DOI: https://doi.org/10.59503/29538009-2026.1.17-152

BLOCKCHAIN-BASED FINANCIAL CONTROL AND AUDIT MECHANISMS FOR SUSTAINABLE DEVELOPMENT

Lusine Arustamyan
Northern University, Ph.D. student
lusinearustamyan758@gmail.com
ORCID ID: https://orcid.org/0009-0005-2368-3275

Abstract: This article examines the application of blockchain technology in enhancing financial control and audit mechanisms within the framework of sustainable development. The increasing complexity of financial flows associated with sustainability initiatives necessitates advanced tools to ensure transparency, accountability, and efficiency. Traditional financial systems are often limited by centralization, lack of trust, and vulnerability to manipulation (Crosby et al., 2016). Blockchain technology, characterized by decentralization, immutability, and transparency, offers a promising solution. The study employs a qualitative methodology, including literature review, comparative analysis, and conceptual modeling. The results indicate that blockchain can significantly improve financial transparency, enable real-time auditing, and reduce corruption risks. A conceptual model is proposed to demonstrate how blockchain can be integrated into financial governance systems.

Keywords: blockchain, sustainable development, financial control, audit, transparency, smart contracts, governance.

JEL codes: M42, Q56, G38

Research aims: The main aim of this research is to explore the potential of blockchain technology as an innovative tool for improving financial control and auditing within sustainable development systems. It examines the limitations of traditional financial governance and highlights how key features of blockchain - such as decentralization, immutability, and transparency - can help address these issues.

The study also proposes a conceptual framework that integrates blockchain solutions into financial monitoring and auditing processes, with a focus on enabling real-time oversight, strengthening stakeholder accountability, and ensuring more efficient resource allocation in sustainability projects.

In addition, the research evaluates both the benefits and the practical challenges of implementing blockchain, including technological, regulatory, and institutional factors that may affect its adoption.

Research novelty: The novelty of this research is reflected in its integrated and practice-focused approach to applying blockchain technology in financial control and auditing within sustainable development.

First, instead of discussing blockchain in general terms, the study specifically examines its application in financial governance and audit procedures. It develops a clear conceptual model that supports ongoing, real-time auditing through decentralized data validation and the use of smart contracts.

Second, the research adds to the existing body of knowledge by connecting blockchain with sustainability goals, showing how greater financial transparency and accountability can contribute to achieving the Sustainable Development Goals (SDGs).

Third, unlike many studies that remain purely theoretical, this work emphasizes practical relevance by considering real-world applications and bridging the gap between theory and implementation.

Finally, the study provides policy-level recommendations to support the adoption of blockchain in financial control systems, aiming to improve institutional performance and minimize corruption risks.

Introduction

Sustainable development is a major priority for governments, international organizations, and businesses, aiming to balance economic growth, environmental protection, and social well-being. Achieving this requires effective financial governance, including transparent resource use, proper monitoring, and reliable auditing.

However, traditional financial control systems face serious challenges. They are mostly centralized, making them vulnerable to inefficiency, manipulation, and corruption. Financial data is often scattered across institutions, which complicates consistency, traceability, and accountability, ultimately reducing trust in financial reporting-especially in large, complex sustainability projects.

Blockchain enables the creation of distributed ledgers where all transactions are recorded in a secure and tamper-resistant manner. This ensures that financial data cannot be altered without detection, thereby increasing data integrity and trust. Moreover,

the use of smart contracts allows for the automation of financial processes and compliance verification, reducing the need for intermediaries and minimizing human error.

In recent years, it has become clear that blockchain can play an important role in financial governance. It helps improve data security, reduce the risk of fraud, and increase transparency and accountability. In my view, it can also be useful in the public sector by helping to lower corruption risks.

Despite its advantages, the use of blockchain in financial control systems - especially in sustainable development - remains limited. Key barriers include regulatory uncertainty, technical complexity, and high implementation costs, along with the absence of well-developed frameworks for integrating blockchain into audit processes.

This study therefore examines how blockchain can improve financial control and auditing in sustainable development. It focuses on identifying its main benefits and challenges, assessing its impact on transparency and accountability, and proposing a practical model for implementation.

Overall, the research aims to support the creation of more efficient, transparent, and reliable financial governance systems aligned with sustainable development goals.

The methodology

This research adopts a qualitative and exploratory methodological approach aimed at analyzing the potential of blockchain technology in enhancing financial control and audit mechanisms within the framework of sustainable development.

The study is based on a combination of several complementary research methods:

1. Literature Review

A comprehensive review of academic literature, institutional reports, and analytical studies was conducted to examine the theoretical foundations of blockchain technology and its applications in financial control and auditing. Key sources include works by Nakamoto (2008), Crosby et al. (2016), and OECD (2020), which provide insights into the technological and governance aspects of blockchain.

