The Impact of Blockchain Technology on Internal Auditing in the Financial Sector

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Abstract Blockchain technology is claimed to lead innovations to many business paradigms by reducing fraud and providing safe transactions. This study examined whether the adoption of blockchain technology will impact their internal audit function (IAF) and the role of IAF in blockchain smart contracts in the financial sector. The study referred to the related literature review and followed the international standards for the professional practice of internal auditing (IPPF). The study found that internal audit function and relative associate with the basics of blockchain technology and reached a continuous audit model with blockchain smart contracts. Considering the significant benefits and also potential challenges of applying blockchain technology in the modern accounting system, the study filled a gap in knowledge on the impact of blockchain on internal auditing.

Keywords Blockchain technology · Internal audit function · Blockchain smart contract · IPPF

1 Introduction

Industry 4.0 creates enormous impact and opportunity, and businesses must find a new path to innovate for competitive advantage that disrupts technology, innovations, and business modes [29]. As an integral part of daily life, these radical developments will inevitably impact the financial sector. In the meantime, globalization and technological advancements are interconnected forces that internal audit function will be a significant impact [11]. The most cutting-edge technology in finance technology is now blockchain technology [4]. It has attracted the attention of government entities, financial institutions, and investors in a number of countries. While the drawbacks of today's credit mechanism are apparent and in crisis, the blockchain-based distributed cryptographic ledger solves the credit insufficiency problem that has a tremendous impact on the current industry ecology and way of operation [23].

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In a questionnaire of global banking executives conducted in May 2016, McKinsey discovered that around half of the executives thought blockchain would have a significant influence within three years, and some predict that this will happen during the next 18 months. Another survey of 200 worldwide banks indicated that 15% would be using blockchain technology substantially by the following year. According to IBM, 66% of banks will have commercial blockchain at scale in four years [15]. In 2016, blockchain representatives from the Big Four accounting firms gathered at the American Accounting Association to explore the creation of a distributed ledger alliance. The Australian Securities Exchange has revealed its desire to use blockchain technology to rebuild its clearing and settlement systems [3]. As the incomplete statistics, according to the website of HACKERNOON, by 2020, approximately 400 banks and financial institutions will have used or will be utilizing blockchain technology [2].

As highly innovative business technology, blockchain technology has disrupted the audit function [8]. Blockchain, essentially an accounting technology, might make asset transfers and ledgers of financial and non-financial data more efficient and accurate. Because all transaction data is stored in up-to-date, immutable, and historical distributed ledgers, the potential of real-time audit is high. Blockchain might finally put an end to auditors' random sampling by allowing them to review every transaction [10]. As a result, it offers increased audit efficiency [8, 31]. Although scholars have affirmed the various advantages of blockchain technology, applying this technology in the financial field is still a relatively new research topic.

This study examined that the adoption of blockchain technology in financial institutions will impact their internal audit function (IAF). In particular, it looked whether and if so, blockchain smart contracts can reach continuous auditing in real-time. To address the research question of the impact of blockchain technology on internal audit in financial sector, the study referred to the related literature review and in accordance with the international standards for the professional practice of internal auditing (IPPF). Considering the significant benefits and also potential challenges of applying blockchain technology in the modern accounting system. The study filled a gap in knowledge on the impact of blockchain on internal auditing.

The remainder of the paper is divided into six sections. Section 2 review relative literature, Sect. 3 illustrate the basics of blockchain technology and internal audit, and Sect. 4 discuss blockchain technology drove internal audit function change. Section 5 discusses the continuous auditing with blockchain smart contracts, and Sect. 6 summarizes of the findings and recommendations for further research.

