Ministry of Education and Science of Ukraine
West Ukrainian National University
Ministry of Education and Science of Ukraine
West Ukrainian National University

Qualification scientific
work on the rights of the manuscript

CHENGYU LIU

UDC: 657.6:004
JEL: M10, M40, M41

DISSERTATION
ACCOUNTING USING BLOCKCHAIN TECHNOLOGY

Specialty 071 «Accounting and taxation»
Field of knowledge 07 «Management and Administration»

It is submitted for obtaining the degree of Doctor of Philosophy

The dissertation contains the results of own research. The use of ideas, results and texts of other authors have references to the relevant source

Research Supervisor:
Muravskyi Volodymyr
doctor of economic sciences, professor

Ternopil – 2025

АНОТАЦІЯ

Лю Чен'юй. Облік в умовах використання технології блокчейн. – Кваліфікаційна наукова праця на правах рукопису.

Дисертація на здобуття ступеня доктора філософії за спеціальністю 071 – Облік і оподаткування. Західноукраїнський національний університет, Тернопіль, 2025.

У дисертаційному дослідженні здійснено теоретичне обґрунтування та запропоновано новий підхід до вирішення наукових і практичних завдань, який передбачає вдосконалення методологічних, організаційних і практичних положень бухгалтерського обліку в умовах використання інформаційної технології блокчейн.

Розвиток глобальної мережі Інтернет сприяв формуванню цифрової економіки, що супроводжувалося зростанням обсягів даних і вдосконаленням технологій їх обробки та аналізу. Оскільки основним джерелом економічної інформації є бухгалтерський облік, цифровізація економіки зумовила трансформацію як теоретичних положень, так і практичних аспектів облікової системи. У дослідженні проаналізовано трансформацію бухгалтерського обліку в умовах цифрової економіки під впливом сучасних інформаційних технологій: Big Data, блокчейн, штучний інтелект, мобільний Інтернет, хмарні обчислення, Інтернет речей та ін, які кардинально змінюють теорію та практику бухгалтерського обліку.

Серед інноваційних інформаційних технологій, які використовуються у бухгалтерському обліку, значна увага приділяється блоково-ланцюговому структуруванню даних. Обґрунтовано трансформаційний вплив технології блокчейн на бухгалтерський облік у цифровій економіці, проаналізовано її роль у підвищенні ефективності, безпеки та автоматизації облікових процесів. Досліджено еволюцію бухгалтерського обліку, новітній етап розвитку якого пов’язаний з використанням технології блокчейн, що сприяло забезпеченню інформаційної прозорості, інтелектуального прийняття рішень та інтеграції облікових систем в глобальні інформаційні середовища та економічні процеси.

Обґрунтовано послідовний перехід суспільних формацій від етапу інформатизації до стадії інтелектуалізації бухгалтерського обліку, що забезпечує вищий рівень інтеграції та стійкості цифрової економіки перед сучасними викликами.

Досліджено структурні та операційні аспекти технології блокчейн, зокрема виокремлено її семирівневу архітектуру, механізми консенсусу та методи шифрування облікових даних. Здійснено класифікацію технології блоково-ланцюгового структурування даних на публічні, альянсні та приватні блокчейни, визначено значущість їх використання в обліку, включаючи захищене зберігання даних, запобігання шахрайству та децентралізовану взаємодію. Встановлено, що альянсні та приватні блокчейни забезпечують розширені можливості контролю доступу та автентифікації, що робить їх особливо придатними для забезпечення кібернетичної безпеки обробки облікової інформації.

Системно проаналізовано функціональні можливості інтеграції технології блокчейн у бухгалтерський облік, що дозволило розкрити його здатність вирішувати проблеми інформаційної асиметрії, фінансового шахрайства та недостовірної звітності. Система бухгалтерського обліку, заснована на принципах блоково-ланцюгового структурування, забезпечує автентичність і достовірність облікової інформації, підвищує рівень кібернетичної безпеки фінансових даних та є основою для цифровізації обробки облікової інформації, що сприяє підвищенню її об'єктивності, своєчасності та надійності. Оцінено вплив блокчейн-технологій на облікову методику, включаючи визнання різних видів електронних (віртуальних) грошей обліковими об’єктами, їх грошову оцінку за різними методами, варіативне відображення на рахунках обліку, деталізовану періодизацію при формуванні внутрішньої та зовнішньої звітності.

Інтеграція інформаційної технології блокчейн з хмарним бухгалтерським обліком формує нові можливості для ефективного управління бізнес-процесами на підприємстві. Завдяки хмарним сервісам делегування облікових функцій незалежним інституціям стає доступним та економічно обґрунтованим варіантом організації обліку, а блокчейн гарантує захист і достовірність даних при їх передачі аутсорсерам. Запропоновано використання технології блокчейн для

організації документообігу у частині автоматичного формування електронних рахунків та облікових записів, що дозволяє мінімізувати ризики шахрайства. Досліджено перспективи інтеграції технології блокчейн з хмарними сервісами обробки облікової інформації для децентралізації бухгалтерського обліку як більш ефективної організаційної форми функціонування підприємства. Доведено, що децентралізована та безпекова природа блокчейну усуває обмеження традиційних хмарних облікових систем, забезпечуючи більш надійний механізм збереження облікових даних.

Удосконалено управління електронними бухгалтерськими документами завдяки впровадженню технології блокчейн, що оптимізує процеси виставлення рахунків, відшкодування витрат та реєстрації грошових операцій. Розроблено методику повного електронного документообігу, що ґрунтується на структуризації бази даних блокчейну, сприяючи оптимізації внутрішніх і зовнішніх комунікацій у бухгалтерському обліку при збереженні комерційної таємниці підприємства. Доведено, що алгоритми шифрування та розподілене зберігання значно підвищують рівень безпеки даних та унеможливлюють несанкціонований доступ сторонніх осіб.

Інноваційними обліковими об’єктами, що виникли завдяки розвитку технології блокчейн, є криптографічні валюти, які з позиції теорії обліку можна визнати активами підприємства. Уточнено методику бухгалтерського обліку електронних грошей та криптовалют з дослідженням їх класифікації та оцінки. Проаналізовано особливості впливу блокчейну на облік електронних грошей та криптоактивів, окреслено різні підходи до їх визнання грошовими коштами, фінансовими інструментами, запасами або нематеріальними активами. Запропоновано концептуальну модель обліку електронних транзакцій, що включає автоматизоване документування, оцінку та звітність у контексті електронних операцій з криптовалютами. Результати дослідження підтверджують, що блокчейн забезпечує повний контроль над цифровими фінансовими операціями, дозволяючи віддалене управління та моніторинг у режимі реального часу.

Уточнено порядок застосування технології блокчейн у розрахунках з контрагентами, що дозволило виявити їх потенціал у підвищенні ефективності грошових операцій через використання системи смартконтрактів. Визначено ризики та виклики, пов'язані з використанням блокчейну, а також запропоновано нову архітектуру блокчейну, що дає змогу обгрунтувати механізм консенсусу в бухгалтерському обліку грошових операцій. Встановлено, що такий підхід підвищує продуктивність системи електронних трансакцій, знижує ризики використання традиційних методів розрахунків з контрагентами та забезпечує ефективність у міжнародних платежах. Зокрема, децентралізований характер блокчейну усуває посередників у сфері міжнародних платежів. Платіжні платформи, такі як Rubik, продемонстрували здатність оптимізувати електронні трансакції, оминаючи складні банківські процедури та валютні конверсії. Підтверджено, що блокчейн сприяє зниженню витрат на транзакції, скороченню часу їх обробки та підвищенню інформаційної прозорості завдяки ефективній системі обліку грошових операцій. Акцентовано увагу на необхідності розробки уніфікованих галузевих стандартів та правових норм для масштабного впровадження технології криптовалютних активів.

Проаналізовано ефективність впровадження технології блокчейн в бухгалтерський облік, досліджено його інтеграцію з інформаційними системами підприємств та вплив на облікові процеси. Використано емпіричні дані діяльності 1598 компаній за 2013–2023 роки для оцінки ефективності застосування блокчейну в бухгалтерському обліку. Застосовано модель DuPont для оцінки ефективності блокчейну в бухгалтерському обліку, що продемонструвало його роль у спрощенні облікових процесів, зниженні кількості помилок та підвищенні точності фінансової звітності. Доведено значне підвищення коефіцієнта оборотності активів, що свідчить про покращення їх використання та загальної операційної ефективності у діяльності підприємства.

Ключові слова: облік, блокчейн, інформаційні технології, криптовалюти, криптооб’єкти, цифрова економіка, цифровізація обліку, інституалізація обліку, електронні документи, електронні комунікації, кібербезпека.

ANNOTATION

Liu Chengyu. Accounting using blockchain technology. – Qualification scientific work on manuscript rights.

Dissertation for obtaining the scientific degree of Doctor of Philosophy in specialty 071 – Accounting and taxation. West Ukrainian National University, Ternopil, 2025.

The dissertation provides a theoretical foundation and introduces a novel approach to addressing both academic and practical challenges through the enhancement of methodological, organizational, and applied aspects of accounting in the context of blockchain-based information technologies.

The development of the global Internet network has facilitated the emergence of the digital economy, accompanied by a significant increase in data volumes and advancements in technologies for their processing and analysis. Given that accounting serves as the primary source of economic information, the digitalization of the economy has led to the transformation of both the theoretical foundations and practical aspects of the accounting system. This study analyzes the transformation of accounting under the conditions of the digital economy influenced by modern information technologies, including Big Data, blockchain, artificial intelligence, mobile Internet, cloud computing, and the Internet of Things, which reshape the conceptual foundations and operational practices of the accounting domain.

Among these technologies, special emphasis is placed on distributed ledger structures. This study explores the transformative impact of blockchain technology on accounting in the digital economy, analyzing its role in enhancing efficiency, security, and automation in financial processes. The evolution of accounting practices has been examined, demonstrating how blockchain technologies have facilitated real-time collaboration, transparency, and intelligent decision-making. The gradual shift from informatization to intelligence-based accounting systems has been justified, ensuring improved integration and sustainability.

The structural and operational aspects of blockchain technology have been investigated, detailing its seven-layer architecture, consensus mechanisms, and

encryption techniques. A classification of blockchain types into public, alliance, and private chains has been conducted, emphasizing their implications for accounting methodologies, including secure data handling, fraud prevention, and decentralized financial interactions. It has been established that alliance and private chains offer enhanced access control and identity authentication, making them particularly relevant for accounting operations.

The integration of blockchain with accounting has been systematically analyzed, revealing its ability to address key challenges such as information asymmetry, financial fraud, and inaccurate reporting. The research has highlighted how blockchain-based accounting systems ensure data authenticity, enhance security, and automate financial statement generation, leading to increased reliability and neutrality in financial reporting. Additionally, blockchain's impact on fundamental accounting principles, including entity recognition, monetary measurement, and accounting periodization, has been evaluated.

The integration of blockchain with electronic invoices and accounting records has the potential to streamline accounting processes and reduce the risk of fraud. Furthermore, the study explores the integration of blockchain with cloud accounting, focusing on its potential to enhance efficiency, security, and transparency. The decentralized and tamper-proof nature of blockchain technology can address the limitations of traditional cloud accounting systems, providing a more robust and reliable platform for accounting data storage.

The management of electronic accounting documents has been improved through blockchain implementation, streamlining invoice issuance, reimbursement processes, and transaction recording. A novel electronic documentation and circulation method has been developed, leveraging blockchain's database structuring to optimize internal and external accounting communications while preserving enterprise trade secrets. The study has confirmed that encryption algorithms and distributed storage mechanisms significantly strengthen data security and prevent unauthorized access.

The combination of blockchain and cloud accounting has introduced new

opportunities for efficient business management. Cloud computing enhances the accessibility and performance of accounting services, while blockchain ensures data security and reliability in outsourced accounting processes. The integration of blockchain with cloud accounting has been examined, demonstrating how decentralized ledger technology enhances financial data management, real-time monitoring, and fraud prevention. Practical applications of blockchain in enterprise financial data storage have been identified, showing improvements in operational efficiency and cost reduction. Despite challenges such as processing speed and scalability, blockchain has been validated as a reliable and efficient tool for financial management.

Innovative accounting objects that have emerged due to the development of blockchain technology are cryptographic currencies, which from the perspective of accounting theory can be recognized as assets of an enterprise. The study also examines the accounting treatment of electronic money and cryptocurrencies, focusing on the challenges and controversies surrounding their classification and measurement as assets. The unique features of blockchain technology impact accounting practices related to electronic money and cryptocurrencies, and the study explores the different perspectives on whether cryptocurrencies should be recognized as cash, financial instruments, inventory, or intangible assets. A framework for accounting electronic transactions has been proposed, incorporating automated documentation, evaluation, and cryptocurrency reporting. The findings indicate that blockchain technology supports comprehensive control over digital financial transactions, enabling remote operations and real-time tracking.

In addition, the dissertation examines the application of blockchain technology in accounting for settlements with counterparties, highlighting its potential to improve efficiency and security. The study discusses the risks and challenges associated with the use of blockchain in this context, as well as the novel blockchain architecture that decouples consensus from transactions. By decoupling consensus from transactions, blockchain has been shown to improve system performance and reliability while mitigating risks associated with traditional settlement methods. The

decentralized nature of blockchain eliminates intermediaries, thereby reducing the time and cost associated with electronic transactions, particularly in the context of international payments. Payment platforms such as Rubik have demonstrated the ability to streamline electronic transactions by bypassing complex banking procedures and currency conversions. The study has identified blockchain's effectiveness in cross-border payments, reducing transaction costs and processing time, and enhancing transparency through decentralized verification systems. The need for standardized industry norms and legal frameworks has been acknowledged as an area requiring further development.

The dissertation explores the efficiency of implementing blockchain technology in accounting, focusing on its integration with enterprise information systems and its impact on accounting processes. Empirical data from 2013 to 2023 of 1598 companies is used to analyze the impact of blockchain on accounting efficiency. The DuPont model has been applied to measure blockchain's effectiveness in accounting, revealing its role in streamlining workflows, reducing errors, and improving financial reporting accuracy. The study has demonstrated a significant increase in total asset turnover rates, indicating improved asset utilization and operational efficiency.

Keywords: accounting, blockchain, information technology, cryptocurrencies, crypto-objects, digital economy, digitalization of accounting, institutionalization of accounting, electronic documents, electronic communications, cybersecurity.

LIST OF PUBLICATIONS ON THE THEME OF THE DISSERTATION

Scientific works in which the main scientific results of the dissertation are reflected

1. Muravskyi V, Khoma N, Khokhlova L., Liu Chengyu. Open document flow based on blockchain technology for cyber security of the accounting system. *Herald of Economics*. 2021. № 4. P. 156-170. URL: https://doi.org/10.35774/visnyk2021.04.156. (1.1 printed sheet, including the author's personal contribution - 0.3 printed sheet; a methodology for using blockchain technology for electronic documentation in accounting has been developed).

2. Muravskyi V, Pochynok N, Reveha O., Liu Chengyu. Accounting and control of foreign economic electronic transactions using cryptocurrencies. *Herald of Economics*. 2022. № 4. P. 44–60. URL: https://doi.org/10.35774/visnyk2022.04.044. (1.2 printed sheet, including the author's personal contribution - 0.3 printed sheet; the place of blockchain technology in accounting for electronic transactions using cryptocurrencies has been clarified).

3. Liu Chengyu, Volodymyr Muravskyi, Wenjun Wei. Evolution of blockchain accounting literature from the perspective of CiteSpace (2013–2023). Heliyon, 2024. Volume 10, Issue 11. e32097. URL: https://doi.org/10.1016/j.heliyon.2024.e32097. URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85194910440&origin=recordpage (indexed in Scopus and Web of Science, first quartile (Q1); 1.2 printed sheet, including the author's personal contribution - 0.5 printed sheet; statistical data was collected and analyzed, with conclusions drawn regarding the prospects for research into the use of blockchain technology for accounting purposes).

4. Liu Chengyu. Accounting for cryptocurrencies in international practice. Herald of Economics. 2024. №3. P. 218-231. URL: https://doi.org/10.35774/visnyk2024.03.218. (0.9 printed sheet).

Scientific dissertations that additionally reflect the scientific results of the dissertation

5. Liu Chengyu. Cryptocurrencies in international accounting. Стан і

перспективи розвитку обліково-інформаційної системи в Україні: матеріали VII Міжнародної науково-практичної конференції, присвяченій 55-річчю кафедри обліку і оподаткування та 85-річчю від дня народження д. е. н., проф. Б. М. Литвина (26-27 вересня 2024 р., м. Тернопіль). Том 1. Тернопіль: ЗУНУ, 2024. С. 288-289. (0.2 printed sheet).

6. Liu Chengyu. The integration of artificial intelligence and blockchain in tax audit. Стратегія розвитку України: фінансово-економічний та гуманітарний аспекти: матеріали XI Міжнародної науково-практичної конференції у 2-х частинах. (15 жовтня 2024 р., м. Київ). Частина 1. Київ: Інтерсервіс, 2024. С. 369-371. (0.2 printed sheet).

7. Liu Chengyu. Improvement of accounting for electronic money and cryptocurrencies. Актуальні аспекти розвитку науки і освіти: збірник матеріалів IV Міжнародної науково-практичної конференції науково-педагогічних працівників та молодих науковців (24 - 25 жовтня 2024 р., м. Одеса). Одеса: ОДАУ, 2024. С. 634-636. (0.2 printed sheet).

8. Liu Chengyu. The role of blockchain in enhancing tax audit accuracy. Інформаційні технології і автоматизація – 2024: матеріали XVII Міжнародної науково-практичної конференції (31 жовтня - 1 листопада 2024 р., м. Одеса). Одеса: Видавництво ОНТУ, 2024. С. 150-151. (0.2 printed sheet).

TABLE OF CONTENT

INTRODUCTION

Relevance of the theme. In the current era of scientific and technological advancement, all spheres of societal activity are undergoing a transformation, shifting from labor-intensive operations toward the implementation of high-tech processes. Over the past decade, the accelerated evolution of information technologies has significantly shortened their life cycle. The emergence of cutting-edge technologies such as 5G, Big Data, artificial intelligence, neural networks, the Internet of Things (IoT), and, most notably, blockchain, has not only contributed to the modernization of financial and economic operations but has also had a profound impact on enterprise management systems.

As an innovative information technology, blockchain possesses substantial functional potential for transformative influence on socio-economic processes and demonstrates considerable applicability across various domains. This potential has attracted the attention of national governments and management teams across different sectors of the global economy. Public institutions and business entities are increasingly striving to harness blockchain technology to gain technological and economic advantages in an environment of global competition.

Achieving competitive advantage requires the optimization of enterprise management through the provision of reliable, complete, timely, and accurate accounting information. With features such as decentralization, immutability of records, and real-time processing, blockchain technology can serve as a robust technological foundation for enhancing the efficiency and reliability of accounting systems. Continuous technological advancement has led to significant changes in both the theory and practice of accounting within enterprises. High-quality accounting information is critically important for ensuring sustainable business development.

