

Research on Improving the Transparency of ESG Information Disclosure Based on Blockchain Technology

Shuo Yang*

Uppsala University, Uppsala SE-751 05, Sweden

*Corresponding email: yashtechy@163.com

Abstract

The purpose of this paper is to discuss the scheme of improving the transparency of ESG information disclosure based on blockchain technology. With the increasing global attention to environmental protection, social responsibility, and corporate governance (ESG), improving the transparency of ESG information disclosure has become the focus of enterprises and society. Blockchain technology provides new possibilities for improving the transparency of ESG information disclosure because of its decentralization, non-tampering, and traceability. This paper first introduces the principles and advantages of blockchain technology, as well as the connotation and importance of ESG information disclosure, and then discusses the combination of blockchain and ESG information disclosure. Subsequently, the paper puts forward a scheme to improve the transparency of ESG information disclosure based on blockchain, including the objectives and principles of scheme design, application architecture, implementation steps, and strategies. It also points out the challenges that may be encountered in the implementation of the scheme, such as technical constraints, uncertainty of laws, regulations, supervision, and acceptance of enterprises and society, and provides corresponding countermeasures. Finally, the paper summarizes the research and emphasizes the enormous potential of blockchain technology in improving the transparency of ESG information disclosure.

Keywords

Blockchain, ESG information disclosure, Data transparency

Introduction

In the current global economic environment, environmental, social and governance (ESG) factors are increasingly becoming the core issues of corporate decision-making and investors' attention. With the improvement of society's demand for sustainable development and transparency, the traditional information disclosure model has been difficult to meet the market's demand for information authenticity, accuracy, and timeliness [1]. In this context, blockchain technology provides a new solution for improving the transparency of ESG information disclosure with its characteristics of non-tampering and decentralization.

The purpose of this study is to explore the potential application of blockchain technology in ESG information disclosure and reveal the possibility and advantages of combining the two through in-depth analysis of the principle and advantages of blockchain technology and the connotation and importance of ESG information disclosure [2]. By building a blockchain-

based scheme to improve the transparency of ESG information disclosure, this study puts forward a series of design objectives and implementation principles, aiming at achieving comprehensive, accurate and real-time disclosure of ESG information through technological innovation, thereby enhancing market trust and promoting sustainable development.

This study will comprehensively investigate the possible challenges in the implementation of the scheme, including technical problems, uncertainties in laws, regulations and supervision, and the acceptance of enterprises and society. By putting forward corresponding coping strategies, this study aims to provide theoretical support and practical guidance for the wide application of blockchain technology in ESG information disclosure [3,4].

Finally, this study is expected to provide useful references for relevant enterprises and regulators, promote the effective application of blockchain

technology in ESG information disclosure, and promote the sustainable development process on a global scale.

Related theoretical and technical basis

Principle and advantages of blockchain technology

Blockchain technology is a decentralized distributed ledger technology, which ensures the security, integrity, and non-tampering of data through chain data structure, encryption technology and consensus mechanism [5].

The data in the blockchain is divided into blocks, each block contains transaction records in a certain period, and these blocks are connected in sequence in time to form a blockchain. Blockchain, also known as chain data structure, records information in the form of blocks, and links these blocks together through specific algorithms to form a continuous chain. Each block contains certain information, such as transaction records, time stamps, etc., and is protected by cryptographic algorithms.

This unique structural design makes the data on the blockchain highly secure and tamper-proof. To ensure the continuity, reliability, and trust of the entire blockchain system.

The abstract structure of blockchain data is shown in the following Figure 1.

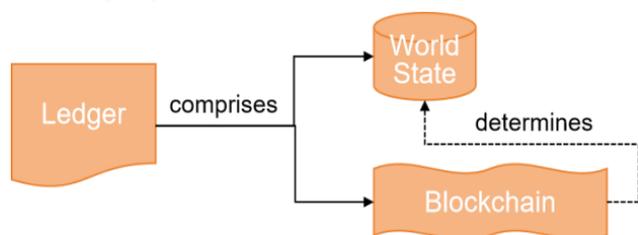


Figure 1. Abstract structure of blockchain data.

The advantages of blockchain technology are reflected in the following aspects.

- (1) Decentralization makes data no longer rely on a single central organization, reducing the risk of single point failure and data tampering.
- (2) Encryption technology ensures the security and privacy of data, and only users with corresponding keys can access and modify data.
- (3) The consensus mechanism of blockchain ensures the consistent recognition of data by all nodes and improves the credibility of data. These principles and advantages of blockchain technology provide dedicated support for solving information asymmetry and improving data transparency and security.