2 Review of Related Literature

In relatively early blockchain studies, researchers highlighted the benefits of reducing operational costs. Lazanis [20] analyzed peer-to-peer transactions, automated settlements, and updated ledgers on blockchain networks, arguing that corporate fund payments can be made through blockchain networks, thereby reducing commission

costs by cutting across settlement intermediaries. This study highlights the advantages of blockchain and looks more closely at the fact that if peer-to-peer payments are made using the blockchain network's own digital currency, the reduction in intermediate cost fees is more pronounced, and it has the potential to greatly streamline the transaction process and lower operational finance expenses. Liu and Shi [21] suggest that accounting in blockchain mode will be transferred from "peer-to-peer" to "peer-to-network." This study found that the common audit of each node will record transactions and maintain updated data, which can reduce the influence of personal subjective factors of bookkeepers to a minimum. This is also one of the most significant benefits of utilising blockchain technology in the accounting profession.

Yoon et al. [36] analyze blockchain from another dimension, and the author argues that the blockchain comes with an audit system that will transform the accounting ecosystem. The process of blockchain information writing is an automated audit of accounting transactions, review, confirmation, bookkeeping, and other bookkeeping activities, in which participants jointly confirm whether the accounts are true and complete, reducing falsification and satisfying stakeholders' requirements for accurate and authentic financial data. Sun et al. [32] investigated blockchain from the standpoint of financial security, simulating a transparent distributed financial system on a private blockchain, with the financial system's customers being a corporation or a collection of companies. Each record node maintains a comprehensive and tamper-proof ledger, allowing any node to query all data at any time; at the same time, visitors' access is limited by cryptographic encryption technology, and external personnel can only access with authorization, ensuring financial data privacy. As a result, the blockchain financial system provides accounting data integrity and openness while preserving financial data safely and securely.

Tapscott [34] suggests that blockchain auditing can be used to replace third-party auditing services, resulting in more secure and trustworthy "self-auditing." All participating nodes in the blockchain distributed ledger network are auditors and recorders of information and data. In data auditing, the decentralised auditing mechanism has significant advantages, and the blockchain ledger can guarantee the independence, objectivity, and impartiality of auditing work compared with the third-party auditors, and the information data of enterprises on their own blockchain financial system can guarantee the objectivity and accuracy of financial reports. Zhong and Jia [38] also studied blockchain from the perspective of data reliability. According to the findings, the characteristics of blockchain and the benefits of big data may be used to tackle the problem of data silos in a targeted manner by evaluating the common difficulties of traditional Internet banking. The application of blockchain technology can improve accounting data structures and meet societal demands for online finance correctness and validity.

Through the analysis of previous studies, as a unique distributed ledger technology, blockchain's own structure can realize the functions of transparency, sharing, and non-tampering, which has a natural fit with accounting bookkeeping and auditing, and it is predictable that blockchain will be the best way to store data and share information. With the exploration and application of technology, the transformative role of blockchain in the audit industry is emerging step by step. In the future internal

audit business, a lot of work can be handed over to blockchain-based smart contracts to complete. After a lot of research and analysis, scholars currently agree more on the great advantages of blockchain technology, which could be the Internet technology with the greatest impact on auditing in the future. However, to the best of my knowledge, there is relatively little research literature on the adoption of blockchain technology in the auditing industry, and more research is needed to deepen our knowledge of blockchain. Overall, the current research on blockchain internal auditing is far from adequate.

3 Basics of Blockchain Technology and Internal Audit

3.1 Definition of Blockchain Technology

In 2008, Satoshi Nakamoto created Bitcoin, the first cryptocurrency designed for peer-to-peer trade. Bitcoin transactions in digital assets are now safe and secure, primarily to the development of blockchain technology [30].