The advantages and functional capabilities of blockchain technology align with the qualitative characteristics required of corporate accounting information, thereby reinforcing the need for digital transformation in accounting methodology and

organizational structures. The integration of blockchain into accounting practices can enhance the efficiency of accounting and information processes, mitigate the risks of unauthorized alterations to financial records, and, in the long term, optimize the financial performance of enterprises. Organizing accounting based on blockchain principles facilitates the effective operation of accounting departments in coordination with other functional units, aiming to improve the quality of accounting information and reduce the costs associated with its digital and automated processing.

The theoretical and practical aspects of blockchain technology in accounting were explored by the following researchers: Neal, James and Paul, Beomsoo, Chen, Pang Jian and Zhu Xinmin, He, Key, Carlsson, Grasso, Huff, Fu, Dai, Gao, Listiadi, Ng, Patil, Balaziuk, Bardash, Brukhanskyi, Fomina, Illiashenko, Kravchenko, Krupka, Lehenchuk, Muravskyi, Nashkerska, Nazarova, Onyshchenko, Osmiatchenko, Pravdiuk, Pyliavets, Resler, Semaniuk, Shevchuk, Spilnyk, Yaroshchuk, Yershova, Zadorozhnyi, Zvarych and others. The review of these studies highlights significant advancements in the field of blockchain application in accounting. However, the potential for further enhancement of accounting practices through blockchain technology, particularly in the context of evolving digital economies, increasing automation of accounting processes, and the transformation of internal and external control, remains underexplored.

This determined the choice of the topic of the dissertation work, confirms its relevance, and made it possible to determine the purpose, tasks and main directions of the research.

Connection of work with scientific programs, plans, topics. The dissertation research was carried out in accordance with the research plans of the Department of Accounting and Taxation at West Ukrainian National University within the framework of the research project titled «Digitalization of Accounting to Ensure Economic and Cybernetic Security of the Enterprise» (state registration number 0125U001067). In this project, the author has improved the accounting methodology in the context of using blockchain technology

The purpose and tasks of the research. The purpose of this research is to

identify the functional capabilities of blockchain technology in the processing of accounting information, with a focus on improving the methodology and organization of accounting in the context of the digital economy, in order to ensure informational completeness, transparency, cybersecurity, and the efficiency of enterprise management..

To achieve this purpose, the following tasks are defined:

- to investigate the impact of the use of information technology on accounting in the digital economy;

- to identify types of blockchain technology and their functional structure in the context of use in accounting;

- to systematize the transformational capabilities of blockchain technology in accounting;

- to clarify the methodology of electronic documentation in accounting using blockchain technology;

- to integrate blockchain technology and cloud services in the context of their shared use in accounting;

- to develop an information scheme for accounting for electronic transactions using cryptocurrencies;

- to explore the application of blockchain technology in transaction settlements and in cross-border payment;

- to examine the efficiency of blockchain technology in accounting, including its integration with enterprise information systems.

The object of research is the operation of enterprises as a set of financial and information flow processes in the context of their accounting activities, with the application of blockchain technology at the enterprise level.

The subject of research is a combination of theoretical and practical principles of accounting under the conditions of using blockchain technology within the enterprise.

Research methods. The following methods and techniques were employed to fulfill the tasks set in the thesis: dialectical method, historical and logical approaches

– in the study of financial activity as an object of accounting and analysis. When elucidating the essence and content of the definitions, methods of theoretical generalization were utilized: analysis and synthesis, induction and deduction, comparison, analogy, abstraction. The method of cause-and-effect relationship, abstract-logical, and method of grouping were applied to study the classification of financial costs, their accounting, and analysis at the stages of data collection and storage, processing, reporting of financial transactions; the method of comparison and economic-mathematical modeling – when conducting an analysis and forming an optimal pool of financial service providers or a resource strategy; graphical – for analysis of financial transactions and formation of financial policies of institutions.

The information base of the research consists of the works of domestic and foreign scholars; international and national legal acts on the organization of accounting and the formation of financial reporting, analytical processing of information; accounting and statistical information of financial institutions; reference and information publications, etc..

Scientific novelty of the obtained results consists in in-depth theoretical, methodical, organizational provisions and the development of practice-oriented proposals regarding the improvement of accounting of financial activities as a set of processes of recording, storing, and reporting financial transactions using blockchain technology at the enterprise. During the course of the thesis research, results were obtained that are characteristic of scientific novelty, in particular:

improved:

- method of electronic documenting and document circulation on the principles of block-chain structuring of the database, which determines the order of fragmentation and recombination of accounting information at the internal and external levels of electronic communications methodology for isolate information in favor of open document management in terms of maintaining trade secrets of the enterprise in accordance with the information needs of users and their classification in the enterprise management system;

- the procedure for integrating blockchain technology with cloud services to

ensure the efficiency, security and transparency of accounting processes based on the capabilities of blockchain data structuring towards their decentralization and cyber protection, which, unlike existing cloud accounting systems, is able to: overcome the functional limitations of blockchain technology, offer effective management solutions for financial management, accumulate accounting information for tactical and strategic purposes, organize effective cybersecurity, as a result, minimize operating costs, increase the efficiency of information processes and ensure the scalability of implementation in the activities of variable enterprises;

- information scheme for accounting for electronic transactions, which provides for documenting operations, inventorying, evaluating, reflecting cryptocurrencies in accounting accounts and in reporting with their recognition as cash, cash equivalents, financial instruments, intangible assets, which explains their evolutionary development in the digital economy, and also provides generating original documents in electronic format, automatically creating accounts, permanently accounting and controlling electronic transactions, and remotely operating company personnel;

further developed:

- generalization of the impact of innovative information technologies (big data, blockchain, artificial intelligence, mobile Internet, cloud computing, Internet of things) on accounting in the digital economy in the direction of ensuring connectivity, automation, data-driven decision-making, innovation, scalability, user-centricity, transparency, security, integration, sustainability in the processing of accounting information, which justifies the gradual evolution of the accounting system from informatization to intelligence stages;

- positioning of three types of blockchain technology (public chains, alliance chain and private chain), which are endowed with specific architectural characteristics, as transformers of the methodology and organization of accounting in the context of decentralization (distributed ledger), trusted interaction technology, smart contracts, coordinated sharing mechanism, new measurement model, time stamp, which provides including enhanced data security, reduced fraud and improved efficiency of accounting operations;

- transformational impact of blockchain technology on accounting was systematized in the direction of impact on: accounting entity, continuing operation, accounting period, monetary measurement, accounting recognition, accounting measurement, accounting report, which gave the effect of increased relevance, enhanced reliability and authenticity, improved timeliness and guaranteed neutrality;

- application of blockchain technology in accounting for settlements with counterparties has the potential to greatly enhance the efficiency and security of transaction settlements by separating consensus from transactions, thereby improving system performance and reliability while mitigating risks inherent in traditional settlement methods, as demonstrated by its practical benefits in cross-border payments and settlements, including cost reduction, faster transaction processing, and enhanced data security; however, despite existing challenges such as the need for standardized industry norms and clear legal frameworks;

- the use of the DuPont model to analyze the effectiveness of blockchain use in accounting based on the determination of net profit margin, total asset turnover, equity multiplier demonstrated the positive effect of digitalization of accounting information processing in medium and large enterprises by simplifying and increasing the efficiency of accounting operations.

Practical significance. The practical significance of the dissertation lies in the possibility of using its main results and developments in the practical activities of enterprises that use blockchain technologies to digitize accounting, as well as financial companies in accounting for financial transactions using cryptocurrencies.

Personal contribution of the applicant. The dissertation is the result of independently performed scientific research. Scientific results and developments, conclusions and proposals contained in the dissertation belong to the author personally.

Approbation of the results of the dissertation. The main results of the dissertation research were reported and received favorable reviews at the following 4 international and all-Ukrainian scientific and practical conferences: VII International Scientific and Practical Conference dedicated to the 55th anniversary of the

Department of Accounting and Taxation and the 85th anniversary of the birth of Doctor of Economics, Prof. B. M. Lytvyn «State and Prospects for the Development of the Accounting and Information System in Ukraine» (Ternopil, September 26-27, 2024), IV International Scientific and Practical Conference of Scientific and Pedagogical Workers and Young Scientists «Current Aspects of the Development of Science and Education» (Odesa, October 24 - 25, 2024), XVII International Scientific and Practical Conference «Information Technologies and Automation - 2024» (Odesa, October 31 - November 1, 2024), XI International Scientific and Practical Conference «Development Strategy of Ukraine: Financial, Economic and Humanitarian Aspects» (Kyiv, October 15, 2024).

Publications. The main provisions and results of the dissertation are set out in 8 scientific publications, including: 4 scientific publications that reflect the main scientific results, including an article in a scientific periodical, which is indexed in the Web of Science and Scopus databases (Q1), 3 articles in scientific professional publications of Ukraine; 4 scientific publications that additionally reflect the scientific results of the dissertation. The total volume of published works is 5.2 printed sheets, the author personally owns 2.8 printed sheets, among them: scientific works that highlight the main results of scientific research on the topic of the dissertation - 2 printed sheets; scientific works that additionally reflect the scientific results of the dissertation - 0.8 printed pages.

Structure and volume of the dissertation. The dissertation consists of an introduction, three chapters, conclusions, a list of sources used and appendices. The full volume of the dissertation is 212 pages of printed text. The volume of the main text is 154 pages of printed text. The dissertation contains 19 tables and 22 figures (of which 1 table occupies a separate page), 5 appendices on 6 pages. The list of sources used has 240 names and is located on 27 pages.

CHAPTER 1.

DIGITIZATION OF ACCOUNTING USING BLOCKCHAIN

1.1. The concept of the digital economy and use the information technology in accounting

«The digital economy's origins date back to the 1980s, as the widespread adoption and advancement of the Internet led to the generation of vast amounts of crucial data» [121]. «This, in turn, accelerated the progress and enduring growth of data processing and analysis technology» [121]. «It is in this context that the concept of «digital economy» comes into being. The term digital economy first appeared in the United States. In 1996, Tapscott first proposed the digital economy, and explained that the arrival of digital economy is imperative, and believed that the development of digital economy will mainly rely on e-commerce in the future» [32]. Japan first defined digital economy as e-commerce in a broad sense in 1997 [180]. «In 1998, the US Department of Commerce released the report «Emerging Digital Economy», an economic operation model that leads the trend of The Times with «high growth, rapid technological progress and low inflation» [156]. «The United States tends to define the digital economy as the sum of measurable e-commerce and information technology industries, and divides the digital economy into e-commerce and information technology industries» [145].

Subsequently, many countries defined digital economy from different perspectives. China and South Korea generally believe that digital economy should be a kind of economic activity, but their focus is different [129]. China believes that digital economy is mainly an economic aggregate generated by the integration of other industries and information and communication industries. South Korea gives a broader definition of digital economy, which means that all economic activities, including e-commerce, Internet services, search services, etc., are based on information and communication related industries, including the Internet and

computer technology. France and the Organization for Economic Cooperation and Development (OECD) focus on measuring the size of the digital economy [35]. The Digital Economy Measurement released by the International Monetary Fund (IMF) in 2018 defines digital economy as network platforms and activities based on such platforms in a narrow sense, and defines digital economy as all activities using digital information in a broad sense [90]. The UK believes that it is more reasonable to use social production to express the digital economy. According to the UK Commission on the Digital Economy, the digital economy is an activity in which people, processes and digital information technology interact to produce outputs for society [114]. According to the relevant research institutions in the UK, all the social and economic benefits generated through the digitalization and informatization of factor input are digital economy [27]. Australia promotes the digital economy as an economic and social progress process. Australia pointed out in the relevant document report that the digital economy is a networked process of economic and social integration through information and communication technologies, mobile devices and Internet of Things networks on a global scale [85]. The digital economy in Ukraine is growing rapidly, impacting socio-economic sectors [86, P.11-57]. It includes e-commerce, digital services, and advanced technologies like AI and IoT [209]. The government promotes digital transformation to boost productivity and competitiveness. E-commerce has surged, with more consumers shopping online. However, challenges like a skills gap and the need for a robust legal framework remain [210]. Despite these, the digital economy offers significant potential for economic growth and social development in Ukraine [211].

With the rapid development of the digital economy, academia is paying more and more attention to digital economy. Neal (1999) argued that digital economy refers to the transformation of existing e-commerce based on the basic framework constructed by the Internet through the mutual integration between the terminal equipment of the Internet and digital information technology [159]. James and Paul (2001) analyzed the digital economy from a more general perspective and pointed out that the digital economy represents a technological revolution, sustainable

development and equity [108]. Beom-soo (2003) pointed out that the goods and services needed by micro subjects are all traded on the basis of Digital information technology - digital economy (Economics). The view is only from the micro perspective, but does not pay attention to the macro characteristics of digital economy [23]. Chen (2024) further pointed out that the scope of information technology covers all aspects of social economy, including information technology, traditional industries, infrastructure and lifestyle [39]. «Pang Jian and Zhu Xinmin (2013) paid more attention to the basic role of information and communication innovation technology in the digital economy» [158]. «The essential feature of digital economy is to clean, screen, store, organize and analyze the massive data accumulated in production and life, and then use it to optimize resource allocation and achieve industrial development» [158]. He (2024) pointed out that as a new way of economic activities, digital economy is based on related knowledge and information, and its core driving force is related digital information technology [94]. According to Key (2004), the focus of the digital economy is based on the creation of new human social activities and products [118]. Winseck (2016) believed that digital economy takes digital information and related communication technology as the core production input, and forms virtual network based on modern communication facilities [196].

In the 1940s, the emergence of the second generation of transistor electronic computers and the utilization of integrated circuits led to the rise of digital technology's influence on our economy and daily life, enhancing human capacity to obtain and analyze information. .The human society is undergoing earth-shaking changes, which are brought about by the Internet and information technology revolution [140]. The rapid growth of the digital economy has been significantly supported by contemporary information science and technology, establishing a strong basis and serving as the cornerstone for its advancement [46].

Table 1.1

The Principles of the Digital Economy and Their Impact on Accounting

Principle of the Digital Economy	Impact on Accounting
Connectivity	«Enhanced data sharing and integration across different departments and systems, enabling real-time access to financial information and improving the accuracy and timeliness of accounting processes» [13].
Automation	«Reduced manual intervention in accounting tasks such as data entry, reconciliation, and report generation, leading to increased efficiency, reduced errors, and lower costs» [16].
Data-Driven Decision-Making	«Greater reliance on data analytics for financial planning, budgeting, and forecasting, enabling more informed decision-making and strategic planning» [18].
Innovation	«The emergence of new business models and revenue streams, requiring accounting practices to adapt to recognize and measure new forms of value, such as digital assets and intellectual property» [24].
Scalability	«The ability to quickly scale accounting systems and processes to accommodate business growth, facilitated by cloud computing and other digital technologies» [27].
User-Centricity	«Increased focus on providing relevant and personalized financial information to different stakeholders, through interactive and customizable reporting tools» [42].
Transparency	«Improved traceability and auditability of financial transactions, facilitated by technologies such as blockchain, which create immutable and transparent records» [46].
Security	«Enhanced protection of financial data and systems from cyber threats, through the use of advanced security measures and protocols» [51].
Integration	«The integration of accounting systems with other business systems, such as supply chain management and customer relationship management, to create a more holistic view of the business» [57].
Sustainability	«The use of digital technologies to support sustainable business practices, such as reducing paper usage and energy consumption, and enabling more efficient resource management» [64].

Source: developed by the author

Since the 1950s, with the wide application of computers, enterprise management and the whole social economy have undergone great changes, and gave birth to

management accounting, and the modern accounting system has been gradually established and improved. Throughout the development and evolution of modern accounting, the basic motivation to promote its development is economic development and technological progress.

1. External motivation: economic development. In the age of the steam engine, the United Kingdom pioneered a new form of business organisation, the joint stock company, to meet the needs of mass production. «This change had a profound impact on accounting and triggered a major reorganisation of the objects and contents of accounting services» [20]. «At the service object level, the responsibility of accounting has expanded from serving only a single enterprise to serving all enterprises, thus transforming accounting into a social activity» [1]. At the content level, the scope of accounting has also been expanded from simple bookkeeping, accounting and additions to the preparation of statements to meet the needs of joint stock companies for transparency and disclosure of information [21]. During the electrical age, cost accounting came into being with the progress of industry, and more scientific management theories and methods began to be incorporated into the accounting field to promote the continuous improvement and maturity of accounting tools . During the first and second industrial revolutions, although the overall level of the economy had not yet reached a higher level and the development of accounting was relatively slow, this period also witnessed the initial transition from manual accounting to mechanical accounting [25]. «In the information technology era, due to the wide application of computers in the accounting field, the development of accounting has also changed from traditional manual accounting to computerized accounting» [78]. «Since the early 21st century, the world has transitioned into the era of automation and intelligence in the digital economy. The increasing demands for information in the digital economy have led accounting, a crucial provider of financial information, to evolve from computerized methods to more advanced forms of information technology and automation» [24].

«The more economic development, the more progress accounting» [76], this is known by reviewing the relationship between economic development and accounting

evolution in various countries around the world [77, P.1148-1156]. Modern accounting from the era of accounting computerization to the era of accounting information, and then to the present era of accounting intelligence, the objective environment of economic development and its changes have a direct impact on accounting [83]. In this period, modern accounting has experienced a gradual development process from low to high, from simple to complex, from never seeking perfection to gradual . In short, the external motivation of the development and evolution of modern accounting is economic development.

2. Internal motivation: technological progress. «Economic development has evolved from the steam era, through the electric era and the information era, to the current digital era, with technological advancements playing an ever more crucial part in fostering economic expansion» [157]. New technologies such as «big intelligence moving cloud» have introduced economic development into the era of digital economy, and also promoted the development of modern accounting into a new era.There are at least two foundations for the development of accounting: rational basis and technical basis.The so-called rational basis refers to the basic premise on which the accounting system is built and exists, such as accounting assumptions and accounting basic theories.The so-called technical basis refers to the technical support or technical means, so that the accounting system can operate normally. The origin of accounting is closely related to the calculation and recording technology. The evolution of modern accounting is directly influenced by every significant advancement in calculation and recording technology. Technological advancements are the primary driver of modern accounting evolution. Technological advancements directly influence the evolution of modern accounting by impacting calculation and recording methods.

After the 1950s, the continuous progress of industrial technology, the acceleration of economic development, a large number of economic business, promote the continuous development of accounting. However, the accounting work at that time needed to spend a lot of time in repeated manual accounting and manual bookkeeping, which made the accuracy of accounting work is not high, low

efficiency . With the emergence of computer and local area network technology, accounting computerization was born in the early 1980s [84]. Replacing manual bookkeeping with computer and other electronic equipment, the hands of accounting personnel were liberated, accounting efficiency was improved, the accuracy of accounting information was also improved, and the efficiency of enterprise management was further improved [92]. But in the environment at that time, the accounting computerization is mainly to simulate the manual account table, its own system, the accounting information provided by the «independent portal», can not be effectively integrated with the information of the whole enterprise, thus the «island phenomenon», the timeliness of accounting information, effectiveness is reduced, therefore, the influence and impact of accounting computerization on the whole enterprise is very limited [12]. To solve the «island phenomenon», the information system of the whole enterprise should be connected together.