The meaning and importance of ESG information disclosure

ESG information disclosure refers to the information disclosure of enterprises in terms of Environment, society, and Governance. Among them, the environmental aspects include energy consumption, pollutant discharge and resource utilization of enterprises; The social aspect covers the protection of employees' rights and interests by enterprises, the contribution of community development and the maintenance of consumers' rights and interests [6].

Governance involves the internal governance structure, risk management, transparency and so on. The importance of ESG information disclosure is increasingly prominent. On the one hand, it helps investors to understand the sustainable development ability and risks of enterprises more comprehensively and make more wise investment decisions [7].

On the other hand, for enterprises themselves, positive ESG information disclosure can enhance their social image and reputation, enhance market competitiveness, and help enterprises find their own problems in ESG and improve them to achieve sustainable development [8].

ESG information disclosure is also conducive to promoting the sustainable development of the whole society and promoting the coordinated development of economy, environment, and society.

Combination of blockchain and ESG information disclosure

The combination of blockchain technology and ESG information disclosure has great significance and potential. The decentralized, tamper-proof, and traceable characteristics of blockchain can effectively solve the problems of information asymmetry and low data reliability in ESG information disclosure. By uploading ESG information, enterprises can ensure the authenticity and integrity of the information, and it is also convenient for stakeholders to query and verify the information. Blockchain technology can also realize real-time updating and sharing of ESG information and improve the timeliness and transparency of information disclosure [9].

For example, using smart contracts can automatically implement the disclosure rules of ESG information, ensuring that enterprises disclose relevant information on time and accurately. In addition, the distributed ledger

technology of blockchain can allow multiple stakeholders to participate in the management and supervision of ESG information, forming a fairer and more transparent information disclosure environment. In a word, the combination of blockchain and ESG information disclosure provides innovative ideas and methods for improving the transparency and quality of ESG information disclosure [10-12].

Blockchain-based ESG information disclosure transparency improvement scheme

Objectives and principles of scheme design

The goal of this scheme is to significantly improve the transparency of ESG information disclosure and ensure the accuracy, completeness, and timeliness of information.

By using the characteristics of blockchain technology, the non-tampering, traceability, and distributed storage of ESG information can be realized, providing reliable information sources for stakeholders [13]. In terms of design principles, it emphasizes security and adopts advanced encryption technology to protect information security and prevent data leakage and tampering; Pay attention to reliability, ensure the stable operation of the system and reduce the possibility of failure; Pursue ease of use, make the information disclosure process simple and clear, and facilitate the operation of enterprises and stakeholders; Emphasize compliance and ensure that the scheme meets relevant laws, regulations and regulatory requirements [14].

Application architecture of blockchain technology in ESG information disclosure

Construct an ESG information disclosure platform based on blockchain, and its architecture includes data layer, network layer, consensus layer, contract layer and application layer. The data layer is responsible for storing ESG information and using the distributed ledger technology of blockchain to ensure security and non-tampering of data. The network layer realizes the communication between nodes and ensures the rapid transmission of information [15].

Consensus layer ensures the consistent recognition of ESG information by each node through consensus algorithm. The contract layer introduces smart contracts to automatically implement the rules and processes of ESG information disclosure, which improves efficiency

and reduces human errors. The application layer provides a friendly interface for enterprises and stakeholders, which is convenient for them to input, query and analyze information.

Implementation steps and strategies of the scheme

First, the preparatory work is conducted, including the evaluation of the current situation of ESG information in enterprises, and the content and format of information that needs to be uploaded are determined. Then build a blockchain platform, select the appropriate blockchain technology and framework, and configure and evaluate the system. In the implementation process, we should pay attention to training relevant personnel to familiarize them with blockchain technology and ESG information disclosure requirements. And formulate promotion strategies, encourage enterprises to actively participate in ESG information disclosure, and communicate with regulators, investors, and other stakeholders to improve the recognition and influence of the program. Then continue to optimize and improve the scheme and adjust the function and performance of the blockchain platform according to the feedback and demand in practical application, to better meet the needs of improving the transparency of ESG information disclosure.

Challenges and countermeasures of scheme implementation

Technical Challenges and Solutions

In the implementation process of ESG information disclosure transparency improvement scheme based on blockchain technology, the technical level faces some challenges. For example, the performance and scalability of blockchain technology may be limited, and efficiency problems may occur when processing a large amount of ESG information.

To solve this problem, we can adopt optimized consensus algorithms and hierarchical architecture to improve the processing capacity and scalability of blockchain. Furthermore, data privacy protection is also a critical issue. ESG information may contain sensitive data, so it needs to be ensured that it will not be leaked during the information uploading process.