2. Comparative Analysis

A comparative analysis was carried out to evaluate the differences between traditional financial control systems and blockchain-based approaches. This method focuses on key criteria such as transparency, data integrity, efficiency, audit frequency, and vulnerability to fraud. The analysis allows for identifying the strengths and weaknesses of each system and assessing the added value of blockchain solutions.

3. Study Analysis

The research incorporates selected international case studies to examine real-world applications of blockchain technology in governance and financial systems. Examples include blockchain implementations in public administration and financial monitoring systems. These case studies provide practical evidence of blockchain's potential and highlight challenges related to implementation.

4. Conceptual Modeling

A conceptual model of a blockchain-based financial control and audit system is developed as part of this research. The model integrates key components such as distributed ledgers, smart contracts, and audit nodes. It is designed to demonstrate how blockchain can support real-time auditing, enhance transparency, and ensure accountability in financial processes related to sustainable development.

5. Analytical Synthesis

The findings obtained from the literature review, comparative analysis, and case studies are synthesized to generate a comprehensive understanding of blockchain's role in financial governance. This method enables the identification of patterns, relationships, and key factors influencing the effectiveness of blockchain-based systems.

The choice of a qualitative approach is conditioned by the exploratory nature of the research. Since blockchain applications in financial control for sustainable development are still evolving, qualitative analysis provides flexibility in examining both theoretical and practical dimensions.

Moreover, the integration of multiple methods ensures the reliability and validity of the research results. The combination of theoretical analysis and practical case studies allows for a balanced evaluation of both opportunities and limitations of blockchain technology.

Despite its comprehensive design, the methodology has certain limitations:

The research does not include quantitative or empirical data analysis. Case studies are limited to available public information.

Rapid technological changes may affect the long-term relevance of findings.

These limitations indicate the need for further empirical research and data-driven analysis in future studies.

Research results

This study is based on a qualitative approach that combines literature review, comparison of financial control systems, and analysis of blockchain applications. Such an approach makes it possible to evaluate how blockchain can transform financial control and auditing within sustainable development.

The findings show that blockchain changes how financial transactions are recorded and verified. Unlike traditional centralized systems, it enables decentralized, transparent, and real-time processes, improving reliability and efficiency. Key improvements are seen in transparency, audit effectiveness, data accuracy, fraud reduction, and overall performance.

Blockchain increases transparency by storing transactions in a shared, immutable ledger accessible to authorized users, reducing data inconsistencies. It also allows real-time auditing instead of periodic checks, as smart contracts automatically verify transactions. In addition, its decentralized nature lowers fraud and corruption risks since data cannot be easily altered.

The analysis also highlights improved efficiency and lower costs due to automation and reduced need for intermediaries. Overall, blockchain supports sustainable development by ensuring more transparent and accountable financial management. These results are summarized in Table 1.

Table 1 Summary of Key Research Results

Dimension	Traditional Systems	Blockchain-Based Systems	Impact	Source
Transparency	Limited	High	Increased trust	Nakamoto, 2008
Audit	Periodic	Real-time	Faster detection	Crosby et al., 2016
Data Integrity	Vulnerable	Immutable	Reduced manipulation	Kshetri, 2017
Fraud Risk	High	Low	Corruption reduction	OECD, 2020
Efficiency	Moderate	High	Cost optimization	Tapscott & Tapscott, 2016

Blockchain systems offer strong transparency since transactions are recorded in a shared, unchangeable ledger that authorized users can access in real time. This makes financial data more reliable and easier to track. In my view, transparency is one of blockchain's biggest advantages, especially where accountability matters, but it still needs to be balanced with data privacy.

Another major shift is in auditing. Instead of periodic checks, blockchain allows continuous, real-time monitoring through automated processes. I think this is a major improvement because it helps detect issues immediately, though its success depends on how well the system is designed.

Blockchain also strengthens data integrity by preventing unauthorized changes. To me, this is essential for trust in financial systems, although incorrect data at the input stage can still be a problem.

Fraud risks are also reduced because the system is decentralized and transactions cannot be easily altered. I believe this is one of blockchain's most valuable benefits, even though new technical risks may appear.

Finally, blockchain improves efficiency by automating processes and removing intermediaries. In my opinion, this speeds up operations and reduces workload, although high setup costs and complexity can be challenges at the beginning.

The functional capabilities of blockchain technology play a crucial role in transforming financial control and audit systems. Unlike traditional approaches, which rely on fragmented processes and manual verification, blockchain integrates multiple functions into a unified, automated, and secure system.