At the end of the 20th century, with the rapid development of technology represented by the Internet and e-commerce, accounting informatization emerged suddenly. The advent of ERP information management software not only replaced the traditional information system with electronic information system, but also further integrated the information of each business link such as procurement, sales, production and inventory [19]. «Terminate the «independent» status of the accounting information system and enhance its integration with other business systems to improve the timeliness and effectiveness of accounting information» [91, P.57]. «As a result, the information integration and sharing not only improves the overall efficiency level of all links of the enterprise, but also reduces the cost of enterprise-level accounting» [91, P.57].

«Since the 21st century, the advent of novel technologies like «cloud computing and big data» has disrupted conventional enterprise-level electronic information systems, enhancing efficiency across industries and society as a whole» [130, P.150-156]. Compared with traditional accounting, accounting accounting has been compressed in a large range» [130, P.150-156]. «Management accounting deeply integrates the data provided by financial sharing with business» [130, P.150-156].

«The industry's accounting costs, as well as those of the industry and society, have significantly decreased» [130, P.150-156]. «The concept of financial sharing has been widely embraced, facilitating a swift shift from conventional accounting focused on accounting to the proactive value creation realm of management accounting» [130, P.150-156].

Technological progress is the basic element of economic development. Economic development creates conditions for technological progress, and also provides objective demand for accounting progress.When the development of accounting can not adapt to the rapid growth of economic business needs, accounting will change [35]. Technological progress is the internal motivation of accounting development and progress. The technological progress of computer and network information, big data, artificial intelligence, cloud computing and other aspects has a decisive and subversive impact on the evolution of accounting [4].

The following table outlines the history of IT development and its impact on accounting, based on the provided documents [167]. Table 1.2 summarizes the key IT developments and their impact on accounting, highlighting the transition from manual processes to advanced digital technologies. The latest technologies, such as AI, IoT, and blockchain, are transforming accounting practices by enhancing efficiency, accuracy, and security [36].

Since half a century ago, the Internet era, symbolized by the Internet and e-commerce, has come, which has greatly changed people's working and living environment, living environment and even way of thinking. Information technology (IT) has begun to become the leading core technology of sustainable economic development and contemporary social progress [89]. Makes the society to electronic information, the global economy gradually to information, the national economy to information, the enterprise to information, accounting posts from the original traditional manual accounting to the computer comprehensive accounting and then to the network accounting processing, from the original independent occupation, business to the integration of financial business, accounting process revolution is in progress, steadily to the accounting information [55].

Table 1.2

Historical Development of IT and Its Impact on Accounting

Time Period	Key IT Developments	Impact on Accounting
Pre-1950s	Manual record-keeping and basic mechanical calculators	Limited to basic transaction recording and financial reporting
1950s-1960s	Introduction of electronic computers and early accounting software	Improved data processing speed and accuracy, enabling more complex financial analysis
1970s	Development of specialized accounting software	Enhanced ability to manage and analyze financial data, supporting decision-making
1980s	Widespread adoption of personal computers and spreadsheet software	Increased accessibility to financial data and facilitated more detailed financial modeling
1990s	Emergence of the internet and networked systems	Enabled real-time data sharing and collaboration among accountants and stakeholders
2000s	Growth of cloud computing and web-based accounting software	Allowed for remote access to financial data and software, improving flexibility and efficiency
2010s	Big data analytics and business intelligence tools	Provided deeper insights into financial performance and trends, supporting strategic planning
2020s	Artificial intelligence (AI) and machine learning	Automated routine accounting tasks, improved fraud detection, and enhanced financial forecasting
Present	Internet of Things (IoT) and blockchain technology	Enhanced data collection from connected devices, improved data security, and facilitated transparent and immutable financial transactions

Source: developed by the author

The complex process of financial accounting informatization is a necessary stage of change, and it is also a comprehensive improvement of accounting process of

change, it indicates the long-term impact of information on accounting.This transformative impact is embodied in accounting theory, accounting work, accounting research and accounting education. In addition, the accounting system based on accounting theory and accounting practice will be deeply affected and even impacted.

The emergence of application technology, centered around computer technology, due to the advancement and widespread use of modern information technology, has significantly enhanced accounting and enterprise management. Notable examples include computerized accounting, e-commerce, and ERP [56].

1. Computer-based accounting. «Simply, computer-based accounting refers to the technique of bookkeeping, accounting and reporting in an accounting style using computers» [92]. «Computerizing accounting streamlines the input of original vouchers, creation of accounting vouchers, bookkeeping, cost calculation, financial statement preparation, and more» [92]. «This enhances the speed and accuracy of processing accounting data, minimizes technical errors, and facilitates the development of a networked accounting system» [92]. With the help of the Internet to achieve internal, enterprise and even international accounting information transmission, thus greatly improving the comprehensiveness and timeliness of accounting information [93, P.39].

2. Electronic commerce. «E-commerce encompasses business operations conducted within the realm of computer Internet technology, comprising business objects, media, events, information flow, capital flow, logistics, and other fundamental components» [131]. Commerce is to include businessmen, consumers and government, so as to form the e-commerce mode of «b to b», «b to c», «b to g» and «c to g» [116]. «The medium of commerce refers to the place where business transactions are conducted, namely the electronic network.

Business events refer to the business contents between related business objects, including inquiry, quotation, placing orders, payment, logistics and distribution, etc» [18]. E-commerce can be categorized into local, domestic, and global e-commerce

based on the scope of electronic transactions. «Local e-commerce involves transactions within a specific region or city, encompassing various information systems such as those of transaction parties, banks, insurance companies, universities, commodity inspection, tax administration, and cargo transportation» [55]. The main characteristics of e-commerce are: low marketing cost, operation scale is not limited by the site (network, intangible), electronic payment method, centralized customer management, electronic transaction can be globalized .

3.ERP. «ERP, as a suite of business management tools, focuses on the supply chain. It integrates enterprise management principles, business processes, essential data, human and material resources, as well as computer hardware and software» [132,P.12632-12650]. Its main goal is to integrate the functions of the whole enterprise into a computer system, and serve the special needs of these functions, so that the enterprise departments and universities can span time and space, conveniently share information, fast and effective communication and coordination, not only requires the sharing of data, but also requires a high degree of integration of functions and management activities (processes) [14]. The main structure and contents are shown in Table 1.3.

In conclusion, the company operates a robust material circulation system backed by warehouse, transportation, and distribution management. It also has a production support system supported by quality control, equipment maintenance, and spare parts management. The company is equipped to handle multinational operations across multiple countries, regions, enterprises, languages, time zones, and currencies. It also provides online analysis and processing, after-sales service, quality feedback, and real-time monitoring of market demand information.

Support enterprise capital operation, investment management, all kinds of supervision management and standardized management and other enterprises with enterprise production characteristics, support remote communication, Internet, e-commerce and so on.

Table 1.3

Basic components of ERP

Components	Main Content
Marketing Management	«Sales forecasting and planning, order management, sales analysis, distribution management» [50]
Production management	«Bill of Materials and process, production planning and scheduling, cost control analysis, equipment management, quality management» [144]
Logistics management	«Procurement planning and control, inventory management, transportation management» [3]
Human resource management	«Personnel needs planning, personnel salary and welfare management, performance appraisal» [124]
Financial management	«Accounts receivable and payable, general ledger accounting, financial analysis, cost analysis, capital planning» [133]
Information processing	«Information system planning, data management, system maintenance» [123]
High level management	«Strategic planning, resource allocation, decision support» [53]

Source: systematized by the author

4. The basic path of technological progress and accounting development and evolution. «The ongoing advancement of information technology continually drives the progress of accounting, with new technologies consistently fostering its development» [212]. «The internal logical connection between technological advancement influences the evolution of accounting» [212].

The era of accounting computerization: computer technology replaces dissertation, pen and ink, and abdominals to improve the accounting efficiency of accounting departments. Accounting has developed from manual accounting to computerized accounting before the third industrial revolution, and accounting is generally in the traditional stage of manual accounting. During that era, due to the technical constraints of dissertations, pens, ink, and basic calculation aids were essential for utilizing physical items as a medium for gathering, analyzing, and sharing accounting data. The handling, validation, categorization, and auditing of primary receipts, along with the creation of accounting documents, ledger books,

general ledgers, reconciliations, and accounts, required significant human and material resources for statement preparation. Moreover, extensive time was needed for repetitive verification and audit tasks to prevent errors, leading to suboptimal overall work efficiency [44]. This period of time to provide accounting data lag, information users are difficult to meet the needs.

«In the early 198s, computer technology supported the evolution of accounting into computerized accounting, initially implemented in the accounting domain» [117]. «This integration merges modern electronic and information technologies with accounting practices, digitizing accounting tasks using computers» [172]. «The adoption of computer technology facilitated the transition of accounting from manual to digital processe» [172]. «By upgrading hardware components such as computers, keyboards, and electronic screens, traditional methods like paper-based calculations were replaced, enhancing efficiency, reducing costs, and minimizing resource wastage» [172]. Second, in the accounting organization procedures, the traditional accounting has a variety of forms, in the implementation of accounting, there are cumbersome procedures.However, computerized accounting uses computers instead of manual bookkeeping, bookkeeping and reporting, through the use of accounting software manual entry of vouchers, the computer receives data after automatic processing to generate accounting statements [57], so that the form of bookkeeping is simple, the accuracy of accounting information has been improved to the greatest extent. Again, in the information processing, the rigorous processing algorithm of the computer program, not only promotes the automation of accounting information processing, but also improves the processing efficiency and reduces the error rate, rather than the traditional manual accounting of double check, error correction and audit work.The era of accounting computerization is a major change caused by technological progress in the evolution of modern accounting. It mainly comes from the accounting department. By improving accounting efficiency, reducing the cost of department accounting, improving the timely accuracy of information, and improving the efficiency of enterprise management, it is possible to automate the processing of accounting data under the background of knowledge economy and supported by

computer technology. It promotes the development of accounting work from manual accounting to computerized accounting, forms a dissertationless office environment and simplifies the form of accounting.Its development path is shown in Figure 1.1.

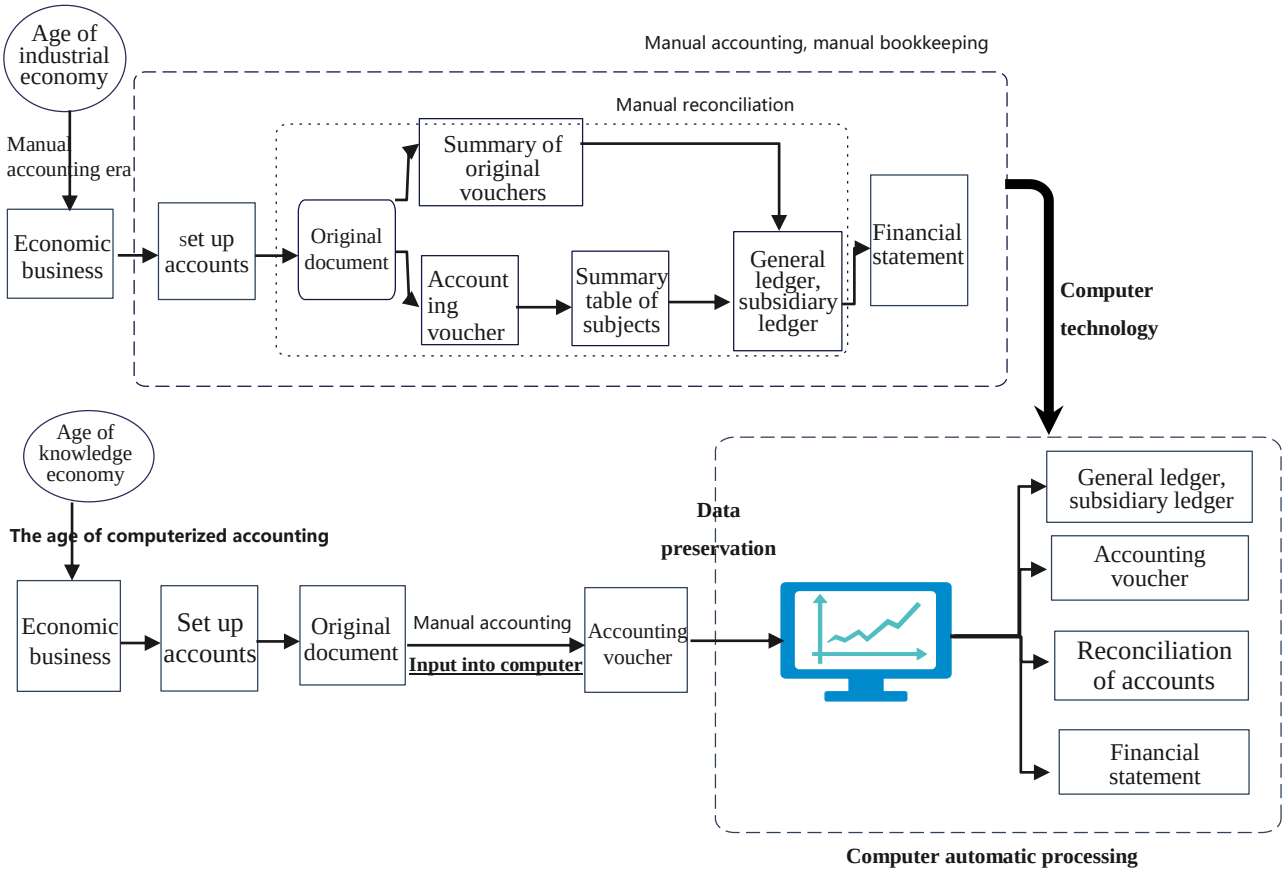


Fig. 1.1. Development path of computerization of accounting

Source: developed by the author

Accounting informatization Era: Enterprise-level electronic information system composed of Internet technology and ERP software replaces the traditional information system to improve the overall efficiency of enterprises. «Accounting develops from computerized accounting to information-based accounting» [164, P.68-74]. Under the information economy, enterprises gradually integrate into financial derivatives from the original single role of production and operation, and their business also expands accordingly. In this context, accounting from the original single role of production and management gradually to diversified development, enterprise business model in the enterprise, the role of financial capital management

is becoming more and more important.However, under the technical environment at that time, accounting computerization is mainly a highly simulated manual accounting information system, which is self-contained.

The accounting information provided is «independent portal» and cannot be effectively integrated with the information of the whole enterprise, resulting in the «island phenomenon». In order to break the «island phenomenon», it is necessary to connect the entire enterprise information system. So that the information system of the whole enterprise with the continuous progress of Internet and e-commerce technology, financial software from a single accounting field, instead of manual bookkeeping to the direction of commercial application software development, enterprise management software in the greater influence of ERP software covers a series of daily processing sections, such as finance, procurement, sales, production, inventory, etc. And has the functions of financial prediction and decision-making assistance, ERP software in enterprise management software has the combination of Internet technology and accounting, promoting the development of accounting from accounting computerization to accounting informatization, which is the combination of Internet technology and accounting.

First, «in terms of basic accounting technology, the emergence of the Internet and ERP has further improved the hardware and software facilities of accounting, making accounting jump out of department boundaries, and the enterprise-level information system has replaced the traditional information system, which has improved the overall efficiency level of all links of enterprises, reduced the cost of enterprise-level accounting, and become the reform of enterprise-level» [10]. Second, «in the initial integration of business and finance, it is no longer limited to the era of «accounting computerization» to collect all kinds of business information manually and then integrate, but to keep pace with business» [27].

During business operations, the system can promptly collect and store data, enabling seamless integration between the accounting information system and other business systems, thereby achieving the initial goal of «integrating business and finance». Let the financial data and business data fusion together, so as to realize the

financial data and financial data information timeliness, accuracy has been improved. Third, in the ERP era of enterprise informatization, enterprise management software integrates information from all business levels. Accounting no longer stands alone but merges with all business resources, offering predictive decision-making support. This integration and analysis enhance the enterprise's core competitiveness. With the background of information economy and the support of Internet technology and ERP software, the formation of enterprise-level electronic information system breaks the «island phenomenon» of accounting information system, connects the information of each link of the enterprise and automatically collects and integrates it, thus making the information integration and sharing, improving the overall efficiency level of all links of the enterprise, and reducing the cost of enterprise-level accounting.

The initial integration of business and finance, through the integration of various resources and information, improve the use value of information, accounting gradually evolved from computerized accounting to information accounting, its development path is shown in Figure 1.2. At this stage, accounting still takes financial accounting as the main content, accounting function is mainly manifested as value recording, and the initiative of accounting to participate in the creation of value by enterprises is not prominent.

The era of accounting intelligence: With the continuous progress of «big intelligence moving to cloud» and other new technologies to subdue enterprise-level electronic information system and improve the efficiency of the industry and the whole society, accounting develops from informatization accounting to intelligent accounting.

In recent years, accounting has developed rapidly from informationization to informationization and informationization cloud computing, which provides a guarantee for computing technology to effectively process big data. «Gary King, professor of sociology at Harvard University, once mentioned a revolution brought by the explosive amount of data that drives the quantitative process in various fields» [13].