Encryption technology and privacy calculation methods can be used to encrypt and calculate data safely to ensure the privacy of data. The complexity of blockchain technology may lead to a high technical threshold, and it

is necessary to train professional technical talents to develop, maintain, and manage the system.

Challenges in laws, regulations and supervision

Challenges in laws, regulations, and supervision cannot be ignored. At present, the application of blockchain technology in ESG information disclosure is still in the development stage, and the relevant laws and regulations are not perfect enough. This may lead to legal risks and regulatory gaps in the information disclosure process.

To meet this challenge, it is necessary to strengthen the formulation and improvement of laws and regulations and clarify the application norms and regulatory requirements of blockchain technology in ESG information disclosure. Regulators should strengthen the supervision of blockchain applications and establish a sound supervision mechanism to ensure the authenticity, accuracy, and integrity of ESG information disclosure. Moreover, it is necessary to strengthen international cooperation and exchanges to promote the application and development of blockchain technology in the field of ESG information disclosure and form unified international standards and norms.

Challenges at the corporate and social levels

At the enterprise and social level, the implementation of

the plan also faces some challenges. On the one hand, enterprises' cognition and acceptance of blockchain technology may be different, and some enterprises may have doubts and resistance to the application of modern technologies. To solve this problem, it is necessary to strengthen publicity and training for enterprises, improve their knowledge and understanding of blockchain technology, and promote enterprises to actively participate in ESG information disclosure. From 2014 to 2023, the registration volume and growth rate of China's blockchain-related enterprises are shown in the following Figure 2.

On the other hand, the public's attention and awareness of ESG information need to be improved, which may affect the implementation effect of the scheme. Therefore, it is necessary to strengthen the education and publicity of the public, improve the public's attention to ESG information and trust in blockchain technology, and create a good social atmosphere. It is also necessary to establish a multi-party cooperation mechanism to promote cooperation and exchanges between enterprises, governments, social organizations, and the public, and jointly promote the transparency of ESG information disclosure.

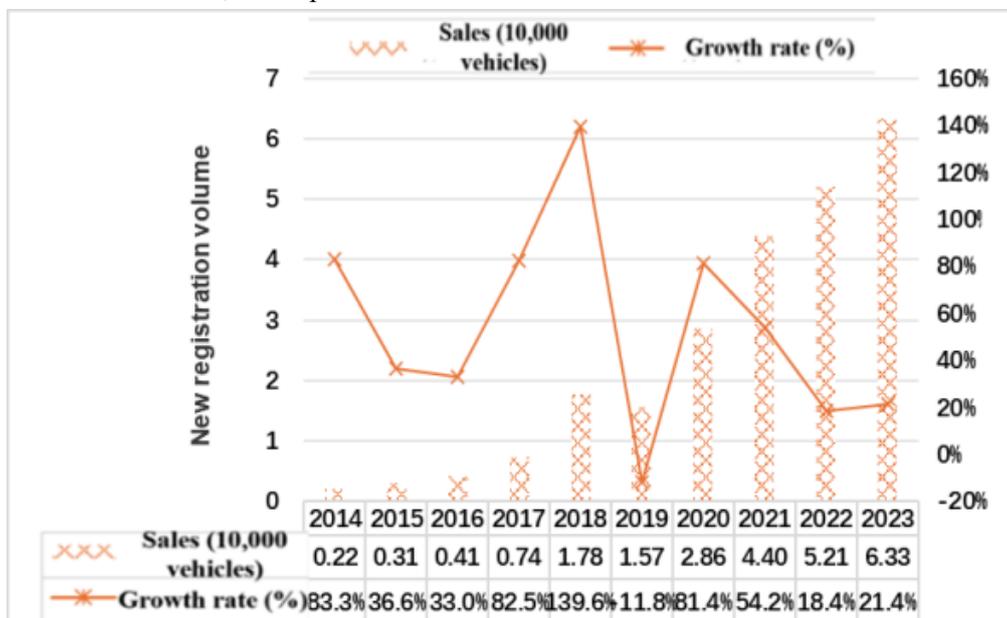


Figure 2. The registered quantity and growth rate of China's blockchain-related enterprises from 2014 to 2023.

Conclusion

Against the background of the increasingly prominent issue of global environment, society, and governance (ESG), improving the transparency of ESG information disclosure has become the focus of common concern of enterprises and society.

Blockchain technology provides a brand-new idea and solution to solve the transparency problem of ESG information disclosure with its unique characteristics of distributed account books, non-tampering, and smart contracts.

This study analyzes the principles and advantages of

blockchain technology, as well as the connotation and importance of ESG information disclosure, and discusses the possibility of combining the two, and puts forward a set of solutions to improve the transparency of ESG information disclosure based on blockchain.

