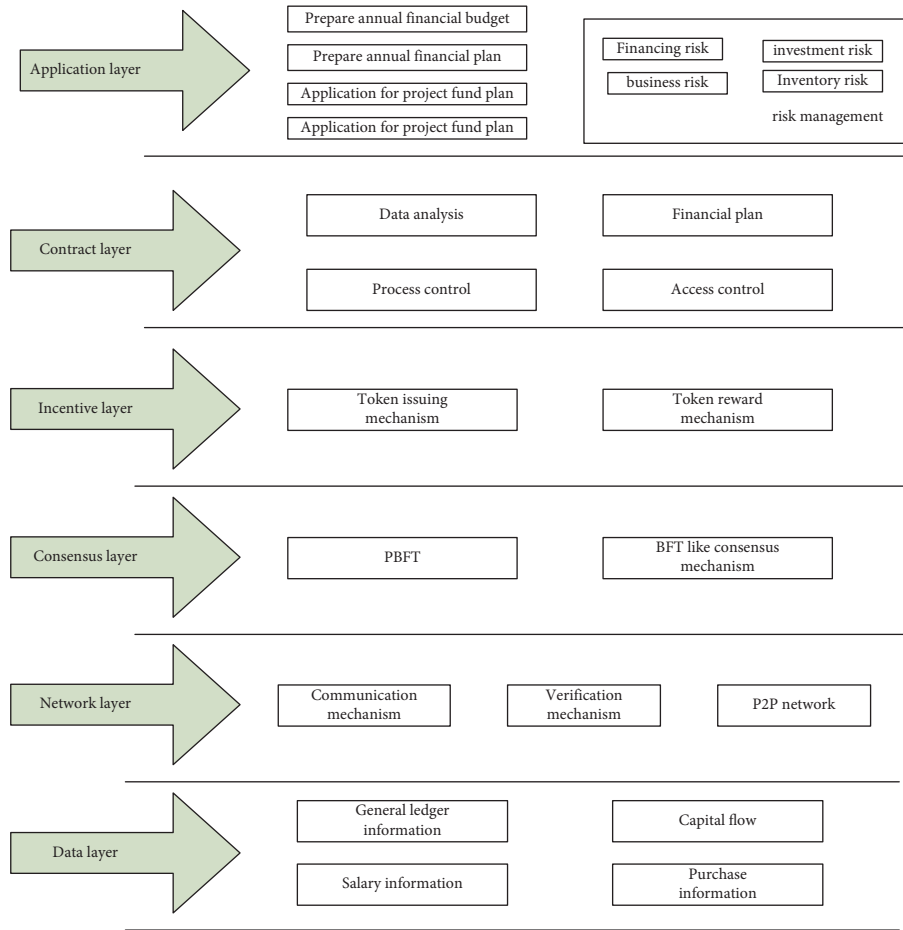


FIGURE 1: Financial management system integrating blockchain technology.

transformation of Ken are automatically generated through smart contract, which has complete transparency, impartiality, and openness in data.

3.5. Contract Layer. Smart contract technology mainly develops its related protocol codes or technical applications from the perspective of privacy, unforgeability, and complex transaction algorithms, so as to improve the efficiency of data transaction and analyse sales, production, and other data through smart contract.

3.6. Application Layer. The application layer can help the financial management department realize data sharing and provide business activity guidance path. The built-in smart contract technology can further improve the automation level of the collaborative office.

4. The Bottom Structure Design of Financial Management System

The financial management system designed in this study adopts the underlying architecture shown in Figure 2. The system architecture is jointly maintained by cash management department, accounting department, audit

department, credit financing department, budget management department, asset management department, and regulatory department. With the use of a financial management system and blockchain technology, all departments may achieve data exchange and data flow. Because the enterprise's internal financial management will generate a large amount of data, this study employs two data storage methods: the entire data are stored in the database, while only the data summary is stored on the blockchain, and a mapping between the blockchain and the database is established. The financial management system's data analysis module may immediately access and analyze data from the database and blockchain, and financial employees use the client to engage with the financial management system.