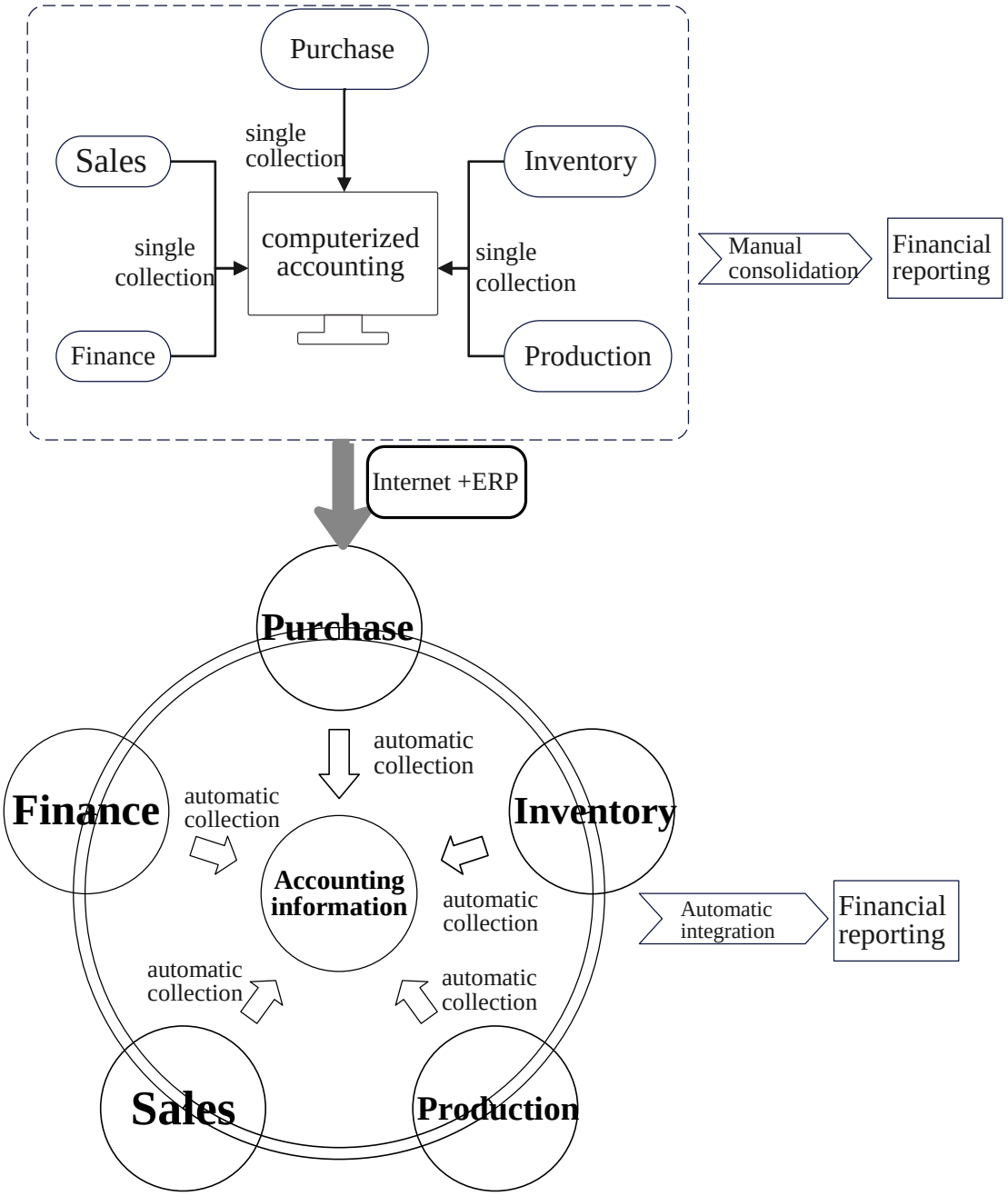


Fig. 1.2. Development path of accounting informatization

Source: developed by the author

The same is true of accounting. «The emergence and development of a series of new technologies, such as «big intelligence moving cloud things», are setting off a wave of change in the whole accounting industry» [14]. «In this context, a series of change and development directions, such as financial sharing services, industry financial integration, scalable business reporting language, accounting big data, cloud

accounting, «Internet + agency bookkeeping», are undergoing new changes» [14]. «The combination of «big intelligence moving cloud» and other new technologies with accounting subverts enterprise-level electronic information system and promotes the development of accounting informatization to accounting intelligence» [14]. The path to achieve includes the following three aspects: The establishment of the financial sharing center, with the support of new technologies such as «big intelligence moving to the cloud», has accelerated the development process of accounting. First, in terms of accounting mode, through the concept of «decentralization to integration», the scattered and repeated business and process of enterprises are centralized to the professional sharing service center for integration and processing, so that it develops from the centralized accounting mode to the financial sharing service mode, which is a new sharing service mode after the transformation and innovation of operation and management mode driven by information network technology [68].

To share the business of financial sector for enterprises. Can effectively reduce costs, improve efficiency. Second, in terms of service objects, for group enterprises, the establishment of financial sharing center can give full play to the advantages of scale, make accounting supply greater than accounting demand, greatly reduce operating costs, improve operational efficiency, ensure service quality, further improve the quality of accounting information, so that financial information to achieve a greater degree of sharing;For small and medium-sized enterprises, the financial accounting work can be outsourced to the financial sharing center and supervised by the information sharing mode, which can greatly save the accounting cost. Third, in terms of value creation, the accounting mode of financial sharing center enables enterprises to concentrate more energy and resources on their core business in order to increase their own irreplaceability, improve their competitive advantage, and further improve their own business and customer satisfaction [178]. Accounting and statement preparation can be promoted and applied as a shared service mode, which can be extended to expense reimbursement, receivables and payables, fixed assets, statement preparation and other accounting work fields, which

accelerates the transformation and development of accounting.

«Accounting in the stage of financial sharing center does not really realize the real-time recording, processing and sharing of data» [179]. «Modern «financial cloud» technology to improve this shortcoming, through «cloud computing» to complete the accounting work to break the space limit, and to the development of cloud accounting, so that the technical basis of accounting data processing has been further changed» [179]. «The advancement of accounting through new technology is evident in three key areas» [115, P.111].

«Firstly, cloud computing in accounting significantly reduces costs by enabling real-time data recording, processing, and sharing» [115, P.111]. «This decrease benefits the industry and society as a whole» [115, P.111]. Secondly, in the realm of information processing and quality, accounting data is now generated in a dynamic «big intelligence moving cloud things» environment, utilizing data and cloud computing for real-time data sharing» [115, P.112]. «This facilitates rapid transmission of accounting information and enhances information quality» [115, P.112]. In terms of value creation, information sharing under cloud computing not only provides more effective and valuable accounting information for the development of enterprises, but also makes the excess or more important accounting ability turn to the field of management accounting for value creation, providing opportunities for the future development of accounting [17].

The fusion of finance and business is crucial for advancing technology-driven accounting. «Historically, financial professionals focused primarily on overseeing post-accounting and monitoring company operations» [47]. «Now, the financial management work has moved forward» [47]. «With the support of new technology and financial sharing center platform, the post-supervision has been transformed to the pre-management and control, realizing the synchronous sharing of business and finance» [47]. «Leveraging new technology and a financial sharing platform, post-supervision has evolved into pre-management and control, enabling real-time sharing of business and financial data» [47]. «By utilizing information tools to promptly convert business data into financial data, it enhances timely financial

reflection and monitoring of business activities» [47]. «This improves the efficiency of sharing management data and advances the integration of industry and finance to a new level» [47]. Commencing from the business process and relying on business processing rules, the integration of industry and finance leverages a shared database in a new technical setting. This approach aims to diminish data entry redundancy and enhance information collection and integration efficiency significantly.

Users are empowered to grasp not only financial data but also business and management insights. Each data user obtains business information within the scope of his/her work according to his/her own scope of work, and after the division of labor processing by each functional department, the business finance such as assembly line is summarized into information statements, so as to realize the organic integration of financial processing and business processing [34]. Turn the focus of financial work to management, and use management thinking to carry out financial work, which is the result of the integration of industry and finance.Through the integration of industry and finance, the original isolated, scattered and lagging management is gradually transformed into a comprehensive, dynamic and real-time management driven by business activities, so that the function of financial reflection, control and service of enterprise business activities is further improved.

«It can be seen that the era of accounting intelligence is under the premise of digital economy, by promoting enterprise-level electronic information system to the industry and society as a whole information intelligence system, with the continuous progress of «big intelligence cloud» and other new technologies, making the industry and society as a whole accounting cost rapidly decreased, accounting efficiency improved» [195]. Simultaneously, leveraging technology and sharing platforms has advanced the integration of industry and finance to a new phase, enhancing the accuracy and customization of accounting data, and progressing towards information symmetry. As shown in Figure 1.3, the development path of accounting intelligentization.

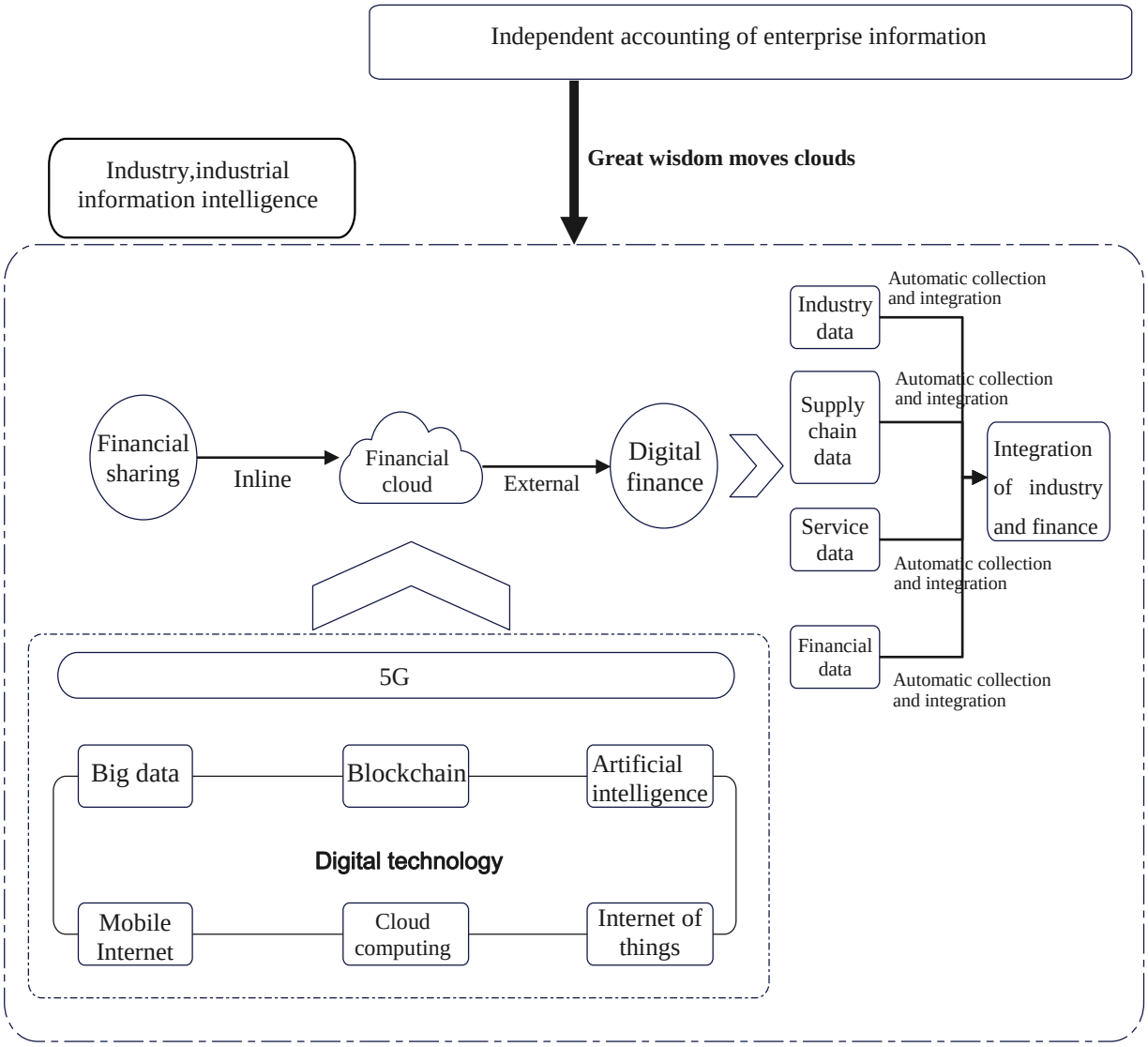


Fig. 1.3. The development path of accounting intelligence

Source: developed by the author

The following summarizes the impact of technology on accounting development based on the analysis of the connection between technological changes and the evolution of modern accounting, the technical features of each stage, and the characteristics of the accounting era (Figure 1.4).

«Ukrainian scholars have extensively explored the integration of modern technologies into accounting automation, emphasizing its transformative impact on the field» [173]. «The emergence of cloud computing has transformed data storage and access, facilitating instant collaboration and distant entry to financial data» [173].

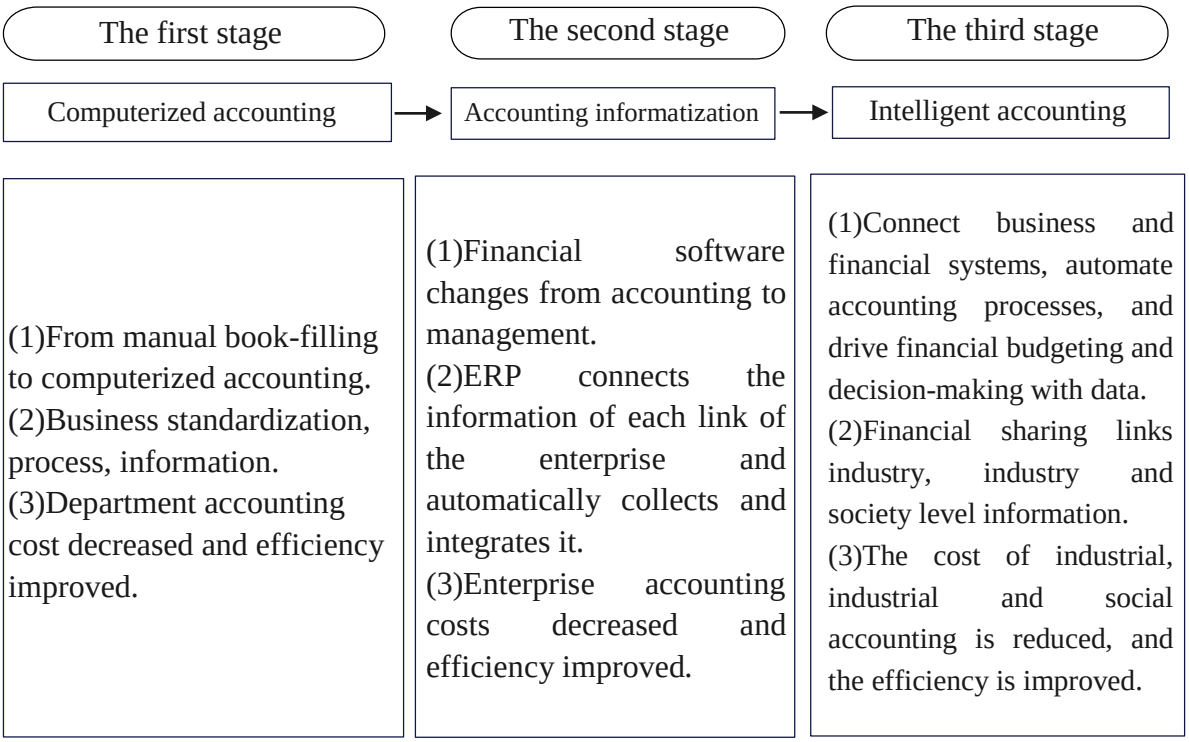


Fig. 1.4. The development process of accounting technology

Source: developed by the author

«This innovation greatly benefits small and medium-sized businesses in Ukraine by streamlining accounting procedures without requiring substantial initial investments in hardware and software» [173]. «Furthermore, Robot Process Automation (RPA) has emerged as a potent mechanism for automating repetitive accounting duties like data input and reconciliation, thereby diminishing errors and enhancing productivity» [173]. «Researchers from Ukraine highlighted the significant potential of RPA in efficiently managing numerous transactions, crucial for businesses in fast-paced markets» [173]. Moreover, the integration of blockchain technology has bolstered the security and transparency of financial transactions, mitigating issues surrounding data integrity and fraud detection. Research in Ukraine shows that blockchain can greatly reduce the risk of unauthorized tampering with accounting records, thereby promoting trust among stakeholders. «The adoption of these technologies not only improved the accuracy and efficiency of accounting processes, but also enables enterprises to adapt to changing market conditions more quickly» [153]. «However, challenges such as the high implementation costs, the

need for specialized training, and the lack of strong digital infrastructure in some parts of Ukraine hinder the widespread adoption of these innovations» [153]. «Despite these obstacles, Ukraine's ongoing digital transformation is expected to promote the further development of accounting automation and ultimately improve the competitiveness of Ukrainian enterprises in the global market» [153].

The digital economy has transformed accounting, enhancing data storage and processing efficiency via cloud computing and robot process automation. These advancements enable real-time collaboration and remote access to financial information, enhancing accuracy and cutting costs. Nonetheless, challenges persist, including steep implementation costs and the necessity for specialized training. This paves the way for investigating blockchain technology in accounting, which could potentially transform financial record-keeping and bolster trust among stakeholders.

1.2. Positioning blockchain technology in accounting

Blockchain was first introduced in Satoshi Nakamoto's 2008 article discussing the structure of Bitcoin. «The article suggested a method to distribute a digital currency through a decentralized network responsible for recording transaction data» [200]. «The hash of each transaction block is added to the expanding proof-of-work chain, timestamping the transaction record» [200]. «An incentive mechanism is implemented using a timestamp server, proof-of-work consensus algorithm, asymmetric encryption, digital signatures, and P2P networks to prevent double-spending and remove the necessity for financial intermediaries» [200]. Transaction data traceability and non-duplication are ensured. A block comprises a block header and a block body. The block header and block body collaborate to validate the blockchain's consistency and integrity, along with the unchangeable transaction details stored in the block, establishing a reliable distributed database [49]. The detailed process is shown in Figure 1.5.

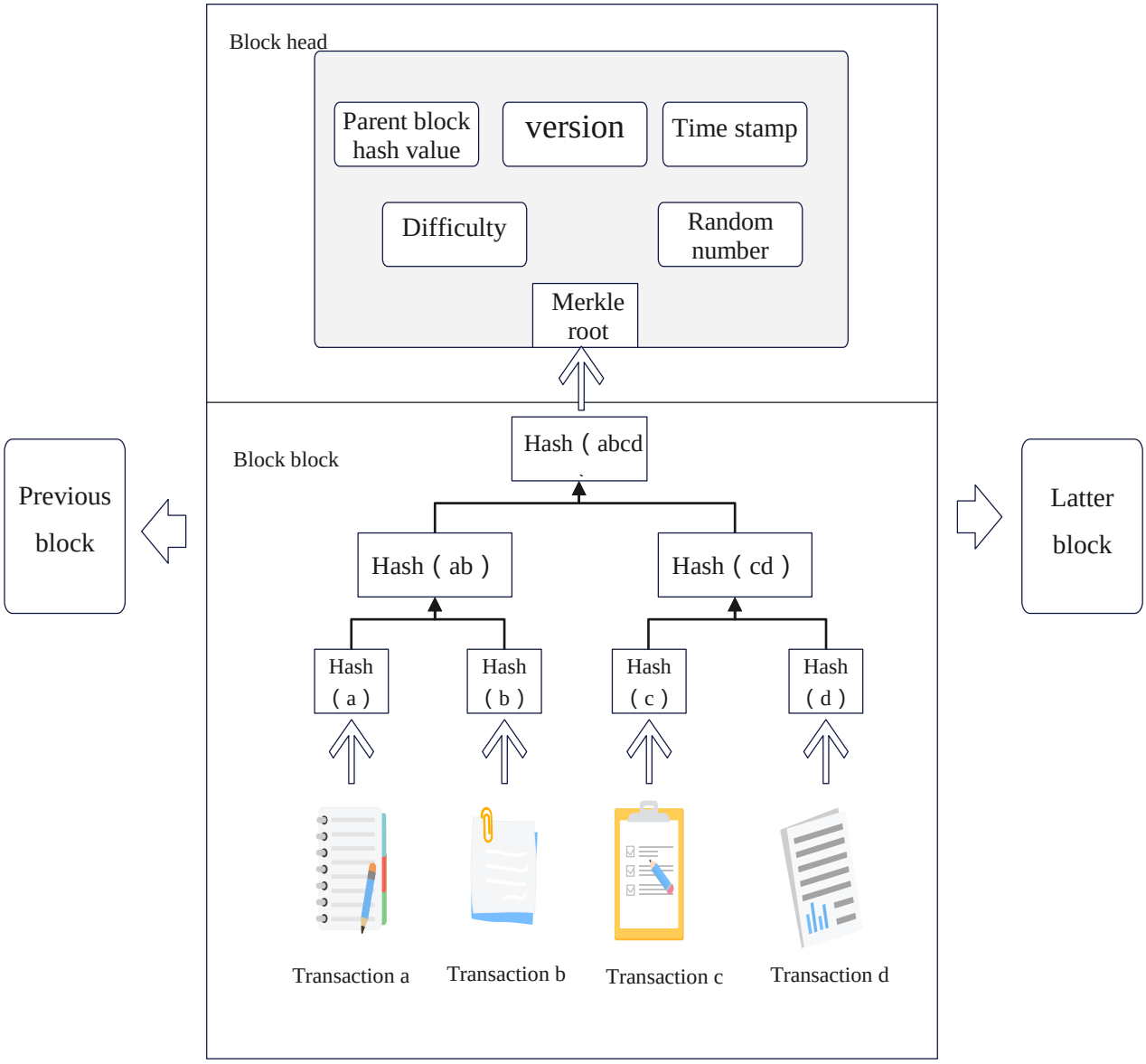


Fig. 1.5. Schematic diagram of blockchain structure

Source: developed by the author

Satoshi Nakamoto laid the technical foundation of the blockchain, and Buterin added the key concept of smart contracts to it, greatly expanding the scalability of the blockchain system.In fact, blockchain is an entirely new combination of technologies, a powerful systematic improvement over existing technologies, rather than a disruptive new technology.Yuan Yong et al. (2016) pointed out that the most representative innovation of blockchain technology is the combination of timestamp based blockchain structure, distributed node consensus mechanism and flexible programmable smart contract [53]. The combination of the above technologies

endods blockchain with distributed features, reliable databases, traceability, open source programmability, collective maintainability, security credibility and quasi-anonymity of transactions.