As a distributed ledger technology, blockchain technology is a data structure that uses cryptography principles to record the flow of transaction funds. It uses its own distributed nodes for network data storage, verification, transmission, and exchange, providing safe and stable, transparent, traceable, and efficient technical solutions for information recording and data interaction. On a blockchain, when a transaction is performed, it is broadcast to all nodes in the network. This transaction is verified by miners that the transaction is valid and called this process mining. Cryptographically signed transactions are organised into blocks once they have been validated by the miners. After validation and consensus, each block is cryptographically connected to the one before it. Each block contains a cryptographic procedure called a "hash" of the previous block, as well as a timestamp and transaction data. New blocks are distributed across network copies of the ledger, and any conflicts are resolved automatically according to pre-determined procedures [27]. As new blocks are added, the transactions in a block cannot be modified (creating tamper resistance). When transactions are recorded, the data in any one block cannot be changed retroactively without affecting all following blocks since a different hash value will be generated, and other blocks related to it will not be able to confirm the hash value, necessitating network majority consensus [26]. Various data is recorded on a list of records, which are linked together like chains. Every node on the blockchain network may see every transaction on that block, as well as all previous blocks, resulting in a comprehensive transaction database that is constantly updated and accessible to all blockchain participants [37].

For an illustration of how does blockchain technology work to prevent any unauthorized data changes, draw an example (see Fig. 1.)

As Fig. 1 explain that there is a hash value in Block 2. This hash value is a 256-byte digital code randomly generated by an encryption algorithm. The authentication of

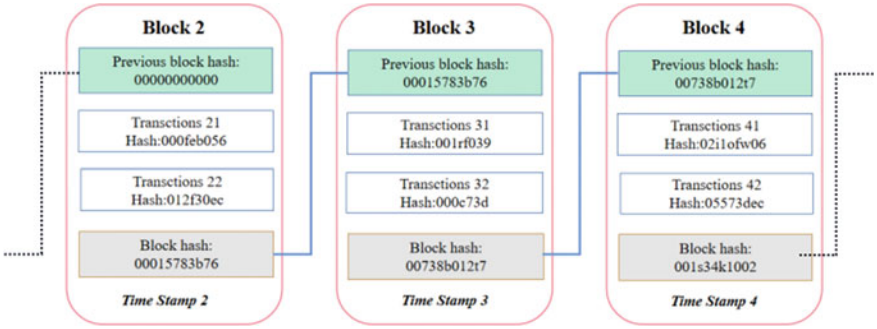

Fig. 1 A figure to explain the way of encryption between blocks

the next block is based on the hash value of the previous block. Once the hash value of a certain block is changed, then every subsequent block cannot be authenticated [14]. Due to the length of the hash value and the number of blocks, it becomes difficult to recalculate the hash after the change. Therefore, it will cause huge modification costs and essentially cannot cause data tampering.

On a peer-to-peer network, blockchain technology allows a digital ledger of transactions to be recorded, preserved, and verified. Decentralized blockchain provides the same function as many intermediaries in our society in establishing trust and maintaining integrity between transacting parties by authenticating and documenting immutable transactions [22]. As a distributed ledger in which groups of transactions or events are recorded and kept in a chain-like data structure, blockchain eliminates the need for costly middleman validation and verification methods [5, 8].

3.2 Characteristics of Blockchain Technology

Blockchain can be thought of as a decentralised architecture with built-in security that improves transaction trust and integrity [9, 22]. This section seeks to provide an overview of the blockchain's most frequent traits as well as its disadvantages.

Decentralisation—In contrast to centralised architecture, which has issues such as single point of failure and scalability, the blockchain uses a decentralised and distributed ledger to take advantage of the processing capabilities of all users in the blockchain network, reducing latency and eliminating the single point of failure [1].

Immutability—One of the most important properties of the blockchain is its capacity to create immutable ledgers, which ensures transaction integrity. Databases can be tampered with in typical centralised designs, necessitating the establishment of trust with a third party to ensure data integrity. Because each block in the distributed ledger is linked to the preceding block in a chain of blocks, the blocks in blockchain technology are permanently recorded and never modified as long as the network is maintained by the participating user [1].

Transparency—By sharing transaction details among all participating users involved in those transactions, blockchain provides a high level of transparency. There is no need for a third party in a blockchain setting, which increases business friendliness and ensures a trusted workflow [1].