The operation process of the enterprise financial management system integrated with blockchain technology is as follows:

- (1) Each department uploads the key information to the corresponding node and then the node server packages and blocks the received information. After packaging, the data will be shared to all nodes in the system and its effectiveness will be verified at the same time. After the data pass the node consensus verification, the blockchain is responsible for storing

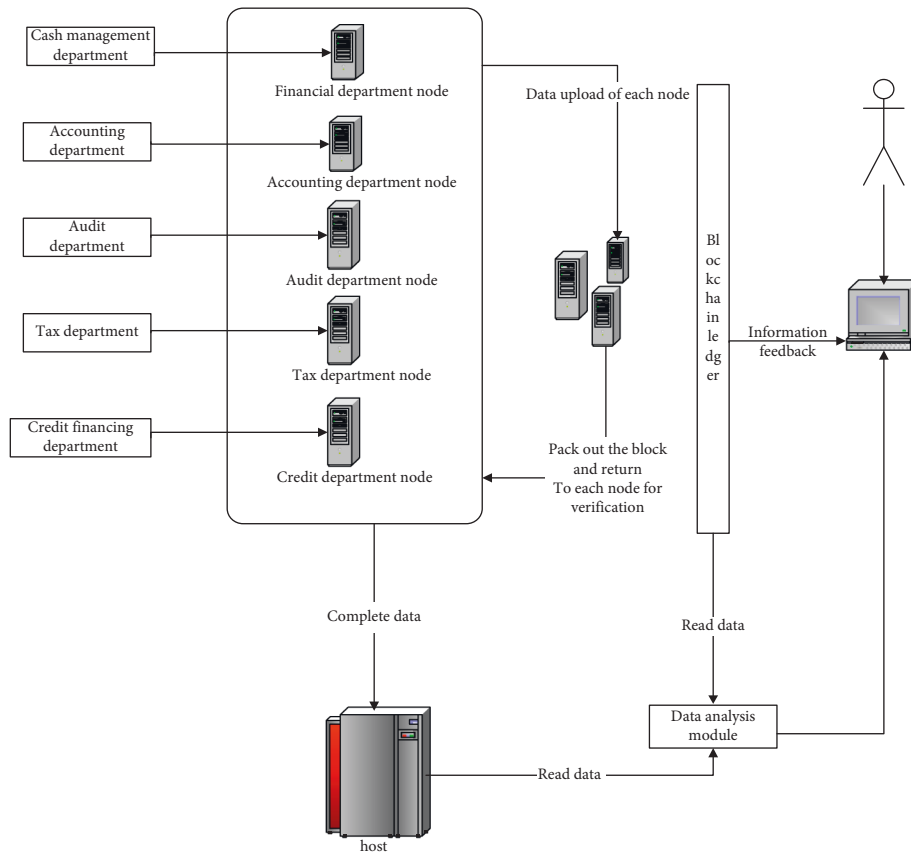


FIGURE 2: Bottom structure of the financial management system.

the data summary, and the database stores the complete data. Since the data in the blockchain cannot be tampered with, it only needs to hash the data in the database and then compare the data summary on the blockchain to verify the authenticity of the data.

- (2) The employee terminal is not responsible for storing the complete blockchain ledger, but is only used as a light node. It works based on the network interaction between the blockchain and the client, and realizes information transmission and information query. The data processing business of each node is carried out under the constraints of smart contract, and financial workers can only operate and query within their own business scope.
- (3) Before obtaining the data of each node, the data analysis module must first pass the verification of the smart contract. Only after passing the verification can it analyse the data in the database nodes of each financial management department.
- (4) In case of errors in data entry, the financial worker first needs to send the modification request to the

regulatory authority. After the regulatory authority has fully reviewed and approved the request, the financial worker can upload new data to the blockchain.

5. Data Access Control

In the enterprise financial management system integrating blockchain technology, every financial worker can view the data in the blockchain. For some highly confidential files, special access rights need to be set. This research designs the access control scheme from the perspective of role access control. This access control technique may reduce system duplication caused by too many permission variables and make authorization administration easier. The particular control technique is storing the access control software directly on the blockchain and executing it through smart contract. Managers must approve the access operation when finance personnel need access to the secret material. When access to the secret material is infrequent, financial employees merely need to be approved via the independent access process. The access process of confidential data is shown in Figure 3.