The basic system of blockchain consists of three layers: data layer, network layer and consensus layer.The extended blockchain system architecture has been upgraded to seven layers: infrastructure, basic components, ledger, consensus, smart contract, interface, application and operation dimension, and system management, as shown in Figure 1.6.

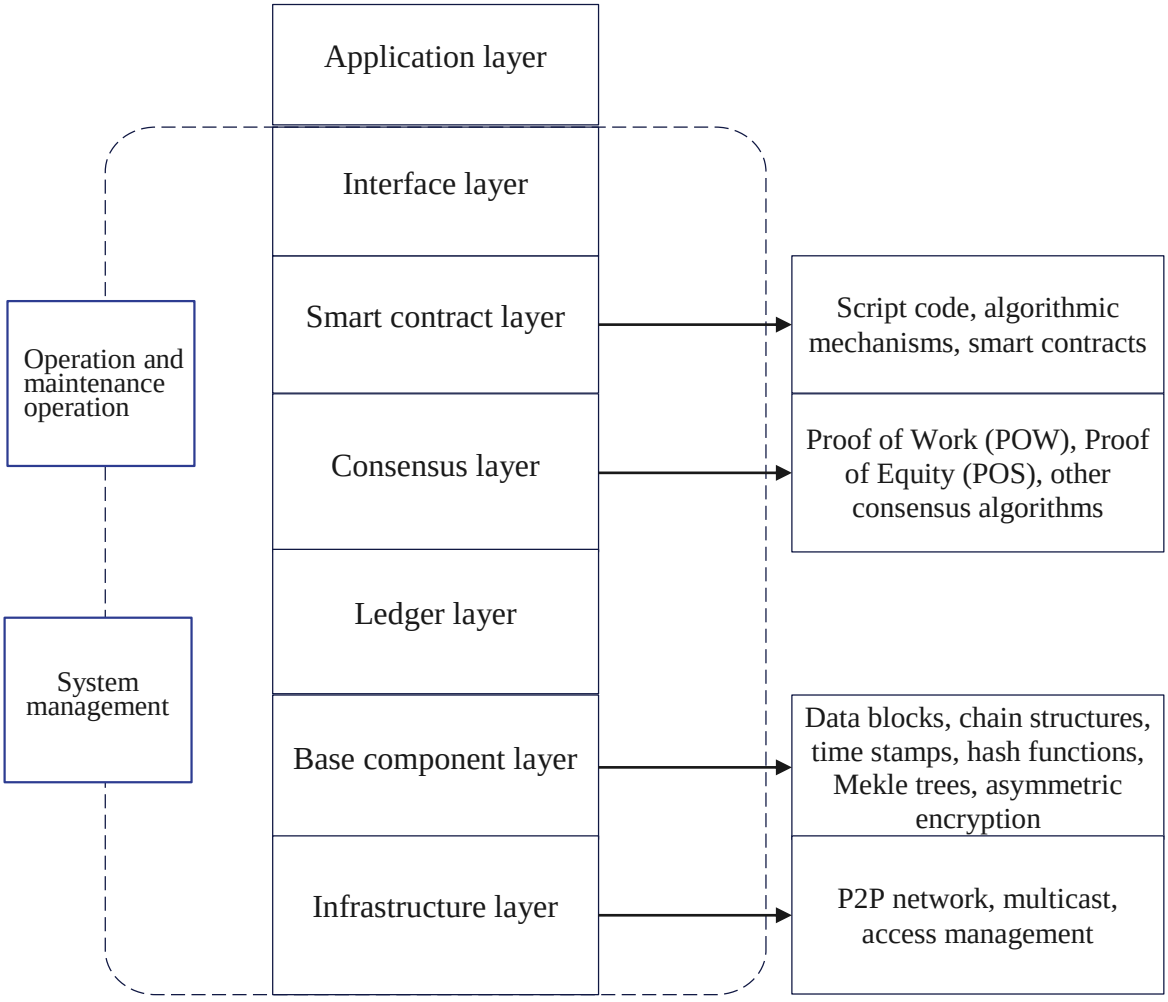


Fig. 1.6 Blockchain system architecture diagram

Source: developed by the author

The infrastructure layer is tasked with the provision of the requisite operating environment and hardware resources for the seamless functioning of a blockchain system. At the infrastructure component level, the programme delivers

communication protocols, database support, and cryptographic libraries required by the blockchain network. The ledger layer, which is responsible for storing data in the blockchain system, integrates underlying data blocks with associated encryption techniques, timestamping, and other essential algorithmic technologies. It is an established fact that the consensus layer, which is situated between nodes in the blockchain network, encapsulates both the consensus mechanism and algorithm. This consensus has been proven to serve as the primary area for their implementation.The smart contract layer is a system that executes predefined rules via code, thereby enabling conditional triggers and automatic operations while concomitantly reducing human intervention. Furthermore, it is capable of handling the compilation and deployment of business logic within the blockchain framework. The interface layer proffers simplified invocation methods for the application layer, enveloping functional modules for the sake of ease of use. The application layer integrates various scenarios and use cases in the blockchain ecosystem, leveraging the smart contract layer's interfaces to deliver diverse services and applications to users, with the objective of achieving technological realisation.System management can be defined as the oversight of two fundamental functions: permission control and node administration. Finally, the operations and maintenance (O&M) layer is charged with the routine functioning and upkeep of the blockchain system.

«According to the research results of China Academy of Information and Communication Technology on blockchain, blockchain can be classified according to whether the network system has a node acceptance mechanism» [201]. In an entirely open blockchain network system, nodes can freely enter and leave, known as a public chain, making it an unauthorized chain. Conversely, if nodes require permission from the relevant system program to participate, it is a permission chain, further categorized as an alliance chain or private chain. These blockchain variations also vary in incentive and consensus mechanisms.The main characteristics, connections and differences are shown in Table 1.4, depending on whether the subject who controls the authority is centralized.

Table 1.4

Features of the three types of blockchain

	Public chains	Alliance chain	Private chain
Participants	Full network nodes	Inside the alliance	Within an individual or business
Nodes join and exit	Freedom	Permission required	Permission required
Degree of deconcentration	Fully de-centered	Polycentric	(Multiple) centers
Incentives	Required	Not essential	Non-essential
Consensus mechanism	PoW/PoS/DPoS	Distributed Consistency algorithm	Distributed consistency algorithm
Speed	slow	slow	fast
Inter-node legal architecture	Incompatibility	Partially compatible	Compatible

Source: developed by the author

It is analyzed from various factors such as whether the application scenario requires database, whether multiple parties are required to write, whether the interests of the participating parties are consistent, whether system control is required, and according to the scenario condition judgment diagram of regional blockchain use in the blockchain white dissertation of China Information and Communication Institute. Blockchain in Europe demonstrates potential for improving transparency and efficiency in different sectors. «For example, in supply chain management, the unchangeable record of blockchain guarantees traceability and responsibility, decreasing fraud and mistakes» [213]. Public sector initiatives, such as the European Blockchain Services Infrastructure (EBSI), strive to offer secure cross-border services by utilizing self-sovereign identity and verifiable credentials. Yet, obstacles persist, including regulatory ambiguity, technical intricacies, and the requirement for broad acceptance [181]. «The experience in Europe highlights the importance of collaboration between governments, businesses, and technology providers to address these issues and unlock blockchain's full potential» [48]. The experience of using blockchain technology in the USA spans across various sectors, with significant advancements and lessons learned. In the financial domain, blockchain has shown potential for enhancing transaction efficiency and security, as seen in the adoption by

major institutions like banks and financial firms [211]. Projects such as R3 CEV's consortium demonstrate the collaborative effort to integrate blockchain for automating processes and reducing costs. However, challenges such as regulatory uncertainty and technical complexity persist. Issues like data privacy concerns and the need for robust regulatory frameworks remain [214].

Overall, the USA's experience with blockchain technology reflects a blend of innovative progress and ongoing challenges, emphasizing the need for continued research and strategic implementation [69]. Alliance chain and private chain can set access system, identity authentication, limited privacy protection and other standards for network participating nodes, because public chain has the necessary incentive and consensus algorithm, which is more suitable for digital currency transactions. Because accountants are born with two functions of accounting and supervision, financial data privacy between different accounting subjects is also essential within a certain scope of authority and supervision [122]. Therefore, «the existing research generally believes that the accounting work of the enterprise's overall external participation in economic business activities can adopt alliance chain and private chain, and the information and value transfer between the enterprise's internal business department and the financial department can adopt private chain» [54]. «Thus, the accounting industry finds alliance chain and private chain more appropriate» [54]. «The introduction of alliance chain and private chain offers a practical avenue for implementing blockchain technology in accounting» [54].

The popularity of blockchain technology in 2016 is closely related to the global popularity of Bitcoin [75]. Leveraging blockchain's technical features to address information asymmetry, guarantee data authenticity, reliability, and secure storage, standardize monetary measurement methods, automate financial report processing, and enhance information supervision and traceability represents advancements in the accounting domain [182, P.1370-1384]. This dissertation constructs a fusion relationship table between blockchain technology and modern accounting concepts, examining the application of blockchain technology in accounting.As shown in Table 1.5:

Table 1.5

Integration relationship between blockchain technology and accounting philosophy

Features	Blockchain technology	Application of accounting concept
Decentralization	Participants connect directly and equally	Low cost, high efficiency and solve information asymmetry
Trusted Interaction technology	Tamper-proof and transparent distributed ledgers	Authenticity and immutability of records
Smart contracts	Ability to automatically execute contracts and Settings	Personalized, automated performance reporting
Coordinated sharing mechanism	All nodes jointly maintain and unify authentication	Information disclosure is fast and extensive
New measurement model	Digital metering mode with virtual encryption	The metering mode is stable and secure
Time stamp	Information is imprinted with time	Traceability and verification of data

Source: developed by the author

Decentralized features (distributed ledger). In the blockchain system, diversified subjects are not only transaction participants, but also the regulator of the whole network transaction information with equal rights and obligations. All subjects have equal and simultaneous access to interconnected information. In the accounting field, financial data flows freely among nodes, enabling all to equally access and request transaction information, thus addressing information disparities and reducing time spent on obtaining financial data without intermediary involvement [125, P.2-6].

Trusted interaction technology. In the blockchain system, when the node information change system automatically discards the tampered node information, the countless nodes of the distributed ledger jointly record the information to ensure the consistency and transparency of information.In the field of accounting, after participants record financial information, the information is spread to all corners in a peer-to-peer manner [142]. Therefore, it is meaningless to tamper with information in

a single terminal, because for the same number of books, more financial information is the real financial data, and the tampered financial information will be automatically deleted by the system, thus ensuring authenticity, reliability, transparency and tamper-proof of financial data.

Smart contract. In the blockchain system, the intelligence and automation of contract execution is guaranteed by a set of pre-set digital programming conditions as the trigger conditions for contract execution.In the field of accounting, the manual processing of financial information and the issuance of financial reports still exist in large numbers, which reduces the work efficiency and affects the timeliness of financial information transmission.The automatic setting of trigger conditions for the preparation of financial statements can provide personalized and automatic reporting for performance evaluation reports, saving additional time and labor costs.

Coordination and sharing mechanism. In the blockchain system, participating entities collectively maintain all node information as a dependable distributed ledger. The security of data storage and transmission is ensured through the use of asymmetric Alpine technology. In the accounting sector, users of financial information engage in transactions collectively, enabling swift sharing of financial information, enhancing the speed and breadth of information disclosure. This approach helps prevent financial information loss and transmission delays, ultimately boosting the security and transparency of financial data [127, P.180-200].

New measurement mode. In the blockchain system, Bitcoin and other digital currencies are used to create a new business model including instant settlement, global interworking, no transaction costs, security, and realize a universal measurement model, which is stable and does not generate risks [204]. In accounting, diverse currency measurement methods across countries impact financial data acquisition. Exchange rate fluctuations further complicate data accuracy, hindering user comprehension and utilization. This novel measurement approach can replace historical cost, replacement cost, net realizable value, present value, and fair value, potentially influencing data precision.

Time stamp. In the blockchain system, the recorded data information will be

stamped with the corresponding time and place, so that the information has both time and space dimensions. In the blockchain system, the data information will be marked at the corresponding time and place.In the field of accounting, the spatio-temporal concept of the financial situation over a period of time is reflected in the accounting period, so that the financial information has a time dimension, which facilitates the traceability of the financial information and the verification of the spatial dimension [207].

«The incorporation of modern IT, blockchain trust, and digitalization is vital for improving oversight» [208]. «It ensures data credibility, tracks transactions thoroughly, protects enterprise accounting integrity, and enhances information quality, facilitating comprehensive preservation of transaction evidence» [208]. «Recognizing the importance of accounting information for businesses and stakeholders is crucial. Improving the quality of accounting information at a societal level is key to promoting the efficient operation of the economy and the optimal use of resources» [28, P.1362]. The extensive involvement of stakeholders in enterprises and the improvement of accounting information quality are crucial for society, as they enhance capital market functionality, safeguard stakeholder interests, and maintain social stability. For businesses, promptly obtaining precise accounting data and consistently improving its quality not only cultivate a favorable corporate reputation and facilitate rapid growth but also strengthen internal control mechanisms.

1. «The blockchain-based accounting system guarantees the reliability and authenticity of accounting information, effectively preventing financial fraud. Guan highlighted that the cloud accounting platform fails to ensure the reliability of accounting information, leading to issues like distorted data and frequent accounting fraud» [7]. Huff et al.(2003) believe that the introduction of blockchain technology into the dynamic accounting information platform can solve the problem of unreliable accounting information caused by information asymmetry, reduce the investment loss of stakeholders, and alleviate the contradiction between principal and agen [104]. «Simultaneously, it can address accuracy, timeliness, and reliability issues with

accounting information. The unalterability of a blockchain-based accounting system can deter financial fraud».Based on blockchain technology,Fu (2019) constructed a procurement activity accounting model, which shows that it can provide services for procurement activity management accounting in practical application, and can effectively ensure the uniqueness of transaction data, so that historical information can not be artificially fabricated and tamper with, and the quality of accounting information is improved [70].

2. Blockchain-based accounting systems can mitigate information disparities, lower transaction expenses, and operational costs. «Dai (2017) highlighted that blockchain technology facilitates direct peer-to-peer transactions, automated settlement, and real-time book updates» [56]. «This technology ensures the credibility and precision of accounting data, enabling parties to engage in transactions without intermediary institutions» [56]. «Consequently, transaction fees are significantly decreased, simplifying financial processes and diminishing operational expenses» [56]. «Gao (2024) proposed that data exchange under blockchain technology would be encrypted online» [72]. «The transmission of accounting information is no longer in the form of point-to-point, but in the form of point-to-point network transmission: data maintenance, update, check and other work is completed by the computer distributed in the nodes, which not only saves transaction costs, but also reduces the impact of subjective judgment factors on accounting information, making accounting more fair and reliable» [72]. «He pointed out that the central characteristics of traditional finance will lead to the increase of reconciliation cost, audit cost and third-party intermediary agency cost of financial accounting, while the addition of decentralized blockchain technology can reduce the maintenance cost, mobilize the enthusiasm of every participating member, improve the efficiency of information communication, and reduce the financial operation cost of enterprises» [72].

3. The openness and transparency of duanchain and the invariance of distributed financial system can strengthen the quality of accounting supervision. Lee's (2021) research on the accounting supervision of enterprises shows that accounting

supervision is of great significance to standardize accounting behavior and enhance enterprise value [126]. However, from the actual situation of accounting supervision in China, there are some problems such as insufficient supervision and improper methods, which shows that there are still many deficiencies in accounting supervision in Chinese traditional accounting.The application of blockchain technology in accounting ensures quality supervision by utilizing an irreversible distributed financial system, non-tampering security keys, smart contracts, and promoting openness and transparency. This integration advances the development of blockchain technology in conjunction with accounting supervision. «Ng (2025) explained that the time stamp signature feature of blockchain technology, in addition to the immitability of blockchain, provides reasonable guarantee for whether there is material misstatement of accounting information, and avoids fraud in audit work, it can also realize auditors to directly obtain effective information in the block and access the accounting accounts to be audited in real time» [82]. After the addition of blockchain technology, audit supervision has been effectively strengthened.Ukrainian researchers, including «Tenyukh and Pelekh (2022), have extensively studied the utilization of blockchain technology in accounting. «They highlighted that blockchain's inherent features, like decentralization and immutability, offer a robust framework for enhancing the security and trustworthiness of accounting data» [184]. «The timestamp signature function of the blockchain system, along with its unalterable nature, offers a reliable mechanism for preventing significant inaccuracies in accounting records» [184]. «This not only deters fraudulent activities in auditing but also allows auditors direct access to reliable information stored within the blockchain» [184]. «Moreover, it facilitates real-time access to the accounting records under audit, thereby enhancing the efficiency and precision of the auditing process» [184]. Similarly, Kobets (2023) emphasizes the revolutionary potential of blockchain in accounting, pointing out that its ability to ensure the integrity and authenticity of financial data can greatly improve the credibility of accounting systems. By leveraging blockchain technology, Ukrainian enterprises can strengthen their accounting practices and improve overall business competitiveness [119].

It was selected the core collection database of Web of Science (WOS) as the data source of blockchain accounting related literature. It entered the database in March 2023, and set the search span from 2010 to 2023.Select the search scope as «Topic», enter «Blockchain accounting» in the search term, and set the literature type as «Article».Excluding non-English literature unrelated to the research object, a total of 941 relevant English literature were obtained.

CiteSpace software is used to standardize and efficiently analyze the basic information related to the international field of blockchain accounting research, such as, etc. Based on this, the scientific knowledge map of blockchain accounting visualization is obtained, including co-occurrence, clustering and time zone map.Through the visual analysis of scientific knowledge map, this dissertation shows the general situation and development trend of international blockchain accounting research related topics. Examining the timing of literature data is crucial for gaining insights into the landscape of blockchain research, offering valuable guidance for scholars, and obtaining a comprehensive understanding of blockchain accounting research trends. The analysis of the publication trends in blockchain accounting research (see Figure 1.7) reveals a consistent growth in publications since 2016, with a notable surge from 2017 to 2022.