Real-time—Because transactions are recorded and reconciled on the blockchain almost immediately after they occur, blockchain technology delivers near-real-time transaction records and account reconciliation [22].

Smart Contract—Smart contracts are supported by blockchain by embedding programming code. When particular contract criteria are met, these applications can conduct transactions and make related ledger entries. In a decentralised setting, self-executing smart contracts allow for the timing of ownership transfers from one party to another [17, 22].

Better Security—Although security is a concern for most new technologies, blockchain is more secure because it has a public key infrastructure that guards against unwanted data manipulation. Participants in the blockchain network put their faith in the consensus mechanism's integrity and security characteristics [1].

High Energy Consumption—Keeping a real-time ledger necessitates the use of energy. Every time a new node is created, it connects with the other nodes at the same time. Transparency is achieved in this manner. Miners on the network are attempting to solve a large number of solutions each second in order to validate transactions. They're putting a lot of processing power into it. Every node provides great fault tolerance, guarantees zero downtime, and assures that data recorded on the blockchain is immutable and censorship-resistant forever. However, these processes use both electricity and time [14].

3.3 The Relationship Between Blockchain Technology and Internal Audit

As known, Internal auditing is an independent, objective assurance and consulting activity designed to add value and improve an organization's operations [7]. It assists a company in achieving its goals by implementing a systematic, disciplined approach to evaluating and improving the efficacy of risk management, control, and governance [25]. Internal auditors are expected to apply and uphold the Internal Audit Standards and IPPF. The Code of Ethics interprets internal auditor should be followed as Integrity, Objectivity, Confidentiality, and Competency. However, the audit risk caused by personal factors is also possible.

Independence—Audit independence is threatened by self-interest, self-evaluation, over-promotion, intimate relationship, and external pressure. Technology can avoid the judgmental influence of such human emotions.

Integrity—Lack of integrity is a flaw in human nature; they may turn a blind eye when auditors find fraud and errors. However, the capacity to create immutable

ledgers ensures the integrity of transactions, which is a key aspect of blockchain technology [1].

Objectivity—With the development of the legislation and International Standards on Auditing, auditors' professional ability will be deviation whether they can catch it in time. Suppose we added the Standards in the protocol layer of blockchain that can be reduced audit mistakes caused by the lack of auditors' professional ability.

Confidentiality—When auditing, many trade secrets can be touched by auditors. By using blockchain technology, it may be protected. Such as, Deloitte used blockchain technology to integrate with the Irish banking system.

Competency—Blockchain technology is more trustworthy than auditors. For example, the blockchain audit application—Perma Rec of Deloitte's Rubix platform. This programme establishes a real-time connection between the audit firm and the audited firm's financial system, monitors and verifies the audited firm's transactions and financial entry, and keeps track of business operations. Through this application, established distributed accounts. This is an innovation in auditing, which enables help to do audits by using blockchain and smart contracts.

4 Blockchain Technology Drove the Role of IAF Changed

Internal audit is an independent supervision and evaluation activity based on the company's internal economic activities and serving the management department. At the same time, it also supervises the authenticity, completeness, and legality of the company's accounting information and plays a role in inspecting, supervising, and evaluating the safety of the company's assets and the company's own business performance. With the development of the market economy, many enterprises have become larger and larger, and their fiduciary and liability relationships have become more and more complicated. Great changes have taken place in the content and main structure, leading to corresponding changes in a wider range of internal audit services and service targets. Internal audits are conducted at many levels, from management to the company, with the goal of improving governance, risk management, and control systems. Internal audit functions that are most effective will reflect each organization's priorities and values. Each organization's senior managers and audit committees will have different expectations of the internal audit role [25].

The impact of blockchain on auditing is still in its early stages [24]. In a world where new technologies, such as blockchain advancements, are thriving but standards are behind [13], the function of internal audit needs to be continuously developed to include the ability to verify the regular operation of the various components of the blockchain, which provides for verification of access rights, encryption, and encryption codes, and proof of smart contract transaction codes, functions, and security [16]. Internal audits will need to build procedures for evaluating the operation of blockchain systems as a result.