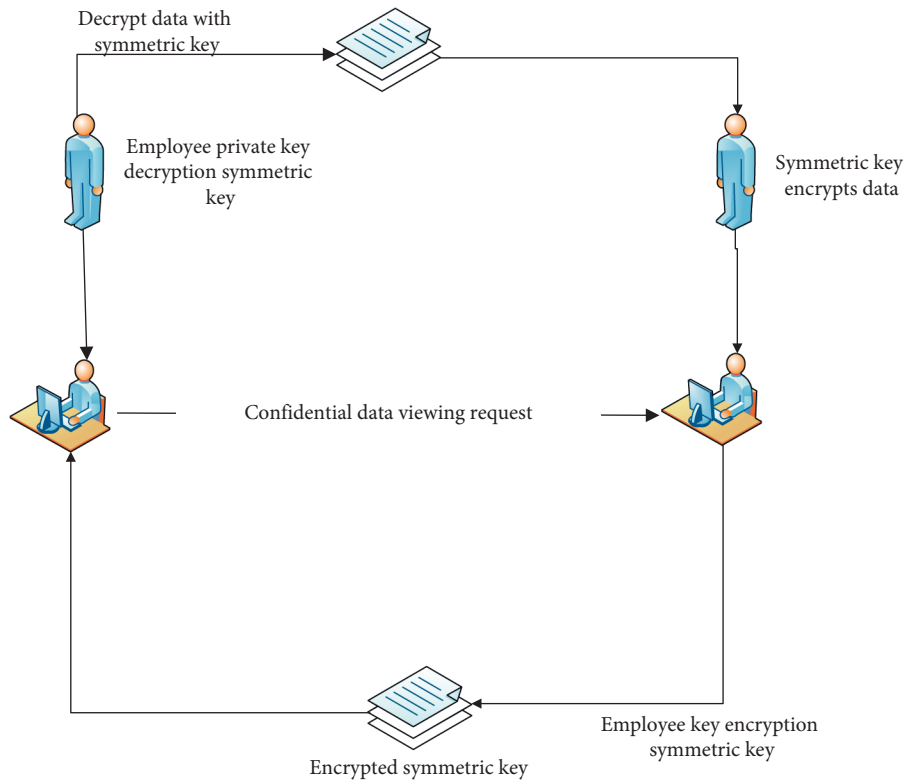


FIGURE 3: Confidential data access process.

The specific process of confidential data access is as follows:

- (1) The financial worker sends the request information of confidential documents with certificate signature to the management personnel.
- (2) The manager verifies the received request and generates a temporary symmetric key, and then encrypts the confidential information.
- (3) The manager encrypts the symmetric key through the public key of the financial worker and sends the encrypted file to the financial worker.
- (4) Financial workers decrypt the symmetric key and extract confidential information through their own private key.

6. Business Scenario Presentation

Take the business trip reimbursement scenario common in enterprise financial work as an example. The traditional reimbursement process is mainly based on on-site operation. The reimbursement personnel need to prepare all the original bills in advance, fill in the application, and be reviewed by the handling personnel on-site. There are many reimbursement items, and there are often queues. The items are moved to the next business point after being examined by the handling people. Accounting professionals will finish bookkeeping, reimbursement, and other operations before

handing them over to the cashier to be transferred to the bank. Finally, the bank will deposit the funds into the reimbursement person's account, and the necessary financial data will be posted to the corporate financial management system. The reimbursement process of the blockchain-based financial management system is shown in Figure 4.

The reimbursement applicant submits the reimbursement application on the computer or mobile terminal, extracts the reimbursement information in the form of a form, or directly copies and pastes the relevant reimbursement information, which is automatically extracted by the artificial intelligence module. The relevant financial information triggers the revenue and expenditure module in the smart contract, and the system automatically gives the trigger conditions required for business completion and automatically connects with relevant data centers to verify the authenticity of invoices. The reimbursement information is broadcast to all business nodes, and each business node cooperates to handle the business in real time according to its own authority. After each node completes the business processing, the relevant financial data are backed up in all nodes, time stamped, and encrypted. After each node is completed, the business meets the trigger conditions of the smart contract. The bank system connected with the system will automatically transfer the money to the reimbursement applicant's account, and the reimbursement business is completed. In this business scenario, the system uses intelligent workflow to reduce the original manual operation process and improve business processing efficiency.