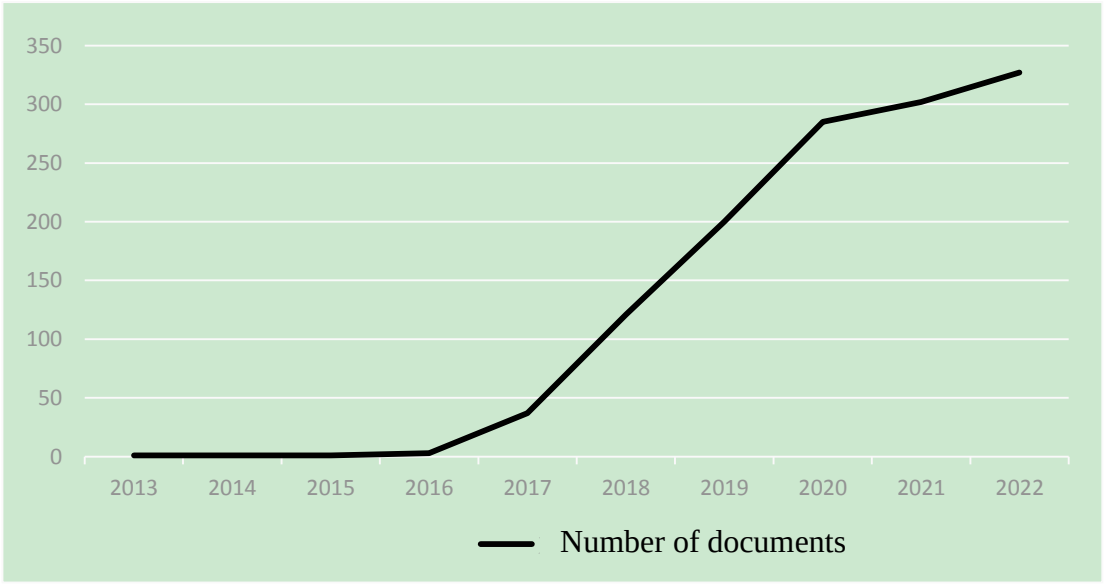


Fig. 1.7. The trend of the number of blockchain accounting literature published

Source: developed by the author

Although the research appears to have plateaued in the last two years, it remains in an upward trajectory. This indicates that blockchain accounting research has emerged as a prominent area of study within the accounting domain. The integration of blockchain technology across various disciplines has paved the way for innovation in finance and its expansion into non-financial sectors such as the Internet of Things, healthcare, and the sharing economy. As a reflection of a company's financial health, accounting has evolved with technological advancements, allowing Blockchain technology to provide a more accurate depiction of a firm's operations. The fluctuation in the number of interdisciplinary blockchain accounting research publications correlates positively with the global industry's interest in blockchain technology. Furthermore, the development and enforcement of national policies directly influence the research landscape of blockchain accounting.

The research hotspots can be accurately and clearly expressed by the keywords of the literature.Keywords are highly refined research content by researchers. Using the co-occurrence, clustering and time zone characteristics of keywords to analyze, it is convenient to quickly and accurately understand the changes of literature research hotspots, which is helpful for researchers to further grasp the research status of blockchain accounting.

Keyword co-occurrence analysis.Table 1.6 lists the top 30 keywords in blockchain accounting according to the co-occurrence frequency,with a cumulative co-occurrence frequency of 722, accounting for more than 70% of total frequencies (722/1028). Table 1.6 shows the most common keywords based on their co-occurrence frequency: smart contract (73 occurrences), internet (55 occurrences), and blockchain (55 occurrences). Hence, blockchain technology, smart contracts, and the internet are fundamental elements of the blockchain accounting knowledge system. «Enhancing the accounting information system has been a key research focus in accounting digitalization.Accounting and IT, such as enterprise resource planning (ERP) systems, big data, artificial intelligence (AI), blockchain technology, the Internet of things (IoT), and cloud computing, are closely linked. Research shows that implementing IT can enhance accounting procedures» [146].

Table 1.6

Top keywords with their frequencies in blockchain accounting.

No.	Keywords	Freq.	No.	Keywords	Freq.
1	smart contract	73	16	security	20
2	internet	55	17	bitcoin	18
3	blockchain	55	18	information	17
4	blockchain technology	39	19	thing	15
5	challenge	37	20	edge computing	13
6	technology	37	21	privacy	12
7	management	32	22	network	12
8	system	31	23	distributed ledger	12
9	supply chain	27	24	architecture	11
10	framework	27	25	access control	11
11	big data	26	26	scheme	11
12	model	25	27	future	11
13	impact	24	28	machine learning	11
14	internet of thing	20	29	iot	10
15	artificial intelligence	20	30	peer-to-peer computing	10

Source: developed by the author

«According to the ICAEW (2018), blockchain is described as an accounting technology used to transfer asset ownership and uphold precise financial records, with the reliability of the ledger stemming from confidence in the underlying system supporting record-keeping» [29]. Blockchain enables encrypted transactions to be publicly displayed, benefiting from validation by multiple parties. This allows companies to offer real-time financial statements, including balance sheets, income statements, cash flow statements, inventory records, and capital investments, to various stakeholders such as business partners, clients, auditors, and regulators within the value chain.

«The technical design of research on the integration of blockchain technology and accounting information technology involves smart contracts, distributed ledgers, peer-to-peer computing, consensus algorithms, and encryption algorithms. «These elements are closely linked to the characteristics of the accounting sector and thus represent crucial areas of investigation» [30, P.43]. Blockchains, in theory, can enhance transparency, precise distribution, immutability, and technological logic to

mitigate information asymmetry and ethical risks through smart contracts or automation. «By facilitating instant information sharing, blockchain could establish a real-time, auditable, and transparent accounting environment for managers, accountants, partners, and investors to collectively validate transactions and offer credible validation evidence» [62]. The consensus mechanism in a decentralized distributed ledger platform is utilized by a third party to finalize the blockchain's accounting records. This platform promotes electronic signatures, transaction records, and electronic certificates within the digital economy. It facilitates cross-platform integrated economic transactions and accounting data records concurrently. Standardizing accounting processes and digitizing business operations simplify the integration and sharing of accounting information, enabling users to engage in generating accounting information.

«Maximizing security management and minimizing risk are essential in accounting» [5]. «Computerized accounting systems are prime targets due to the valuable company information they store, including financial records, contact details, and banking information» [5]. «Corporate accountants prioritize preventing hacker intrusions as these systems contain coveted dat» [5]. «Many accounting software products prioritize security and emphasize safeguarding data with robust passwords» [5]. «Blockchain technology operates on decentralized accounting, where network participants collectively validate and record transactions, instead of relying on a single entity» [99]. «Accounting departments store their documents online for efficiency and convenience, but unlike other data, they handle confidential customer information. Insecure practices like downloading, local storage, and sharing data via email can expose sensitive information to hackers, facilitating theft» [99].

More companies are now creating partnerships within the supply chain, known as the «horizontal integration» model. Both essential and non-essential businesses cannot handle the risk of supply chain disruptions. «Supply chain management involves gathering, analyzing, and assessing data to anticipate and pinpoint potential risks and advantages promptly» [101, P.976-980]. «This process allows for precise assessment of each stage and the overall status of the supply chain, leading to cost

management and enhanced productivity» [101, P.976-980]. «A blockchain can track goods' origin and movement in a supply chain, record consortium transactions, generate business documents, and accounting records. Smart contracts trigger and record accounting «entries» for payables' credit terms on the blockchain» [103].

Keyword cluster analysis. The aggregation of blockchain accounting research topics can be observed by analyzing blockchain keyword clustering.Keyword clustering analysis focuses on the structural characteristics between clusters, which can accurately reflect the key nodes and highlight the core connections.Generally speaking, the higher the cluster number is, the higher the attention is received and the more important it is.Therefore, in order to explore more research hotspots related to blockchain accounting comprehensively and deeply, CiteSpace software is used to draw the knowledge graph of blockchain keyword clustering (Figure 1.8).

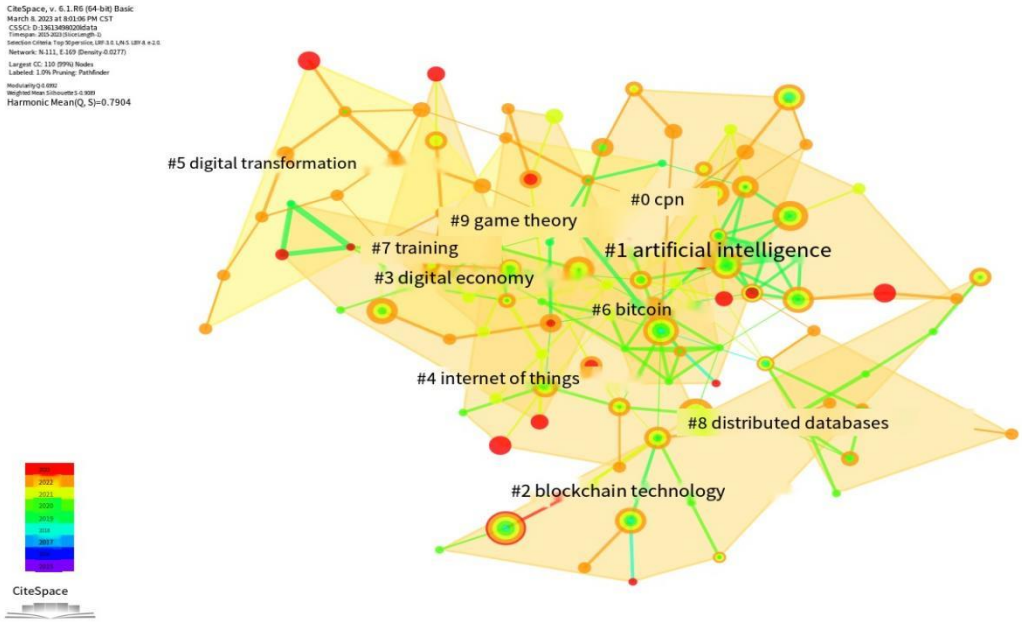


Fig. 1.8. Blockchain accounting keyword clustering knowledge graph

Source: developed by the author with CiteSpace software using

CiteSpace software cluster was used to analyze the keywords in the research field of blockchain accounting, and a total of 10 clusters were obtained, which are as follows: cpn, artificial intelligence, blockchain technology, digital economy, Internet of things, digital transformation, bitcoin, training, distributed databases, and game theory.In the realm of blockchain accounting, the focus lies on the potential benefits

that artificial intelligence and blockchain technology can offer to corporate accounting in the digital economy era, aiding in enhancing digital transformation and upgrade efforts. The distributed database in blockchain accounting forms a robust basis for enterprises' triple-entry accounting approach, garnering significant industry attention. The top five clusters resulting from the analysis conducted using CiteSpace are presented. (Table 1.7)

Table 1.7

Top-ranked clusters and the terms within the clusters

NO	Size	Silhouette	Mean	Label（LLR）（p-value）
0	15	0.812	2020	cpn (6.96, 0.01); data security (3.53, 0.1)
1	15	0.91	2020	artificial intelligence (11.57, 0.001); big data (9.22, 0.005); security (6.83, 0.01)
2	14	0.98	2019	blockchain technology (13.52, 0.001); smart contracts (10.54, 0.005);distributed ledger (8.19, 0.005)
3	13	0.978	2020	digital economy (17.18, 1.0E-4); accounting information systems (12.8, 0.001); triple entry accounting (11.43, 0.001);
4	11	0.941	2020	internet of things (23.45, 1.0E-4); cloud computing (4.81, 0.05)

Source: developed by the author

The most extensive group comprises artificial intelligence and blockchain technology, encompassing 15 papers. Leveraging these technologies can improve the reliability and transparency of accounting systems, ensuring authentic and traceable transaction data. It also protects investors' rights to access financial information and mitigates information disparities. An accounting framework integrating AI and blockchain links financial data with cash flows and IoT in real-time, curbing revenue and expense fraud. Real-time cash flow tracking prevents fraudulent transactions, enhancing accounting data quality. This approach facilitates shared, verified, and consensus-driven auditable data, improving audit efficiency through AI tools and traceable blockchain records. «Han (2023) applied agency and stakeholder theories to elucidate how blockchain-based accounting mitigates information asymmetry and

involves all stakeholders by enabling novel collaboration methods» [87]. Furthermore, integrating blockchain technology can boost corporate governance, leading to enhanced accounting information quality. «Research by Bin Fang and colleagues (2016) explored the influence of blockchain technology adoption on global firms' accounting information quality. The findings reveal that blockchain's positive impact involves reinforcing corporate governance and facilitating collaborations with prominent audit firms. Economic assessments indicate that adopting blockchain enhances firms' financing activities and overall value» [64].

The blockchain technology cluster, the second largest, comprises 14 articles. Facilitating the integration of business and finance, the creation of a trading platform was highlighted. «Wu et al. (2019) developed AIS models using the EABAT method» [196]. «These novel AIS models enable automatic identification, analysis, and assessment of contracts; automatic contract execution (i.e., transactions); automatic data transmission, event information recording, and storage; and personalized financial report generation» [196]. «Smart contracts enable impartial assessment of enterprises' financial status, mitigating risks from information disparities» [76]. «Embracing global accounting standards can enhance international collaboration» [76]. «Corporate leaders may reassess their perspectives on IT and its influence on financial disclosures due to smart contracts» [76]. «Due to the complex and advanced nature of business dealings and concerns regarding the limited transparency of financial records, stakeholders may hesitate about the possibility of company insiders exploiting information gaps to deceive stakeholders about firms' actual financial performance» [41]. «When a company employs GAAP-compliant Deferred Acquisition Costs (DACs) for revenue recognition and financial reporting, stakeholders gain increased confidence in the accuracy of the accounting figures» [148].

«The digital economy, the third largest cluster, comprises 13 articles. The transition from manual accounting to the digital era began with the introduction of computerized accounting in the 198s. Currently, the accounting sector is experiencing a new reform trajectory due to the rise of blockchain technology, which is fostering

the advancement of enterprise management. According to Nguyen et al. (2024), digital transformation can positively influence the integration of blockchain technology with management accounting systems in manufacturing firms» [148]. «Implementing blockchain technology in management accounting systems can decrease inefficiencies in production processes and foster more enduring outcomes» [149]. «To stay relevant in the era of digitalization, accountants need to embrace a digital shift» [149]. «Accountants need to pivot their attention towards enhancing their skills in data analysis and decision-making support, moving away from conventional accounting practices» [149]. Mastering digitalization-related technologies, such as data analysis, artificial intelligence, and blockchain, empowers individuals to detect issues from data, analyze patterns, and make data-informed decisions. The utilization of distributed ledger technology in accounting records will transition financial reporting from enterprise-focused to exchange-focused, enhancing the quality and reliability of financial reports significantly. «Ballou (2018) proposed a blockchain-based shared ledger design for the accounting information system. The research applies the COFRIS economic exchange model, merging economic exchange with accounting standards. Additionally, smart contracts are implemented to automate and ensure shared account books» [15].

The internet of things is the fourth largest cluster, comprising 11 articles. The application of blockchain technology in the accounting sector needs to tackle three main challenges. Initially, it should guarantee the safe retention of accounting data while also dealing with capacity worries. «Zhang and Zhu (2022) employed cloud storage to extend blockchain capacity and the Paillier encryption scheme to safeguard shared data privacy» [206]. «Ethereum blockchain enhances cloud functionality by ensuring data origin and facilitating cloud supervision» [206]. «Khan (2024) suggested a data storage security model for cloud computing utilizing Ethereum blockchain. Additionally, the reliability of the access control system. Conventional cloud access control typically relies on trusted centers and internal administrators, making it vulnerable to both internal and external attacks» [119]. «Rouhani(2021) discussed how permissioned blockchains could be helpful as trustable backends in

access control systems, thus providing a solid basis for audits» [169]. Thirdly, accounting big data information can be shared through the establishment of a blockchain data sharing platform. «This involves using ETL tools (Extract, Transform, Load) to extract, transform and load data from the accounting system for integration» [120, P.32-35]. «The integrated data is then standardized, including unified naming and data format specifications, to enable different systems to understand and share data with each other» [120, P.32-35]. The confidentiality and integrity of data are ensured through encryption technology, access control, and data sharing protocols. Additionally, rules and constraints for data sharing are defined.

Keyword burst analysis. In order to distinguish the research hotspots and present the evolutionary trend structure of knowledge, this dissertation draws a clear, standardized, scientific and reasonable keyword emergence map (Figure 1.9) based on the obtained information.This figure can clearly and intuitively show the evolution trend of related keywords in blockchain research. According to this figure, keywords appearing in different research times will be distributed in different time periods in the figure. Based on this, it can not only deeply understand the emergence time of each keyword, but also fully grasp its relevance.

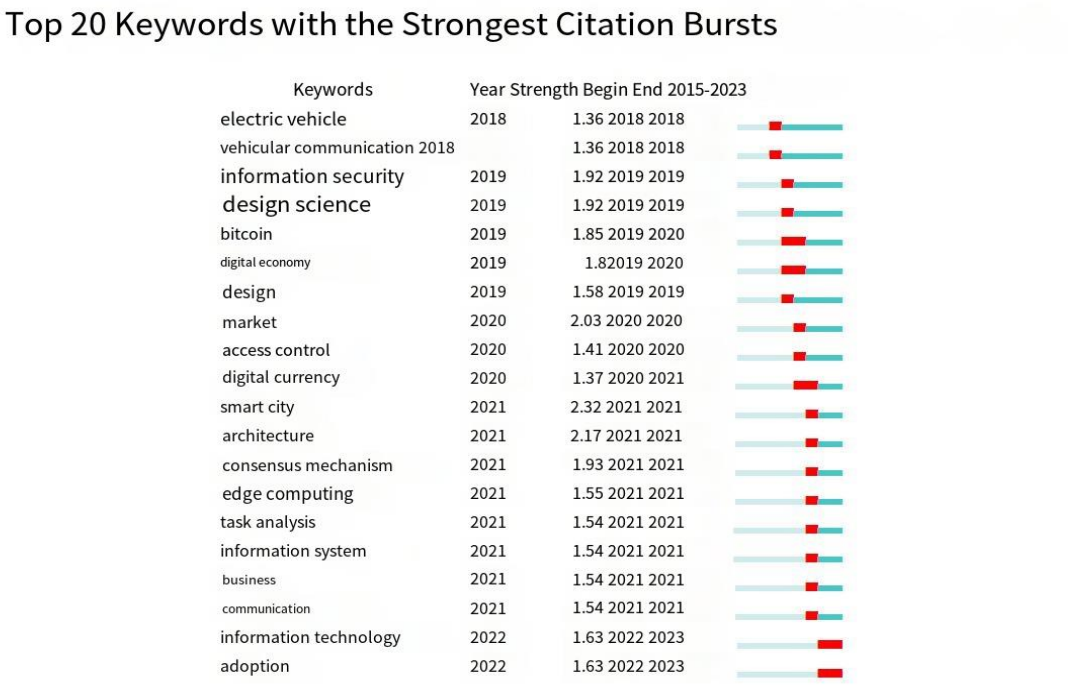


Fig. 1.9. Emergence diagram of blockchain accounting keywords

As can be seen from Figure 1.9, the research hotspots in this field are constantly changing over time.Since the research period of blockchain accounting is still relatively short, the research hotspots are mainly concentrated in 2018 to 2023.In 2019, scholars mainly focused on the discussion and analysis of information security, Bitcoin, digital economy and other related contents;In 2021, the research hotspots will turn to smart city and consensus mechanism.In 2022, research on supply chain finance and distributed ledger will be carried out.Research related to accounting is mainly reflected after 2019. As keywords such as digital assets, distributed ledgers and digital economy have become research hotspots in the field of blockchain, the attention of «blockchain + accounting» research has also increased rapidly.

