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THE ROLE OF BLOCKCHAIN IN ENHANCED REGULATORY COMPLIANCE AND IMPROVEMENT OF AUDIT PROCESSES

Abstract. *The modern world is shaped by continuous technological progress. Given the benefits of technological innovation for society, it is necessary to explore whether similar benefits can be achieved by implementing breakthrough technologies in accounting systems, namely blockchain. Blockchain was created by Nakamoto in 2008 with the intention of using the technology as the infrastructure for Bitcoin. Blockchain is a decentralized and distributed digital ledger that records transactions in an immutable, traceable, and secure manner. A literature review was conducted to examine how smart contracts, triple-entry systems, and real-time accounting impact organizations' compliance and audit processes. The overall results demonstrate that blockchain technology offers numerous benefits in accounting, transforming traditional practices and enhancing overall efficiency, transparency, and security.*

Keywords: *blockchain, accounting systems, audit processes, technological advancement, digital ledger, accounting, efficiency, security.*

1. Introduction

To maintain the security and integrity of the transaction verification process, private and public keys are used as part of a cryptographic system. A private key is a set of generated numbers that users use to sign transactions, confirming ownership and accessing their assets. A public key is used to identify users on the network and creates addresses used when sending and receiving transactions [1]. After verification, transactions are combined to form a new data block. These blocks, containing multiple transactions, are appended to previous data blocks, thereby creating a blockchain. Thus, the blockchain becomes an immutable ledger. The innovation of blockchain technology lies in the programming that enables the formation of interconnected blocks that form the so-called blockchain. After a block is created, it receives a block header containing information such as a timestamp, nonce, the hash value of the previous block, the Merkle tree hash value, and other information [2].Because many transactions occur simultaneously, a mechanism is needed to determine which block will be the next one in the chain. Blockchain solves this problem through a Proof of Work (PoW) mechanism.

Under this mechanism, network nodes (miners) receive a financial reward for finding a solution, known as a nonce, to a mathematically complex problem. After a node calculates a nonce containing hashes with a certain number of zeros, other nodes must verify its correctness. Once verification is complete, the block is added to the chain [3].

2. Methodology

This work is relevant because technologies are developing at an exponential pace and have the potential to penetrate and transform traditional business processes. Therefore, this article is intended for organizations considering the benefits of blockchain technology, as well as for auditors who may need to conduct a financial audit of this technology in the near future. The structure of a blockchain resembles linked lists or binary trees.

Karimov [4] defines linked lists as "a data structure containing a group of data elements representing a sequence. Each data element is called a node. Nodes contain data and are connected to the next node in the sequence via links." In a blockchain, nodes are connected via hash pointers. A hash pointer is a cryptographic hash function that creates a fixed-length string of characters to represent data. When a new block is created, this hash function is used in the block header to link to previous blocks, forming a tamper-proof transaction ledger. The Merkle tree hash is another element of the block header, used to represent all transactions within the block. The Merkle tree is topped by a top hash consisting of leaf nodes. These leaf nodes are hashed together to accurately represent the list of transaction data (Kulkarni, [5]).

This structure means that any data change will result in a different root Merkle hash, which is easily detected.Peer-reviewed articles from highly ranked academic journals were used to obtain information. These sources were chosen because the information they contain is considered credible and reliable. In addition to academic journals, alternative sources, such as publications by Deloitte, PwC, and the AICPA, were used. They were included because they were

considered relevant and necessary for understanding the practical application of the theories discussed in the article.

It is becoming clear that blockchain architecture offers a number of advantages, including transaction transparency and traceability, immutability of ledgers, which enhances data integrity, and enhanced security, which reduces the likelihood of fraudulent activity [6]. All of these factors could become significant advantages when implementing blockchain in accounting systems.

3. Literature Review

There are two types of blockchains, which will be discussed below. The first to emerge was the permissionless blockchain, best known for its use in cryptocurrencies such as Bitcoin and Ethereum. Swan [7] defines a permissionless blockchain as "shared by all network users, updated by miners, controlled by everyone, and owned by no one." This means that no special permission is required to send transactions, other than having the funds to pay the transaction fee. Furthermore, anyone can participate in the transaction verification process and potentially become a validator [8]. Helliar et al. [9] note that permissionless blockchains, particularly in the form of cryptocurrencies, have gone through various stages of adoption and are approaching widespread public and industry acceptance. This may be due to the advantages highlighted by Liu et al. [10], including decentralization, transparency, inclusiveness, and security. Despite this, permissionless blockchains have drawbacks, such as the inability to quickly process large transaction volumes. Privacy is a particularly important issue for organizations, as companies fear that sensitive business data will become publicly available [10].