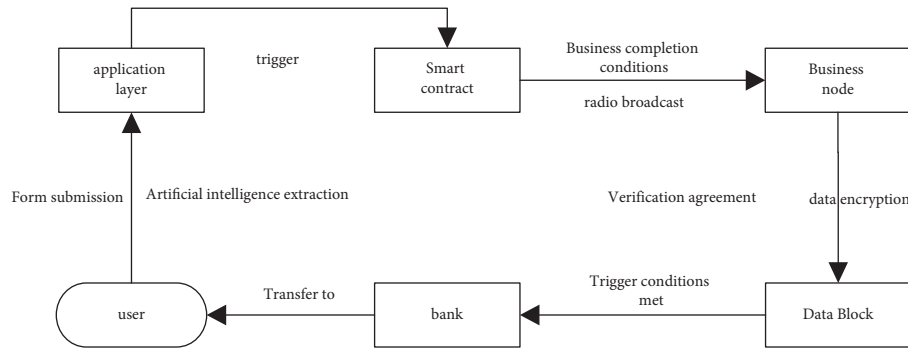


FIGURE 4: Business scenario demonstration.

7. Application Suggestions

7.1. Hardware Equipment. The enterprise intelligent financial system based on blockchain technology has changed the original centralized system mode, so that each business node has the same business management authority, data processing capacity will be greatly increased, and hardware requirements for each node will be higher. As a result, each business node must update its hardware and memory, improve the speed of the CPU and graphics processor, adapt the system configuration to big data computing and deep learning processing, and fulfil the operating requirements of the intelligent financial system.

7.2. System Connection. The intelligent financial system based on blockchain technology is based on the original financial information system. The application of blockchain technology at the bottom of the system needs to do a good job in system connection and solve basic problems. First, it is necessary to unify the system interface standards, ensure interface security and interface access efficiency, standardise various functions according to the version requirements of the system protocol, ensure that the system functions meet the standards, and ensure the scalability of the system. Second, the connection between blockchain technology and financial information system also requires unified data format coding to ensure the data communication of various data sources and business types, and verify the legitimacy of the data according to the system protocol. Third, the system docking needs to pay attention to compatibility. The version of the interface protocol can be downward compatible. It is necessary to determine the functional characteristics of the interface and determine the appropriate access parameters. Fourth, the system docking needs to pay attention to security control, conduct security assessment regularly, and do a good job in the control of system access.

7.3. Data Security. The financial data distributed in each company node is stored in the intelligent financial system based on blockchain technology, which dramatically improves the requirements for node data security. When establishing the system, each business node must create a dedicated intranet for data transmission and ensure that the data on the dedicated intranet is kept separate from the data

on the public network. The dedicated line network's access authority must be closely managed, and each node may utilize encryption hardware to improve data management and control. At the same time, each node must pay close attention to network threats and use high-security protection software to prevent data theft.

7.4. Business Process. The workflow of enterprise financial management is based on the financial information system. After the integration of the financial information system and blockchain technology, the original workflow needs to be adjusted and optimized, different smart contracts and trigger conditions are set for different business scenarios, and internal control is taken into account for revenue and expenditure, accounting, and budget management. Replan business nodes according to business content, and re-optimize external business processes for banks and other co-operative units.

8. Summary

The emergence of blockchain provides technical support for the management of enterprise financial information. Blockchain not only effectively saves costs for enterprise financial information management and improves the security and efficiency of enterprise financial information management, but also promotes the transformation and upgrading of enterprise financial information management mode and promotes the gradual networking and intellectualization of enterprise financial information management.

The application of blockchain technology to the enterprise financial management system can maintain the openness of network data without the threat of tampering, so as to meet the information sharing needs of collective office. In the future research work, it is also necessary to use blockchain technology to combine financial management with ERP system, expand the data source of financial management, and provide richer data support for other departments in the enterprise through financial management.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