Utilizing CiteSpace software, this dissertation thoroughly examined blockchain-related literature through bibliometric and knowledge graph analyses. The software facilitated the creation of keyword co-occurrence, clustering, and emergence maps to identify research trends and dynamics in blockchain accounting.The research results show that: (1) The research hotspots of blockchain accounting focus on blockchain technology, smart contract, digital currency, bitcoin and other directions closely related to blockchain itself.As blockchain accounting research progresses and technology matures, the future focus will shift towards integrating blockchain with traditional industries, presenting a significant research opportunity.(2) Although some scholars are involved in the research direction of «blockchain + accounting», such research is relatively rare in the field of blockchain research.

Conclusions to the Chapter 1

The digital economy has fundamentally reshaped accounting through technological integration. The development and application of the global Internet generated massive data, driving advancements in data processing and analysis technology, leading to the concept of the «digital economy.» Various countries have defined the digital economy from different perspectives, emphasizing its role in

economic growth and social development. Technological advancements, such as ERP, AI, and blockchain, have significantly enhanced efficiency, transparency, and strategic decision-making in accounting. The evolution of accounting can be divided into three stages: computerized accounting, accounting informatization, and intelligent accounting. In the computerized accounting stage, electronic computers and accounting software improved data processing speed and accuracy. The accounting informatization stage involved the integration of Internet technology and ERP software, connecting business information and automating data collection and integration. The current stage, intelligent accounting, leverages AI and blockchain to automate processes, drive financial planning, and integrate business and finance.

Blockchain technology has the potential to enhance the quality and efficiency of accounting systems by ensuring the authenticity and reliability of information. Its decentralized and immutable nature improves the security and transparency of financial data when integrated with accounting principles. This technology can reduce transaction costs, eliminate information asymmetry, and strengthen accounting supervision. Despite challenges like high implementation costs, skill gaps, and the need for robust digital infrastructure, digital transformation is essential for global competitiveness. Future studies should prioritize interdisciplinary methods to tackle ethical and infrastructural hurdles. Integrating blockchain technology with accounting systems can boost the dependability and openness of financial information, enhance corporate governance, and elevate the quality of accounting data. With the progression of the digital economy, incorporating cutting-edge technologies such as blockchain will be pivotal in molding the accounting landscape.

The results and proposals presented in the first chapter of the dissertation have been published in [134; 137; 138].

CHAPTER 2.

THE APPLICATION OF BLOCKCHAIN TECHNOLOGY IN ACCOUNTING

2.1. Impact of blockchain technology on accounting methodology and organization

Traditional accounting operates manually, posing risks of errors compromising data accuracy and security. Blockchain data offer traceability, trustlessness, decentralization, anonymity, non-tampering, openness, and transparency. Integrating blockchain with accounting creates original vouchers at each node, enhancing security management to prevent falsification and fabrication, thereby boosting security, accuracy, and authenticity of accounting data.

Traditional accounting assumptions, such as entity assumption, going concern assumption, monetary measurement assumption and historical cost measurement assumption, are facing challenges and changes under the impact of blockchain technology.

1. Impact on the accounting entity. Restore an accounting entity to a business entity. In order to ensure that the accounts of both parties are consistent, the accounts of both parties shall be checked regularly. The introduction of blockchain technology simplifies the process because both A and B are nodes in the blockchain. If there is a transaction between A and B, all nodes in the blockchain record the transaction. The content of the record is based on the transactions of A and B, with no emphasis on who keeps accounts with whom. Therefore, the accounting entity «for whom» is diluted in the blockchain system, and the accounting entity is more reduced to a business entity.

The accounting check between different accounting entities was cancelled. The distributed accounting model of blockchain system enables transactions between Party A and Party B to be recorded throughout the network, and the recorded information cannot be tampered with at will. Under this accounting model, trust is

established between different accounting entities, so that Party A and Party B do not need to check their accounts regularly to keep the data consistent. The establishment of this «public trust» model not only improves the trust between different accounting entities, but also saves social resources. «By digitizing and coding the accounts through the blockchain technology, the trust of both parties to the transaction is re-established without checking the accounts of both parties» [52].

The accounting entity is replaced by a transaction chain. Different from the traditional accounting entity assumption, which focuses on the accounting objects, the blockchain emphasizes more on the transaction chain in which the entity is located, i.e. in which procurement and sales chain, and with which partners to establish supply chain cooperation relationship. blockchain is a computer protocol within a network structure that objectively records network-wide transactions throughout the network. Compared with a single accounting entity, it is more important to which entity is in which chain and with which entity the transaction occurs.

2. Impact on Continuing Operation. «The assumption of a going concern is replaced by the risk response assumption to ensure accounting accuracy» [97]. «Enterprises are expected to operate continuously despite challenges, such as the common issue of «cliff termination» due to market changes and technological advancements» [97]. «However, the going concern concept is increasingly unrealistic» [97]. «As economic activities evolve, obtaining relevant data from various sources is feasible but maintaining an efficient accounting process requires adherence to the notion of continuous operation» [97]. «The emergence of blockchain technology is poised to revolutionize information equality and eliminate the traditional information center model» [97]. With the popularity of the whole network, each node has complete information, which makes it possible to not only rely on accounting to make assumptions, therefore, the future operation will be displayed in a perfect form, so that it is advisable to better predict future risks and take corresponding measures to deal with them.

It can accurately judge whether the operation can be continued in advance. The

traditional accounting assumption is based on going concern, mainly because when judging whether an enterprise can continue to operate, it usually depends on the subjective judgment of the accounting personnel, but the accounting personnel's experience, risk preference and information mastery level are different, which results in that they are often not objective enough when assessing whether an enterprise can continue to operate, and different accounting personnel have different judgments, leading them to choose different accounting methods. In order to avoid the difference caused by the accountants' judgment based on past experience, the enterprise should assume the premise of going concern, so as to reduce the influence on the accounting method caused by the accountants' experience judgment. However, the information in the blockchain is shared and cannot be modified at will. «Therefore, «it is possible to objectively judge whether an enterprise can continue to operate and whether there is any risk of bankruptcy, and to establish corresponding judgment rules to code the information of whether an enterprise can continue to operate, instead of the traditional judgment made by accountants based on experience» [43]. Under the influence of blockchain technology, it is possible to judge more accurately and objectively whether an enterprise can continue to operate.

The advancement of IT enables more precise forecasting of enterprise development trends, decreasing future uncertainty. Hence, the conventional accounting premise should assume normal business operations rather than a pessimistic evaluation. Through distributed accounting tech, real-time monitoring of every node, encompassing financial reports, customer relations, market status, business prospects, IoT management, etc., is achievable.Due to the fact that information cannot be tampered with and is shared, the sharing mechanism of information at the bottom of the blockchain enables network nodes to judge in advance whether an enterprise's operation is sustainable or not, and even to establish an operation risk early warning model in order to timely discover and deal with possible risks. Take appropriate measures to deal with the problem.

3.Impact on the accounting period. The accounting period will still exist. Through the accounting stage assumption, it is possible to better compare the

operating conditions and results of different entities across various time dimensions, thereby meeting the necessary requirements for horizontal and vertical information comparison. In order to ensure the comparability of accounting data, the accounting period of time dimension is still essential regardless of the accounting method.

Accounting phasing will be more flexible. «The accounting phasing assumption aims to divide the future time period into several stages in order to better forecast the future development trend» [100]. «Because the traditional accounting method has some limitations when dealing with enterprise data, it is necessary to adopt a more flexible way, i.e. dividing the accounting period into several segments, so as to make the work of statistics and aggregation more efficient» [100]. «With the help of the powerful computing power of blockchain technology, it is possible to comply with uniform rules while significantly reducing the time required for collecting and sorting accounting information» [100]. In addition, accounting periods can be divided more flexibly according to the needs of users of accounting information, because the calculation speed of blockchain can enable users of information to meet the requirements of data statistics for accounting periods ranging from large to small, so the application of blockchain technology can make accounting periods more flexible.

4. Impact on monetary measurement. Virtual currency will pose a severe challenge to the position of functional currency. In recognizing, recording and reporting transaction activities, corporate accounting should follow the monetary measurement assumption, i.e. based on the currency actually issued by each country (i.e. local currency), in order to accurately reflect the transaction. «As «Bitcoin» is widely used as a reward, it has become a virtual currency available for global use and can be widely used. With the support of blockchain technology, all transactions can be recorded in the form of bitcoin, making virtual currency the core currency of the «bookkeeping» system. «With the development of blockchain technology, traditional financial assets may face the impact from virtual currency, thus changing their original pricing model» [12]; With the emergence of global unified currencies such as bitcoin, they can effectively offset the economic losses caused by exchange rate fluctuations, making «bitcoin» and other virtual currencies expected to replace the

traditional physical currency.

The range of objects for value measurement is wider. Assuming that all economic activities are measured based on money, this means that all economic activities must be expressed in money. «Although traditional accounting can reflect the value of economic activities in monetary form, their value is difficult to be directly reflected in monetary form in complex management activities such as strategic management and human resources» [79, P.325-378]. Therefore, the importance of management activities is ignored. Using the blockchain technology, the application field of «bookkeeping» has been greatly expanded. «From traditional economic transactions to text editing and PPT production, the thinking mode of «bookkeeping» can be realized by computer programs» [80]. «Therefore, management and thinking are important indicators to measure a person's value» [80]. «Under the current situation, the blockchain technology poses a huge challenge to the monetary measurement hypothesis» [80]. Different from the traditional way of economic transactions, the application of blockchain technology expands the scope of the definition of money, classifies all activities into «bookkeeping», adds new value to these activities, and thus improves the scientific and rational definition of money.

The assumption that the monetary value will remain stable will still be challenged. An implicit premise of monetary measurement assumptions is that the value of money does not fluctuate due to changes in the market. Although in reality the value of money is bound to be affected by factors such as inflation, resulting in fluctuations in value, in order to simplify the accounting process, these factors that affect the value of money are generally not considered, assuming that the value of money is stable and constant. With the progress of science and technology, the modern functional currency has replaced the previous physical currency, its circulation is no longer restricted by any issuing institution, and the price is more stable. «Driven by blockchain technology, Bitcoin no longer needs a specific issuer, but is generated and circulated through a large number of computer algorithms» [101]. As a result, the number of bitcoins is extremely limited and is almost a rare item. «Bitcoin's price is more reliable than traditional physical currency because it

has not been issued or circulated in any way» [56, P.30-35]. «Although bitcoin has a very high value, it is still unable to maintain absolute stability due to its scarcity, so the fluctuation of currency price will still be inevitable» [56, P.30-35]. The stability of monetary value remains a challenge with the advancement of blockchain technology.

Additionally, the use of blockchain technology can enhance the accessibility of accounting information. The stability of monetary value remains a challenge with blockchain advancement. Simultaneously, blockchain technology facilitates easier access to accounting information. It can automatically identify accounting information, check according to the data of different regions and different nodes, automatically screen and eliminate irrelevant information, and intelligently analyze accounting information, thus strengthening the relevance between different information. The occurrence of account errors and omissions is reduced, so that the accounting work can be carried out more efficiently.

5. Accounting recognition. «Accounting recognition is a complicated process, which involves integrating all financial records, financial reports and financial statements into a unified financial management system, and according to specific rules, principles, standards and norms, etc., to ensure the authenticity and reliability of financial statements, thus ensuring the normal operation of the financial position of enterprises» [106]. «Hence, in accounting, the precision and validity of financial data are crucial» [106]. «To guarantee accuracy, accounting recognition is divided into initial recognition and re-recognition stages to uphold data reliability and usability» [106]. The purpose of initial recognition is to identify which transactions should be recorded and the specific dates, amounts and other valid information about those transactions. Re-recognition, from the accounting books to the financial reporting, our focus is on the preparation and analysis of the financial statements.

«Under the traditional accounting management mode, because the information sender can master more true and effective information than the information receiver, the problem of information asymmetry will occur, and there are also drawbacks in the accounting process» [24]. In addition, there may be loopholes in the manual entry

process, resulting in endless cases of financial fraud and whitewashing of accounting statements. Luckin coffee's financial position has become extremely poor, mainly due to the fraud in its accounting process. «In 2018, Kangmei Pharmaceutical disclosed in the «Correction Announcement for Early-Stage Accounting Errors» that the monetary funds in 2017 exceeded 29.944 billion yuan due to accounting errors in the company's account funds» [199]. Both Asia Pacific Pharmaceutical and Yihua Life were severely punished for not making public disclosure in accordance with relevant laws and regulations» [199]. Due to the lack of effective control, forgery and falsification often occur. Such fraudulent vouchers can not only cover up the actual financial situation, but also transfer a certain amount of funds to the accounts of related parties through false bank records, or use them on a large scale, causing huge financial risks to investors. «Due to the false financial statements disclosed by enterprises, investors' trust in them has dropped sharply, thus causing a serious trust crisis» [98, P.85-93]. The operation of accounting informatization has been realized before, but the core of the accounting process is still accounting personnel, which makes the accounting supervision function unable to give full play to its role, which is easy to cause the problems of missing accounts, wrong accounts and false accounts. «For example, if the accounting is not timely, the accounting method may be changed at will; In order to rationalize illegal income or evade taxes, illegal collection and distribution of costs and expenses, which makes the cost accounting inconsistent with the objective economic business accounting» [106]; No actual amount has been selected for valuation adjustment. These violations of accounting standards will lead to a decrease in the reliability of financial information. For investors, the low-quality financial information has no reference value, which increases the investment risk of investors.

Blockchain technology can enhance accounting information quality significantly compared to the traditional double-entry bookkeeping method and trial balance. «It plays a crucial role in accounting recognition by ensuring that data between nodes is verified to create new information independently, thereby enhancing accuracy and reliability» [163, P.63]. It is also a mutual check. With the emergence of new

transactions, it is advisable to use blockchain technology to realize real-time transmission; After the broadcast, the nodes of each partition block will begin to perform information verification on the newly initiated transaction to ensure that their virtual nodes are exactly the same as the existing nodes [81]. Once confirmed, they can be combined into a complete chain structure, thus making the whole network more stable and reliable; If the virtual node is found to be different from the expected content, it will be eliminated to prove that the information it provides is wrong. It is essential to guarantee the precision and uniformity of accounting data via this process. «The blockchain technology possesses strong error correction abilities and can accurately identify accounting data» [112, P.10-30]. «Using a hash algorithm, every transaction gets logged in the system, and each node validates it to secure the transaction's accuracy and dependability» [112, P.10-30]. «In the accounting acknowledgment procedure, each fresh transaction record receives a distinct timestamp for easy tracking, thereby upholding the data's precision and trustworthiness» [112, P.10-30]. Third, the blockchain technology has strong security and stability. It can store all nodes' data safely and can back it up in real time. In this way, once a system failure occurs, it can effectively ensure the smooth progress of accounting. This can not only ensure the data security, but also allow the enterprise to make adjustments according to relevant businesses and appropriately modify the internal business system in the actual work. With the passage of time, in order to ensure the security of the original data, it is necessary to continuously expand and optimize the data resources so that they can realize efficient information exchange, sharing and scheduling under the blockchain technology environment.

At this stage, the accounting recognition method adopted by most enterprises in China is accrual basis, and some institutions use cash basis. Therefore, the accrual basis is the most important accounting recognition method used by enterprises for a long time. However, «this does not mean that the accrual basis has no defects» [42]. «It can even be said that the accrual basis has very clear defects» [42]. «The accrual basis of accounting is most likely to be a fraud committed by someone in the confirmation process» [42]. Take corporate sales as an example, because sales are the

main link for an enterprise to achieve profits, so this link is also the link that is most prone to fraud. Under the traditional accrual basis, because accounting recognition often leaves room for collusion and misrepresentation due to business barriers between sales segments, at the same time, because the corporate income under the accrual basis is not exactly the same as its cash inflows, it will cause inaccurate recognition of accounting income, in addition, accounting personnel cannot timely understand the credit status of customers, which in turn causes problems such as the authenticity of financial data cannot be guaranteed [111]. Although many enterprises want to solve this problem through the introduction of enterprise resource planning system (ERP system), but ultimately because the ERP system is human-computer co-management, leaving a certain gap for collusion.

The introduction of blockchain technology into accounting recognition can effectively solve the defects of accrual basis at this stage. Similarly, taking sales as an example, blockchain technology can connect all departments related to sales within an enterprise to the same platform to form a block; In this block, the sales-related business of each department is open and transparent, so that the information barrier between each department will disappear and the accounting personnel will know all the processes at a glance [33]. Moreover, this block is placed on the Internet. Each department only has the right to fill in the specific contents of the contract and relevant information, and does not have the right to change the information in the block. In this way, the occurrence of yin-yang contracts can be effectively avoided. In addition, the block can be connected with the Internet of Things through cross-link technology, so that accountants can clearly understand the consumption of goods and grasp the logistics of goods [38]. More importantly, through cross-chain technology, enterprises can form larger blocks with other cooperative enterprises, thus ensuring the quality of accounting information recognition in a wider range.

6. Accounting measurement. The core concept of accounting is based on money. Therefore, it is advisable to decide which measurement method to adopt according to the specific circumstances, such as historical cost method, fair value method, etc.However, due to the existence of standard differences, information

asymmetry and other problems, the application effect of these methods is limited, which leads to the transfer and change of value.

The introduction of blockchain technology can enable enterprises to select more appropriate measurement attributes. In the traditional accounting system, due to the information asymmetry and lack of trust, enterprises cannot measure the fair value of assets accurately and can only rely on historical cost or other means to measure, which makes the actual value of assets difficult to reflect in the statements. However, the use of blockchain technology, the use of network-wide authentication and distributed features, can greatly improve the accuracy of the fair value of assets, so that the value of assets more in line with the actual situation [128]. Using blockchain technology, it is advisable to effectively ensure the openness and transparency of the measurement process. The «time stamp» specifies the marking of past nodes, making it advisable to trace back to past transactions and events, thereby enhancing audit efficiency. In addition, each node in the blockchain system keeps transaction information separately, so the nodes will review each transaction, avoiding accounting information fraud and other behaviors, and providing information users with more objective and accurate information such as net realisable value and historical cost [3]. In addition, if someone wants to modify the measurement data at a certain node, they need all other nodes in the blockchain system to agree before making the modification, and will leave a modification mark in the blockchain system. Therefore, the accuracy and reliability of accounting measurement can be significantly improved, financial fraud can be effectively prevented, and the quality of accounting information can be ensured.