This leads to an alternative form of blockchain—permissioned or private blockchains. In such blockchains, participation in the sending of transactions and the validation process is limited [8]. This means that transactions are confirmed by authorized participants rather than anonymous miners. The privacy protection provided by permissioned blockchains makes them better suited to the needs of organizations. Helliar et al. [9] note that "the financial industry has been and remains at the forefront of permissioned blockchain development." Casey and M [10] found that managers can take excessive risks for personal gain to the detriment of the principal (owner).

Providing shareholders and regulators with relevant and accurate accounting information is paramount. Therefore, reliance on reliable accounting information systems has become a critical element of the agency relationship between shareholders and managers [11]. (Antwi, 2021). Khan et al. [12] define smart contracts in a blockchain environment as “computer protocols designed to facilitate, verify, and automatically enforce negotiations and agreements between multiple untrusted parties.”

4. Results and Discussion

Benefits of Implementing Blockchain in Accounting

Blockchain clearly has the potential to transform existing accounting systems, as evidenced by the fact that all Big Four firms have explored distributed ledger technologies such as blockchain [13]. Furthermore, a Deloitte survey found

that companies are eager to adapt their business processes to accommodate blockchain implementation (Deloitte, [14]). It should be noted that blockchain technology is better able to address modern accounting challenges than existing financial record-keeping systems, as it provides protection against data forgery, as well as higher levels of transparency, traceability, and timeliness. Blockchain has the potential to "simplify operations, reduce transaction settlement times, reduce counterparty risk, minimize fraud, and improve capital regulation and liquidity" [15].

One of the pressing challenges is paper-based document management. Blockchain can solve this problem by digitizing documents, which simplifies operations, increases efficiency, reduces costs and human error, and enables automated data reconciliation.

The second problem is the lack of a mechanism for tracking transactions between different ledgers. To reduce counterparty risk, blockchain creates an audit trail, where transactions are encoded and executed on a shared, immutable ledger. Furthermore, accounting is susceptible to fraudulent activity. This problem is solved by the transparency and immutability of blockchain, as fraudulent transfers can be detected in real time, making the system extremely secure [15].

Another issue is the lengthy transaction settlement process. To speed up this process, blockchain uses smart contracts. These contracts, which will be discussed in detail later, ensure real-time transactions by automatically executing contract terms once pre-set requirements are met. Furthermore, many processes involve intermediaries. Blockchain eliminates the need for them, reducing information asymmetry between market participants and promoting liquidity and capital efficiency. Finally, accounting faces regulatory complexity, which is costly for organizations. The implementation of blockchain will make reporting faster and more accurate, enabling real-time monitoring between regulators and regulated companies.

Thus, the analysis shows that the implementation of blockchain in accounting systems has the potential to solve many existing problems in the industry.

Blockchain as an Accounting Information System

The Institute of Chartered Accountants in England and Wales (ICAEW) describes blockchain as "an accounting technology… concerned with the transfer of ownership of assets and the maintenance of a register of accurate financial information. For accountants, the use of blockchain provides clarity regarding the ownership of assets and the existence of liabilities" [16]. The next section examines the unique characteristics of blockchain that make it suitable for use as an accounting information system. These innovative features provide the foundation for understanding how organizations can use blockchain for regulatory compliance.

Smart Contracts

The idea of smart contracts was first proposed in 1994 and refers to computer programs that automatically execute the terms and conditions of real-

world contracts. Blockchain has undergone three stages of development, each adding new features. The primary purpose of Blockchain 1.0 was cryptocurrency trading, while Blockchain 2.0 expanded its scope to include financial applications [7]. Smart contracts function similarly to a bank, collecting and consolidating transaction history, but differ in that they allow users to encode their agreements and trust relationships, enabling automated transaction execution without the oversight of a central authority [17].

Traditional contracts require trusted central authorities for execution and oversight, but blockchain smart contracts eliminate this need by distributing control among all nodes in the network, making the system secure and tamper-resistant.