- [1] E. Cardinaels and P. M. G. van Veen-Dirks, "Financial versus non-financial information: the impact of information organization and presentation in a Balanced Scorecard," *Accounting, Organizations and Society*, vol. 35, no. 6, pp. 565–578, 2010.
- [2] M. C. Pucheta-Martínez, I. Bel-Oms, and G. Olcina-Sempere, "Corporate governance, female directors and quality of financial information," *Business Ethics: A European Review*, vol. 25, no. 4, pp. 363–385, 2016.
- [3] T. Liu, "Smart financial management system based on intelligent data dimensionality reduction technology," in *Proceedings of the 2021 5th International Conference on Electronics, Communication and Aerospace Technology (ICECA)*, IEEE, Coimbatore, India, December 2021.
- [4] L. Chen, J. Peng, Y. Liu, J. Li, F. Xie, and Z. Zheng, "Phishing scams detection in ethereum transaction network," vol. 21, no. 1, pp. 1–16, 2020.
- [5] Z. Zheng, S. Xie, H. N. Dai, X. Chen, and H. Wang, "Blockchain challenges and opportunities: a survey," *International Journal of Web and Grid Services*, vol. 14, no. 4, pp. 352–375, 2018.
- [6] X. Wang, X. Zha, W. Ni et al., "Survey on blockchain for internet of things," *Computer Communications*, vol. 136, pp. 10–29, 2019.
- [7] X. Li, P. Jiang, T. Chen, X. Luo, and Q. Wen, "A survey on the security of blockchain systems," *Future Generation Computer Systems*, vol. 107, pp. 841–853, 2020.
- [8] M. Liu, K. Wu, and J. J. Xu, "How will blockchain technology impact auditing and accounting: permissionless versus permissioned blockchain," *Current Issues in Auditing*, vol. 13, no. 2, pp. A19–A29, 2019.
- [9] R. W. H. Bons, J. Versendaal, L. Zavolokina, and W. L. Shi, "Potential and limits of Blockchain technology for networked businesses," *Electronic Markets*, vol. 30, no. 2, pp. 189–194, 2020.
- [10] N. K. Ostern, F. Holotiuk, and J. Moormann, "A critical realist perspective on organizations' approach to blockchain," in *Academy of Management Proceedings*, vol. 2020, Academy of Management Briarcliff Manor, 2020.
- [11] G. J. Nam, D. M. Lee, and L. Chen, "An empirical study on the failure factors of startups using non-financial information," vol. 14, no. 1, pp. 139–149, 2019.
- [12] A. Karamchandani, S. K. Srivastava, and R. K. Srivastava, "Perception-based model for analyzing the impact of enterprise blockchain adoption on SCM in the Indian service industry," *International Journal of Information Management*, vol. 52, p. 102019, 2020.
- [13] A. Tapscott and D. J. H. B. R. Tapscott, "How blockchain is changing finance," vol. 1, no. 9, pp. 2–5, 2017.
- [14] T. Wang, Y. Wang, and A. McLeod, "Do health information technology investments impact hospital financial performance and productivity?" *International Journal of Accounting Information Systems*, vol. 28, pp. 1–13, 2018.
- [15] T. Yu, Z. Lin, and Q. Tang, "Blockchain: the introduction and its application in financial accounting," *Journal of Corporate Accounting & Finance*, vol. 29, no. 4, pp. 37–47, 2018.
- [16] S. Demirkan, I. Demirkan, and A. McKee, "Blockchain technology in the future of business cyber security and accounting," *Journal of Management Analytics*, vol. 7, no. 2, pp. 189–208, 2020.
- [17] N. R. Mosteanu and A. J. Q. Faccia, "Digital systems and new challenges of financial management—FinTech, XBRL, blockchain and cryptocurrencies," vol. 21, no. 174, pp. 159–166, 2020.
- [18] M. Sumathi and S. Sangeetha, "Blockchain based sensitive attribute storage and access monitoring in banking system," *International Journal of Cloud Applications and Computing*, vol. 10, no. 2, pp. 77–92, 2020.
- [19] D. Knezevic, "Impact of blockchain technology platform in changing the financial sector and other industries," *Montenegrin Journal of Economics*, vol. 14, no. 1, pp. 109–120, 2018.
- [20] H. I. Ozercan, A. M. Ileri, E. Ayday, and C. Alkan, "Realizing the potential of blockchain technologies in genomics," *Genome Research*, vol. 28, no. 9, pp. 1255–1263, 2018.
- [21] H. F. A. Surikhi, "Knowledge and financial management in households: an examination of married women's perspectives in Chadbourn, North Carolina," *Taiwan Journal of Public Health*, vol. 22, no. 1, pp. 69–78, 2012.
- [22] B. Y. Heo, J. K. Min, and W. H. Heo, "An algorithm for validation of the efficiency of disaster and safety management budget investment in South Korea," *International Journal of Disaster Risk Reduction*, vol. 47, Article ID 101566, 2020.