Auditors could consider using relevant data analytic in blockchain and expanding consulting services such as control design, change management, and blockchain

governance with resources freed up from traditional evidence collection and testing [22]. Internal auditors will also need to update their understanding of both internal and external risks associated with blockchain processes, as well as develop relevant monitoring procedures [16], as the internal audit function has changed as a result of blockchain technology, necessitating the development of a conceptual framework to envision the function of internal audit.

5 Continuous Auditing with Blockchain Smart Contract

Blockchain has a lot of potential as a tamper-proof audit trail because of its cryptography and consensus methods that ensure transaction integrity. Smart contracts on the blockchain can be used for a variety of things, including the automatic settlement of financial derivatives and the secure transfer of property titles [6, 12]. When combined with smart contracts [33], which are computer programme that perform tasks on behalf of a human user, blockchain has the potential to drastically change current business procedures. If a financial institution's database architecture is a blockchain platform, blockchain-enabled smart contracts can generate agile supply chains and financial organisations by automatically monitoring and executing the terms of bills of lading and financial derivatives [3, 28]. Then according to the encryption and consensus mechanism, the execution of many businesses is realized through the blockchain smart contracts, including internal audits. Therefore, based on blockchain technology, the roles of internal audits of financial institutions can get a conceptual framework.

Continuous auditing was pioneered by Vasarhelyi and Halper [35], and continuous monitor the internal control was implemented. Also can achieve continuous data assurance, continuous risk, monitoring and assessment, and continuous auditing in management systems [19, 28]. Internal auditing has been associated with commonly continuous auditing because they are less constrained by legislative obligations [18]. Rozario and Vasarhelyi [28] stated that audit data analytic advance to the natural progression ADA3.0 with blockchain smart contracts. Fundamentally, the blockchain platform enables smart audit procedures' developing that run prediction models autonomously, discover critical items, and offer real-time audit data. Smart auditing models can improve audit quality and reduce the gap between auditors' and stakeholders' expectations [28].

However, with the application of blockchain platforms by financial institutions, internal audits only need to design corresponding smart contracts for the audit tasks to be carried out. Smart audit methods are now included in the definition of blockchain smart contracts (e.g., the analyses of audit evidence) [28]. Through data analysis and mining, risk assessment and abnormal early warning of supervision and special audits can be realized in a timely manner. Find audit doubts or audit trails. For example, commercial banks have added loan usage analysis rules, credit risk early warning rules, and internal control monitoring rules to the blockchain platform.

In addition, when internal auditors design automated audit procedures-smart contracts when smart business contracts executed by financial institutions violate the rules and cannot be executed, internal auditors need to audit smart business contracts. For example, bank deposit and loan pledge third-party supervision and credit business. Inventory pledgee applies to the bank for inventory pledge third-party supervision and credit business, including pledge price, quantity, description, pledge verification, etc. These phrases will be embedded in business logic and implemented on the blockchain. The blockchain enables banks and pledgers to authenticate the data given by the pledger and the actual pledge through smart contracts. An error message is generated if one or more of the smart contract's rules are broken, and the transaction cannot be completed. The internal auditor must rectify such breaches in order to authenticate the transaction's authenticity.

6 Conclusion

The idea of adopting blockchain technology in internal auditing is investigated in this study. Internal audits demand decentralisation and tamper-proof characteristics, which blockchain technology provides. Traditional internal audits will be drastically altered by the concept of blockchain technology internal audits. However, data security difficulties, timeliness issues, and legal issues remain obstacles to using blockchain technology in internal audits. In this paper, a conceptual framework for the application of blockchain technology to internal audits is presented. The results will be more generalised if a questionnaire is given to a large number of internal auditors at financial institutions. Conducting comparisons with empirical research as a future study option might be intriguing.

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