Real-Time Accounting

Blockchain technology can improve the quality of accounting information for investors in two ways: by increasing its reliability and ensuring its timeliness [18]. Currently, companies' ledgers are updated monthly or quarterly, and financial statements are prepared quarterly or annually. These are then audited by an external auditor. Due to the lengthy process, users receive information that may already be out of date. Blockchain can solve this problem because a company's entire transaction history can be stored with a permanent timestamp. This means that a company's accounting records can be accessed by shareholders, customers, creditors, and other stakeholders in near real time.

Real-time accounting refers to the near-instantaneous or daily updating of a company's accounting data. Users will be able to generate profit and loss statements or balance sheets in real time [19]. This has both internal and external implications for organizations. Within a company, managers' ability to manipulate earnings will be significantly reduced. Yermack [19] notes that real-time accounting reduces the importance of quarterly earnings manipulation and reduces distortions in investment policy. From an external perspective, "blockchain could save financial institutions at least $20 billion annually on settlements, regulation, and international payments" [20].

Implications for Compliance and Auditing

Compliance means ensuring that companies accurately report financial data in accordance with established rules and standards governing the accounting of revenue, expenses, assets, and liabilities. Public companies publish financial statements so that stakeholders can assess their financial position. To ensure the reliability of the information, an independent external auditor audits the financial statements. However, in today's environment, ensuring and assessing the reliability of data is becoming increasingly complex. This challenge can be mitigated by integrating blockchain into accounting systems.

Blockchain provides instantly verified transaction records—so-called real-time accounting—which differs from traditional auditing, which relies on reviewing sample transactions and closing balances. Unlike traditional auditing, which only reviews a sample of transactions, blockchain creates an audit trail in real time. Auditors have access to a complete and reliable transaction history. This

is called continuous auditing. The benefits of continuous auditing include increased efficiency, reduced costs, and reduced risk of human error.

Smart contracts also impact compliance and auditing. They enable the automated execution of multilateral agreements and enable the automatic recording of transactions in accordance with established standards [6]. This means that many transactions will be recorded correctly from the outset, reducing the need for verification. However, some accounting estimates still require human judgment, such as impairment testing or fair value assessment. Therefore, Rozario and Vasarhelyi [21] propose a hybrid audit model that combines automated and traditional procedures.

Smart contracts can also be used for auditing purposes. The decentralization, immutability, and accountability of blockchain improve the reliability of audit evidence. This makes auditing more proactive rather than retrospective. Auditors can monitor transactions for compliance with accounting rules in real time and immediately identify discrepancies, reducing the likelihood of material misstatements. This raises questions about the future role of accountants and auditors. Some researchers argue that automated data reconciliation could make these professions obsolete. Nevertheless, it can be argued that the role of accountants and auditors will remain. Blockchain cannot confirm the actual physical execution of transactions, prevent asset misappropriation, or prevent errors in transaction valuation.

Therefore, the professions of accountants and auditors will remain, although their functions will change. The use of blockchain will reduce the need for labor-intensive auditing tasks and allow specialists to focus on strategic consulting, analytics, and data analysis.

5. Conclusion

The study results demonstrate that blockchain technology offers numerous benefits for accounting, transforming traditional practices and improving efficiency, transparency, and security. Blockchain provides access to immutable financial data in real time, reduces the risk of data tampering, and enhances trust between participants. Security is achieved through cryptographic protection and decentralization. The technology simplifies processes by automating tasks using smart contracts, reducing transaction costs.

Furthermore, blockchain creates an immutable audit trail, facilitating regulatory compliance and strengthening stakeholder trust by providing accurate and reliable data. Financial auditing remains a critical element in ensuring user and investor confidence. Blockchain's capabilities for continuous auditing and real-time monitoring reduce the risk of fraud and facilitate compliance with accounting standards. This demonstrates that blockchain implementation will significantly improve regulatory compliance and simplify organizations' audit processes.

In conclusion, the implementation of blockchain technology in accounting systems will have a multifaceted impact on regulatory compliance and audit processes for organizations. The immutable ledger of the blockchain ensures a chronological record of all transactions and the impossibility of changing them

once confirmed. This transparency and traceability help regulators access data in real time and conduct compliance audits.