These functions are primarily enabled by core technological features such as distributed ledgers, cryptographic security, and smart contracts. As a result, blockchain enhances not only the accuracy and reliability of financial data but also the efficiency of monitoring, verification, and reporting processes.

To better illustrate these contributions, Table 2 presents the key functional components of blockchain technology and their impact on financial control systems.

The data presented in Table 2 highlights the core functional advantages of blockchain technology in financial control systems.

Blockchain allows constant monitoring of financial activity since transactions are updated in real time. I think this greatly improves control and helps detect problems early, although it requires strong technical infrastructure to work properly.

Table 2 Functional Contributions of Blockchain

Function	**Blockchain Feature**	**Result**	**Source**
Monitoring	Distributed ledger	Continuous tracking	World Bank, 2020
Verification	Smart contracts	Automated compliance	Crosby et al., 2016
Reporting	Real-time data	Instant audit reports	OECD, 2020
Security	Cryptography	Data protection	Kshetri, 2017

Verification is also automated through smart contracts, which follow predefined rules without human involvement. In my view, this is one of blockchain's most innovative features because it reduces errors and increases consistency, but it fully depends on how accurately the system is programmed.

Another advantage is real-time reporting, as financial data becomes instantly accessible. I believe this supports faster and better decision-making, though it also requires users to have the skills to properly understand and use the data.

Finally, blockchain strengthens security through advanced encryption. In my opinion, this is essential for modern financial

systems, but potential technical vulnerabilities and cyber risks still need careful attention.

In addition to the analytical results presented above, it is essential to provide a visual representation of the identified relationships and improvements associated with blockchain technology. The use of conceptual diagrams allows for a clearer understanding of how blockchain transforms financial control and audit mechanisms, particularly in terms of transparency, efficiency, and risk reduction.

These visual models complement the previous analysis by illustrating the structural and functional changes introduced by blockchain systems. They also help to highlight the interconnected nature of key dimensions such as real-time auditing, data integrity, and fraud prevention.

The following figures present a graphical interpretation of the main research findings and demonstrate the practical implications of blockchain implementation in financial governance systems.

To further illustrate the results of this study, several conceptual diagrams are presented below. These figures visually demonstrate the impact of blockchain technology on financial control and audit mechanisms, supporting the findings discussed in the previous sections.

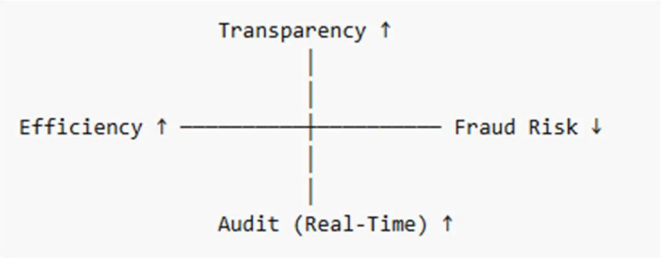
```
Traditional System:
Transaction → Record → Audit (Delayed) → Report

Blockchain System:
Transaction → Blockchain → Smart Contract → Real-Time Audit → Report
```

Figure 1. Blockchain Impact on Financial Control Dimensions

This diagram summarizes the core findings of the research. Blockchain improves transparency, efficiency, and audit capabilities while simultaneously reducing fraud risks. These results directly correspond to the key dimensions identified in the study.

In my view, this multidimensional impact highlights the systemic nature of blockchain transformation. Rather than improving a single aspect, blockchain simultaneously enhances multiple



components of financial control systems.

Figure 2: Real-Time Audit System (Blockchain vs Traditional)

The diagram demonstrates the transition from delayed auditing to continuous real-time verification. Blockchain eliminates the time gap between transaction and audit.

From my perspective, this shift is one of the most important innovations in financial control. Real-time auditing significantly increases responsiveness and reduces financial risks.



Figure 3. Blockchain-Based Financial Control Model

This model illustrates how blockchain integrates financial processes into a unified system, ensuring transparency, automation, and continuous monitoring.

In my opinion, this model represents a practical framework for implementing blockchain in financial governance systems. It demonstrates how different components interact to ensure accountability and efficiency.

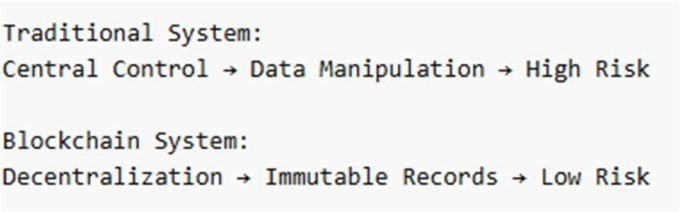


Figure 4. Fraud Risk Reduction Mechanism

The diagram highlights how decentralization and immutability reduce opportunities for fraud and corruption. We think that reducing fraud risk is one of the most critical contributions of blockchain, especially in large-scale financial systems related to sustainable development.