This scheme aims to ensure the authenticity, integrity, and traceability of ESG data by building a secure, efficient, and transparent information disclosure platform, which is designed to enhance the trust and confidence of investors, consumers, and the public in corporate enterprise ESG practices and performance.

In the process of implementation, the scheme follows clear objectives and principles, and constructs a complete application architecture including data collection, storage, processing, verification, and disclosure.

By implementing the strategy step by step, the enterprise ESG data will be fully wound-up step by step, and the information will be shared openly, transparently, and efficiently. Although the implementation of the scheme faces many challenges in technology, law, supervision, enterprise, and society, these challenges are expected to be effectively overcome through continuous technological innovation, policy improvement, and joint efforts of all sectors of society.

The wide application of blockchain technology in the field of ESG information disclosure is expected to bring more efficient management and wider market recognition to enterprises and provide more authentic and credible ESG information references for the public.

Therefore, with the continuous progress of technology and the in-depth promotion of applications, the application prospects of blockchain in the ESG field will be broader.

Funding

This work was not supported by any funds.

Acknowledgements

The authors would like to show sincere thanks to those technicians who have contributed to this research.

Conflicts of Interest

The authors declare no conflict of interest.

References

- [1] Sun, Y., Shahzad, M., Razzaq, A. (2022) Sustainable organizational performance through blockchain technology adoption and knowledge management in China. *Journal of Innovation & Knowledge*, (4), 100247.
- [2] Ousefi, S., Tosarkani, B. M. (2022) An analytical approach for evaluating the impact of blockchain technology on sustainable supply chain performance. *International Journal of Production Economics*, 46, 108429.
- [3] Bag, S., Rahman, M. S., Gupta, S., Wood, L. C. (2023) Understanding and predicting the determinants of blockchain technology adoption and SMEs' performance. *The International Journal of Logistics Management*, 4 (6), 1781-1807.
- [4] Park, A., Li, H. (2021) The effect of blockchain technology on supply chain sustainability performances. *Sustainability*, 3(4), 1726.
- [5] Rehman Khan, S. A., Yu, Z., Sarwat, S., Goil, D. I., Amin, S., Shujaat, S. (2022) The role of block chain technology in circular economy practices to improve organizational performance. *International Journal of Logistics Research and Applications*, 25(4-5), 605-622.
- [6] Parentela, A., Petrillo, A., Tutored, I., De Felice, F. (2022) Is blockchain able to enhance environmental sustainability? A systematic review and research agenda from the perspective of Sustainable Development Goals (SDGs). *Business Strategy and the Environment*, 31(1), 194-217.
- [7] Ahl, A., Goto, M., Yarime, M., Tanaka, K., Sagawa, D. (2022) Challenges and opportunities of blockchain energy applications: interrelatedness among technological, economic, social, environmental, and institutional dimensions. *Renewable and Sustainable Energy Reviews*, 166, 112623.
- [8] Erol, I., Neu Hofer, I. O., Dogru, T., Oztel, A., Searcy, C., Yorulmaz, A. C. (2022) Improving sustainability in the tourism industry through blockchain technology: challenges and opportunities. *Tourism Management*, 93, 104628.
- [9] Tanwar, S., Parmar, A., Kumari, A., Jadav, N. K., Hong, W. C., Sharma, R. (2022) Blockchain adoption to secure the food industry: opportunities and challenges. *Sustainability*, 14(12), 7036.
- [10] Beshkardana, K. (2023) Reversing the irreversible: Mitigating legal risks of blockchain-based data breach through corporate governance. *Hastings Sci.*

& *Tech. LJ*, 14, 175.

- [11] Zhu, F., Liu, D. (2024) Impact of blockchain technology on the quality of ESG information disclosure. *Rcedia Computer Science*, 243, 197-205.
- [12] Yu, T. (2024) Blockchain Technology and the Improvement of ESG Information Transparency. *Disruptive Human Resource Management*, 211-219.
- [13] Zheng, W., Zheng, Z., Dai, H. N., Chen, X., Zheng, P. (2021) Block-EOS: Extracting and exploring blockchain data from EOSIO. *Information Processing & Management*, 58(3), 102477.
- [14] Han, X., Cao, T. (2021) Study on corporate environmental responsibility measurement method of energy consumption and pollution discharge and its application in industrial parks. *Journal of Cleaner Production*, 326, 129359.
- [15] Niu, Y., Fu, Y., Liu, X., Harish, A. R., Li, M., Huang, G. Q. (2024) Blockchain-based incentive mechanism for environmental, social, and governance disclosure: a principal-agent perspective. *Corporate Social Responsibility and Environmental Management*, 31(6), 6318-6334.