Auditors have access to an immutable history of all transactions, simplifying audits and increasing their reliability. Cryptographic security mechanisms protect the integrity and reliability of financial data, reducing the risk of non-compliance due to information manipulation. Furthermore, blockchain reduces the risk of fraud and errors, making audits simpler and more reliable. Organizations can provide regulators with up-to-date financial information through real-time accounting, and auditors are able to conduct continuous audits instead of periodic reviews.

Blockchain technology offers significant benefits for regulatory compliance and auditing by increasing transparency, security, and efficiency. However, to fully realize these benefits, organizations must address issues of regulatory uncertainty, integration, and data privacy. As the technology and regulatory environment evolve, blockchain is likely to become a fundamental component of modern accounting and auditing practices.

REFERENCES

1. Crosby, M.; Pattanayak, P.; Verma, S.; Kalyanaraman, V. (2016). Blockchain technology: Beyond bitcoin. Appl. Innov., 2, 6–10.

2. Yu, T., Lin, Z., & Tang, Q. (2018). Blockchain: The Introduction and Its Application in Financial Accounting. TheJournal of Corporate Accounting & Finance, 29(4), 37–47.

3. Z. Zheng, S. Xie, H. Dai, X. Chen and H. Wang, (2017). "An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends," IEEE International Congress on Big Data (BigData Congress), Honolulu, HI, USA, 2017, pp. 557-564.

4. Karimov, E. (2020). Linked Lists. Data Structures and Algorithms in Swift: Implement Stacks, Queues, Dictionaries, and Lists in Your Apps, 41-54.

5. Kulkarni, K. (2018). Learn bitcoin and blockchain : understand blockchain and bitcoin architecture to builddecentralized applications (1st edition). Packt.

6. Dai, J., &Vasarhelyi, M. A. (2017). Toward Blockchain-Based Accounting and Assurance. The Journal of Information Systems, 31(3), 5–21.

7. Swan, M. (2015). Blockchain: Blueprint for a New Economy (1st ed.). O'Reilly Media.

8. Szabo, N. (1997). Formalizing and securing relationships on public networks. First Monday 2 (9): 1–9.https://doi.org/10.5210/fm.v2i9.548.

9. Solat, S., Calvez, P., &Naït-Abdesselam, F. (2021). Permissioned vs. Permissionless Blockchain: How and WhyThere Is Only One Right Choice. J. Softw., 16, 95-106.

10. Helliar, C. V., Crawford, L., Rocca, L., Teodori, C., &Veneziani, M. (2020). Permissionless and permissionedblockchain diffusion.International Journal of Information Management, 54, 102136.

11. Liu, M., Wu, K., & Xu, J. J. (2019). How Will Blockchain Technology Impact Auditing and Accounting:Permissionless versus Permissioned Blockchain. Current Issues in Auditing, 13(2), A19–A29.

12. Antwi, I. F. (2021). Bibliometric Analysis: Agency Theory in Accounting. Journal of Accounting, Finance and Auditing Studies, 7(1), 56–76.

13. Khan, S.N., Loukil, F., Ghedira-Guegan, C. et al. (2021). Blockchain smart contracts: Applications, challenges, andfuture trends. Peer-to-Peer Netw.Appl. 14, 2901–2925.

14. O'Neal, S., (2019). Big Four and Blockchain: Are Auditing Giants Adopting Yet? Available at.https://cointelegraph.com/news/big-four-and-blockchain-are-auditinggiants-adopting-yet.

15. Deloitte., (2017). Blockchain in banking While the interest is huge, challenges remain for large scale adoption.Available at.https://www2.deloitte.com/content/dam/Deloitte/in/Documents/strategy/in-strategy-innovation-blockchain-in-banking-noexp.pdf.

16. Han, H., Shiwakoti, R. K., Jarvis, R., Mordi, C., & Botchie, D. (2023). Accounting and auditing with blockchaintechnology and artificial Intelligence: A literature review. International Journal of Accounting Information Systems, 48.

17. Institute of Chartered Accountants in England and Wales (ICAEW). (2018). Blockchain and the Future of Accountancy. ICAEW Thought Leadership—IT Faculty. London, U.K.: Institute of Chartered Accountants in England and Wales.