Conclusion

In conclusion, blockchain has strong potential to transform financial control and auditing in the context of sustainable development. It improves transparency, data reliability, efficiency, and reduces fraud, while shifting systems from centralized models to more decentralized and verification-based approaches.

In my view, one of its biggest strengths is enabling real-time monitoring, automated processes, and more accountable financial management, which increases trust between stakeholders. It also supports better use of financial resources, making systems more transparent and effective.

However, blockchain is not without challenges. Issues like high costs, technical complexity, scalability, and unclear regulations can slow its adoption. I believe that a gradual implementation, especially through hybrid systems that combine traditional and digital methods, is the most practical approach.

Overall, blockchain is a powerful tool for improving financial governance, but further research and real-world application are still needed to fully realize its potential.

References:

1. ***Nakamoto, S.*** (2008). *Bitcoin: A peer-to-peer electronic cash system*. https://bitcoin.org/bitcoin.pdf
2. ***Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V.*** (2016). Blockchain technology: Beyond bitcoin. *Applied Innovation Review*, 2. 6–19. https://scet.berkeley.edu/wp-content/uploads/BlockchainPaper.pdf
3. ***Kshetri, N.*** (2017). Blockchain's roles in strengthening cybersecurity and protecting privacy. *Telecommunications Policy*, 41(10). 1027–1038. https://doi.org/10.1016/j.telpol.2017.09.003

4. ***Tapscott, D., & Tapscott, A.*** (2016). *Blockchain revolution: How the technology behind bitcoin is changing money, business, and the world*. Penguin. https://www.penguinrandomhouse.com/books/533992/blockchain-revolution-by-don-tapscott-and-alex-tapscott/
5. ***Swan, M.*** (2015). *Blockchain: Blueprint for a new economy*. O'Reilly Media. https://www.oreilly.com/library/view/blockchain/9781491920480/
6. OECD. (2020). *Blockchain and public governance*. OECD Publishing. https://www.oecd.org/gov/blockchain-public-governance.htm
7. World Bank. (2020). *Blockchain and distributed ledger technology (DLT)*. World Bank Group. https://www.worldbank.org/en/topic/financialsector/brief/blockchain-dlt
8. ***Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L.*** (2019). *Blockchain technology and its relationships to sustainable supply chain management. International Journal of Production Research*, 57(7). 2117–2135. https://doi.org/10.1080/00207543.2018.1533261

ԲԼՈԿՉԵՅՆԻ ՎՐԱ ՀԻՄՆՎԱԾ ՖԻՆԱՆՍԱԿԱՆ ՎԵՐԱՀՍԿՈՂՈՒԹՅԱՆ ԵՎ ԱՈՒԴԻՏԻ ՄԵԽԱՆԻԶՄՆԵՐ ԿԱՅՈՒՆ ԶԱՐԳԱՑՄԱՆ ՀԱՄԱՐ

Լուսինե Առուստամյան
Հյուսիսային համալսարան, ասպիրանտ

Բանալի բառեր – բլոքչեյն, կայուն զարգացում, ֆինանսական վերահսկողություն, աուդիտ, թափանցիկություն, խելացի պայմանագրեր, կառավարում:

Ուսումնասիրվել է բլոքչեյն տեխնոլոգիայի կիրառման հնարավորությունը ֆինանսական վերահսկողության և աուդիտի մեխանիզմների կատարելագործման մեջ՝ կայուն զարգացման համատեքստում: Վերլուծվել են ավանդական և բլոքչեյնի վրա հիմնված համակարգերի առանձնահատկությունները՝ առանձնացնելով դրանց առավելություններն ու սահմանափակումները:

Հետազոտության ընթացքում կիրառվել են գրականության վերլուծության, համեմատական գնահատման և կոնցեպտուալ մոդելավորման մեթոդներ: Արդյունքները ցույց են տվել, որ բլոքչեյն տեխնոլոգիան կարող է ապահովել ֆինանսական հոսքերի ավելի բարձր թափանցիկություն, իրական ժամանակում աուդիտ և նվազեցնել կոռուպցիոն ռիսկերը:

Առաջարկվել է բլոքչեյնի վրա հիմնված ֆինանսական վերահսկողության և աուդիտի կոնցեպտուալ մոդել, որը հնարավորություն է տալիս բարձրացնել կառավարման արդյունավետությունն ու վստահությունը կայուն զարգացման գործընթացներում:

Submitted: 10.03.2026; Revised: 27.03.2026; Accepted: 13.04.2026