18. Chou, C.-C., Hwang, N.-C. R., Schneider, G. P., Wang, T., Li, C.-W., & Wei, W. (2021). Using Smart Contracts to Establish Decentralized Accounting Contracts: An Example of Revenue Recognition. The Journal of Information Systems, 35(3), 17–52.

19. Byström, H. (2019). 'Blockchains, Real-time Accounting and the Future of Credit Risk Modeling', Ledger Journal, 4, pp.40-47.

20. Yermack, D. (2015). Corporate Governance and Blockchains.NBER Working Paper Series, 21802-.

21. Fanning, K., & Centers, D. P. (2016). Blockchain and Its Coming Impact on Financial Services. The Journal of Corporate Accounting & Finance, 27(5), 53–57.

22. Forbes. (n.d.).Crypto Prices. Forbes. Retrieved fromhttps://www.forbes.com/digital-assets/crypto-prices/?sh=5412c7752478.

23. Rozario, A.M. &Vasarhelyi, M.A. (2018). 'Auditing with SmartContracts', International Journal of Digital Accounting Research,18 (1): 1–27.

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БЛОКЧЕЙННІҢ РЕТТЕУШІЛІК СӘЙКЕСТІГІН ЖАҚСАРТУДАҒЫ ЖӘНЕ АУДИТ ПРОЦЕСТЕРІН ЖЕТІЛДІРУДЕГІ РӨЛІ

Аңдатпа.*Қазіргі әлем үздіксіз технологиялық прогресспен қалыптасады. Технологиялық инновацияның қоғам үшін пайдасын ескере отырып, есеп жүйелерінде, атап айтқанда блокчейнде, серпінді технологияларды енгізу арқылы ұқсас пайдаға қол жеткізуге болатынын зерттеу қажет. Блокчейнді 2008 жылы Накамото технологияны Bitcoin үшін инфрақұрылым ретінде пайдалану мақсатында құрды. Блокчейн - транзакцияларды өзгермейтін, бақыланатын және қауіпсіз түрде тіркейтін орталықсыздандырылған және таратылған сандық кітап. Ақылды келісімшарттардың, үштік жазба жүйелерінің және нақты уақыт режиміндегі бухгалтерлік есеп ұйымдардың сәйкестік және аудит процестеріне қалай әсер ететінін зерттеу үшін әдебиеттерге шолу жүргізілді. Жалпы нәтижелер блокчейн технологиясының бухгалтерлік есеп саласында көптеген артықшылықтар ұсынатынын, дәстүрлі тәжірибелерді өзгертетінін және жалпы тиімділікті, ашықтықты және қауіпсіздікті арттыратынын көрсетеді.*

Түйінді сөздер: *блокчейн, бухгалтерлік есеп жүйелері, аудит процестері, технологиялық жетістіктер, сандық кітап, бухгалтерлік есеп, тиімділік, қауіпсіздік.*

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РОЛЬ БЛОКЧЕЙНА В ПОВЫШЕНИИ НОРМАТИВНОГО СООТВЕТСТВИЯ И СОВЕРШЕНСТВОВАНИЯ АУДИТОРСКИХ ПРОЦЕССОВ

Аннотация. *Современный мир формируется благодаря постоянному технологическому прогрессу. Наблюдая преимущества технологических инноваций для общества, необходимо исследовать, могут ли аналогичные преимущества быть достигнуты путем внедрения прорывных технологий в бухгалтерские системы, а именно технологии блокчейн. Блокчейн был создан Накамото в 2008 году с целью использования технологии в качестве инфраструктуры для функционирования Bitcoin. Блокчейн представляет собой децентрализованный и распределённый цифровой реестр, который фиксирует транзакции неизменяемым, отслеживаемым и безопасным способом. Для изучения того, как смарт-контракты, системы тройной записи и бухгалтерский учёт в реальном времени влияют на соблюдение нормативных требований и аудиторские процессы организаций, был проведён обзор литературы. Общие результаты показывают, что технология блокчейн предоставляет многочисленные преимущества в бухгалтерском учёте, трансформируя традиционные практики и повышая общую эффективность, прозрачность и безопасность.*

Ключевые слова: *блокчейн, бухгалтерские системы, аудиторские процессы, технологический прогресс, цифровой реестр, бухгалтерский учёт, эффективность, безопасность.*