At the same time, the introduction of blockchain technology into accounting measurement can effectively ensure the compatibility between accounting measurement system and digital currency, because blockchain technology was born based on virtual economy, and the basic assumption of accounting measurement is money. With the continuous digitalization of money, accounting measurement will also develop towards digitalization in the future [171, P.239-246]. In addition, the blockchain technology can also solve the problems such as research and

development, goodwill and so on, which are difficult to measure accurately in monetary form under the current accounting system, resulting in the value it may create is also difficult to estimate accurately. The introduction of blockchain technology enables enterprises to place these hard-to-value information in the blockchain. Due to the distributed bookkeeping feature of the blockchain, enterprises in the blockchain can see part of the information. If they are interested in the information, they can further inquire about it. The information has market price due to the supply-demand relationship. On the one hand, enterprises can obtain more profits through the blockchain; On the other hand, accounting personnel can have more effective and clear control over the measurement work of enterprises.

Although accounting records are only the process of recording the accounts after accounting recognition and accounting measurement, it also plays a decisive role in the quality of accounting information, so there are many financial problems in this link. The accuracy and completeness of accounting records are essential to prevent data fraud. Failure to conduct timely and effective audit may result in serious economic losses. With the development of science and technology, the use of blockchain technology to improve the accuracy and reliability of accounting records has become extremely important.

The current accounting bookkeeping method adopts double-entry bookkeeping method, which only reflects the changes of accounting information through two dimensions of borrowing and lending, and cannot reflect the business information in depth. Moreover, it is tedious to query accounts and related transactions, because the bookkeeping systems of different accounting entities are obviously different. With the popularization of blockchain technology, accounting records have been greatly improved. Its large account book can realize the rapid replication and backup of information between nodes, enabling participants to monitor and correct errors in real time. Therefore, the blockchain technology has brought great improvement to the traditional accounting measurement.

Blockchain technology can make the three-way accounting method of accounting records more rigorous and non-falsifiable. Through the establishment of

the blockchain, enterprises can trace back all businesses related to cash flows, and information related to physical assets is clearly recorded in the Internet of Things. For accounting personnel within an enterprise, these information can be queried through the enterprise's private chain, and can also be reconciled through the external alliance chain. And a third party can be introduced through the blockchain technology to supervise the accounting behavior, which is usually used in the private chain of the enterprise [88]. Due to the network-wide authentication function of the Internet, the enterprise does not need to supervise the accounting behavior in the external alliance chain.

With the adoption of network verification and traceability technology, it is necessary to effectively prevent financial personnel from tampering with accounting data, ensure the accuracy of accounting information, and reduce the occurrence of fraud.Accounting records are the work that records economic transactions in a specific way.

By applying blockchain technology, it is possible to effectively avoid duplicate transactions and decentralization, thereby significantly enhancing the efficiency and quality of accounting management. Due to deficiencies in accounting management and records, businesses often repeat operations when using digital currency for transactions. In the traditional accounting management model, enterprises usually transfer important transaction information to third-party institutions to ensure the accuracy and reliability of transactions. This may also lead to potential security risks as third-party authorities collect more and more enterprise user data. By applying blockchain technology, it is advisable to better manage accounting information and provide a more secure solution using the principles of cryptography.It also uses time stamps to mark various accounting data, so that various information is managed and protected separately. In addition, due to the particularity of blockchain technology, it can accurately record all transactions, thus preventing duplicate transactions.

7. Accounting report. Accounting reports are intended to provide all relevant personnel with accurate and reliable information so that they can understand and apply them. The preparation of financial reports is people-oriented, and the amount of

accounting-related data of enterprises is large, so the workload of sorting out and preparing accounting reports is large and complicated. Due to the fragmentation of information in modern society, there is a serious asymmetry in the disclosure of accounting information, which may lead to a large deviation in the authenticity and accuracy of accounting information, thus bringing great risks to enterprises [137].

The introduction of blockchain technology has changed the accounting report from ex post financial report to immediate financial report. Most of the current financial statements are prepared after the fact, which may result in missing information and delayed reporting, thus weakening the reliability and availability of accounting data. «By using blockchain technology, it is advisable to track and store all transactions in real time, ensuring the information is traceable» [175, P.360-365]. In this way, it is possible to conveniently inquire about and understand the operation of the enterprise, and it is necessary to improve the efficiency and competitiveness of the enterprise.With this approach, it is necessary to move beyond traditional post-event reporting to real-time financial reporting, thus enhancing the efficiency and competitiveness of the enterprise.

At the same time, the blockchain technology enables the disclosure of corporate financial information to be automatic and real-time instead of passive disclosure, eliminating the risks caused by information asymmetry. And different from the traditional accounting report preparation, the introduction of blockchain technology makes the accounting report separate from the human-oriented information disclosure method [71]. Users of the accounting report can comprehend data in the blockchain system and minimize risks from human errors. Transactions trigger the system to record and differentiate information. If a node contains incorrect data, it will be rejected by other nodes. This process ensures the reliability and precision of financial data in the accounting report, enhancing the portrayal of the enterprise's current financial status for optimal utilization of the report.

The application of blockchain technology can also trace and self-audit the accounting information and data, effectively reducing the business cost of the enterprise.As shown in the Table 2.1.

Table 2.1

Impact of blockchain on the quality of accounting information

Affect	Descriptions
Increased relevance	Meet diversified user needs, improve financial management efficiency and facilitate user access to and analysis of financial data
Enhanced reliability and authenticity	Decentralised and de-trusted features to ensure the objectivity and authenticity of the initial input information, encryption technology to enhance security, double key and anti-tampering features to avoid information leakage
Improved timeliness	Meet the market's requirements for information timeliness, once business information is recorded, all nodes are automatically updated to ensure the timeliness of information
Guaranteed neutrality	Real-time monitoring and validation of accounting information, decentralised data sharing system, effective prevention of fraudulent transactions, reduction of bad debt rate and reduction of information asymmetry problems

Source: developed by the author

1.Relevance. The users of accounting information include not only internal shareholders, but also external investors, creditors, government agencies, etc. As the demand of users of accounting information changes, their attention to accounting information is also increasing, so as to meet their diversified needs. With the progress of blockchain technology, the traditional accounting model has been difficult to meet the growing demand for digital finance in today's society. Therefore, the emergence of «general ledger» has greatly improved the efficiency of financial management and allowed users of various financial data to more conveniently access, analyze and process financial data.

2.Reliability and authenticity. The integration of blockchain technology can enhance accounting data accuracy and bolster financial information security through decentralization and trustlessness. Decentralization guarantees the impartiality and authenticity of entered accounting data, while encryption of recorded information under anonymous transactions heightens security. Leveraging blockchain's dual-key and tamper-proof attributes can mitigate data breaches, resolving conventional security concerns and upholding data precision and completeness. Consequently, enhanced accounting data accuracy reduces enterprise transaction costs and

inter-entity trust issues, elevating the value of accounting information.

3.Timeliness. As the economy evolves, the market grows increasingly dynamic, elevating the need for swift information. Yearly financial reporting, a conventional practice, falls short of meeting market demands. The advent of blockchain enhances the timeliness of accounting data, alleviating market pressure. With blockchain, recorded business data triggers automatic updates across all nodes, ensuring irreversibility and enhancing the timeliness of accounting information.

4.Neutrality. It is essential to monitor and validate accounting information in real time using blockchain technology, ensuring strict updating and maintenance of this data. Utilizing blockchain technology can enhance the creditworthiness of entities in daily accounting operations and revamp the credit system. The evolving blockchain technology renders the traditional financial accounting model obsolete. This innovative approach offers a secure decentralized data sharing platform for businesses, effectively curbing fraudulent transactions and enabling better credit management and oversight. Integration of blockchain technology can notably diminish enterprise bad debt rates, mitigate issues stemming from information asymmetry, and promptly access partner performance data to grasp the true financial standing of counterparties, thereby averting non-market agreement pitfalls. Prior to engaging in partnerships, acquiring comprehensive information is crucial to ensure seamless operations.

Utilizing blockchain technology can significantly decrease labor involvement, cut labor expenses, and enhance operational efficiency. Automation systems can effectively minimize errors from manual tasks, lessening the financial workload on companies. Additionally, the technology can prevent calculation and entry mistakes common in large enterprises, which are often challenging to detect promptly and correct within accounting periods. By leveraging blockchain, intricate and monotonous tasks can be streamlined, enhancing the accuracy of accounting data and freeing up a substantial workforce. This allows accounting professionals more time for learning, enabling them to delve deeply into current policies and regulations [177,P.122-158].

2.2. Electronic accounting documents using blockchain technology

The accounting field is rapidly evolving due to advancements in science and technology, including the widespread use of Internet technology. This evolution is evident in the transition from manual bookkeeping to digital, automated, and intelligent systems, leading to a significant enhancement in financial management. The integration of «internet plus» mobile Internet, cloud storage, and blockchain technology has revolutionized accounting practices, replacing traditional methods of record-keeping and significantly boosting the efficiency and convenience of managing accounting files [205]. Effective management of electronic accounting files is not only the demand of enterprise management, but also the trend of the times. The popularity of electronic invoices makes electronic archives an important part of accounting archives.

1. Blockchain e-invoicing. In order to promote the process of dissertationless and information, electronic invoice is indispensable. With the development of economic modernization, electronic invoice has become an inevitable product. In order to meet the requirements of promoting the use of electronic invoices, abolished the original invoice supervision seal and adopted the electronic invoice supervision seal in a unified way. In 2021, it officially announced the pilot of the value-added tax electronic special invoice to ensure the smooth implementation of the electronic invoice system [40].

In 2018, Shenzhen introduced the blockchain technology into the field of electronic invoices for the first time, which greatly improved the relevant management and ushered in a brand-new era, bringing the value of electronic invoices into full play [180]. Adopting advanced technical means, such as organically integrating multiple links and accurately recording each step, can effectively track the invoice process, not only ensure the accuracy of information, but also avoid the loss of data, so as to ensure the reliability and safety of invoices. In the future, by introducing blockchain technology, it is possible to better integrate business processes, capital flows and tax flows, allowing traditional electronic invoices to be

replaced by digital invoices. In addition, this technology can also extract, make statistics and analysis in real time, helping us to better deal with the problem of information isolation.

Electronic invoices serve as original accounting vouchers and efficient financial management tools. Traditional paper-based invoicing is inadequate due to manual data entry, leading to decreased efficiency and accuracy. Electronic invoicing enhances the precision and dependability of accounting data by automatically generating invoices from system transactions, enabling paperless transmission, and preventing data distortion from human errors. This technology reduces accountants' workload, ensuring the reliability and efficiency of accounting data. The outdated paper-based invoicing system is no longer viable with advancing technology. Automation streamlines financial data collection, classification, reporting, eliminating the need for multiple department head signatures and simplifying processes. Electronic invoicing enables comprehensive automation, streamlining financial management tasks and enhancing efficiency. Businesses can cut operational costs, enhance financial management, expedite tax filings, and advance accounting digitization through electronic invoicing. The benefits include cost savings, environmental conservation, speed, convenience, and improved tax compliance.

Get rid of dependence on hardware such as tax-controlled equipment. Using advanced encryption algorithms, it is possible to effectively protect the integrity and security of blockchain electronic invoices. With the progress of science and technology, taxpayers can now use smart devices, such as smart phones and tablets, to easily issue invoices, which not only greatly reduces the workload, but also brings them a better invoicing experience.

Electronic invoice (E-invoice) systems are essential for enhancing operational efficiency in modern business environments. However, their implementation often encounters challenges such as inadequate training, technical issues, and system integration difficulties. To address these challenges, a comprehensive approach is necessary, involving qualitative assessments of current E-invoice practices, training needs analysis, and stakeholder feedback. Data collected through surveys and

interviews with professionals, administrators, and IT specialists can identify key issues and recommend solutions. Possible tailored training programs are crucial, covering various aspects of the E-invoice system. These programs can help users better understand and utilize the system, thereby improving overall efficiency and effectiveness.Technical challenges, including system compatibility, user interface design, and connectivity issues, must be resolved to ensure smooth operation. Integrating the E-invoice system with existing workflows can enhance data accuracy, streamline processes, and improve user satisfaction. E-invoicing facilitates faster payments and approval processes, reduces operational costs, and eliminates manual tasks, thereby improving efficiency and customer satisfaction. The successful implementation of E-invoice systems relies on comprehensive training, proactive technical support, and effective integration strategies. These measures optimize billing and reimbursement processes, foster collaboration, and enhance organizational sustainability. Future research should focus on generalizing these enhancements across entire business blueprints and improving the integration of legacy systems with new components.

Through the use of blockchain technology, taxpayers can easily complete invoice application, issuance and inspection operations, which greatly simplifies the traditional invoice business process and improves service quality and management efficiency. Using the blockchain technique, once the invoice is issued, it is automatically uploaded to the reimbursement system. In this way, the enterprise can quickly find the invoices that need to be paid according to the personal information of the users, and can also track the changes of the invoices in real time after the payment is finished. With the introduction of management cost reduction, the application of blockchain technology has greatly improved the efficiency of invoice processing, making the accounting process more convenient and reliable.

Data security is guaranteed. Invoices, whether in dissertation or electronic form, carry potential security risks. Due to the fact that the traditional dissertation invoices are easy to be lost and stored incorrectly, and there may be false issuance or cover-up, these factors may cause errors in tax information, thus damaging the national

revenue; With the progress of technology, the traditional electronic invoice has been facing more and more challenges, including the lack of a perfect platform, the lack of reasonable legal provisions and the over-centralized management model. Due to the networking of electronic invoice platform and enterprise financial system, enterprises are facing potential security risks: once these data are leaked or tampered with, it will cause great damage to tax revenue and market order. With the advancement of technology, electronic invoices can be directly accounted for and reimbursed without being printed in dissertation form, which greatly improves the use efficiency of electronic invoices and makes it possible to realize the vision of dissertationless. The electronic invoice system built by using blockchain technology can effectively implement asymmetric encryption and hash algorithm, effectively prevent the financial information of the enterprise from being violated externally, and also effectively prevent the tax-related behavior of the tax authorities. By applying blockchain technology, it is possible to ensure the security of electronic invoices and effectively control and disseminate this information.

Help the tax authorities to crack down on tax evasion. With the development of technology, the application of traditional invoices is no longer limited to the exchange of information between the drawee, the tax bureau and the drawer, but can realize cross-department cooperation. Due to the lack of complete connection between many electronic invoice platforms and corporate financial systems, the processes of issuing, checking, accounting and reimbursement are separated, which affects the efficiency and accuracy of corporate financial management. Due to the lack of effective linkage between the enterprise and the tax bureau, as well as between the electronic invoice platform and the tax bureau, the information cannot be transmitted in real time, which results in the information isolation of the electronic invoice in the whole process of circulation and tax payment. As the data between various electronic invoice platforms cannot be effectively shared, cross-platform electronic invoice data cannot be effectively collected and integrated, which brings great challenges to the management of the tax department [217, P.200-202]. Although a data sharing mechanism has been established, due to the differences in

the informatization level of each platform and the different standardization requirements of tax-related information, in order to ensure the accuracy and availability of data, it must be screened, sorted out and extracted several times, which limits the application of electronic invoices and makes the data flow more difficult. With the progress of science and technology, electronic invoices no longer need to be printed in dissertation versions, but can be directly used, which not only greatly reduces the workload of management personnel, but also can avoid tedious operations such as document copying, repeated printing and multiple reimbursement.

All transaction parties must input tax data into the blockchain system. Invoice details should link to both parties' information. Blockchain enables swift storage and transfer of diverse tax data like capital flow, taxpayer details, transaction logs, and logistics records. This fosters an efficient tax management system [74]. Through the introduction of a unified collection and management system and tax assessment system, the tax-related acts of enterprises can be comprehensively and accurately recorded and analyzed by the tax bureau, thus improving the efficiency of tax administration. Through the application of blockchain technology, it is necessary to achieve comprehensive supervision of all funds, including invoicing, circulation, payment and appeal, thereby forming a complete closed loop. The electronic invoice system based on blockchain technology has powerful distributed functions. Its architecture design and encryption algorithm can effectively prevent the leakage of data, thus realizing the safety, stability and integrity of data. «After careful analysis and comparison, it is advisable to clearly identify the transactions between enterprises and consumers, which can fully reflect the whole picture of the entire transaction, thus effectively avoiding the generation of false invoices» [185, P.988-990]. By adopting a series of measures, it is necessary to not only effectively prevent the occurrence of false invoices, but also help enterprises reduce the cost of invoice inspection, thereby reducing the audit burden of tax authorities, improving their supervision efficiency, and enabling them to more strictly implement the relevant provisions of invoices.

2. **Blockchain technology to improve accounting electronic records**. The

introduction of blockchain technology can alleviate issues in traditional electronic accounting archives management. Blockchain technology is crucial in accounting information systems as a distributed ledger and database, enhancing information management for enterprises. Its key advantage lies in its tamper-proof nature, ensuring complete traceability and confidentiality. By leveraging blockchain technology, digital encryption management of accounting information can be achieved, expanding the scope and diversity of accounting records. Furthermore, blockchain technology significantly impacts the accounting role and technology importance by enhancing information security through cryptography, anti-counterfeiting measures, and digital signatures. This, in turn, improves the traceability of information, clarifying the roles and responsibilities of internal control and corporate management entities.

Utilizing blockchain enhances accounting data credibility and reduces expenses. This technology allows assessing enterprise operations using its data and distinctly segregating public and private keys. Accounting plays a crucial role in guaranteeing precision and trustworthiness during economic transactions. Blockchain is a groundbreaking approach that records all network node transactions, enabling real-time monitoring to prevent risks and ensure information accuracy and timeliness [186]. In addition, due to the special nature of the blockchain, the security and stability of these data can also be well guaranteed. Through strict monitoring and management, tampering has been effectively prevented. Through the use of blockchain technology, data can be processed more securely, thereby significantly enhancing the accuracy and reliability of accounting work. By establishing a traceable node mechanism, the circulation of financial information within the enterprise can be effectively monitored, thus ensuring the authenticity and accuracy of the data [186, P.120-125]. By using the blockchain technique, information about a transaction is recorded on the nodes, so that the management of the enterprise will not easily change the financial data, which greatly reduces the possibility that they will force the financial personnel to change the financial statements in order to cover up the real situation. With the development of blockchain technology, transactions can

be broadcast globally without the guarantee of the central government, which greatly reduces the workload of accountants and thus effectively reduces the risk of deterioration in the quality of accounting information due to human error.

With the continuous development of Internet technology, the processes of application, issuance, payment, issuance and audit of electronic bills can be completed online, and all information can be stored in the database. As the electronic bill can dispense with the traditional dissertation carrier, its printing cost is extremely low, and it can be quickly transmitted through the network, thus effectively replacing the traditional dissertation bill, thus saving the printing cost. The use of electronic accounting files can significantly reduce the use of dissertation printing and ink, thus greatly reducing the pollution to the environment, which not only reflects our attention to green environmental protection, but also is a concept of sustainable development. With the support of blockchain technology, a large amount of financial data is stored electronically, which can help enterprises reduce storage and management costs. Currently, accounting records can be kept for 10, 30 or more years. For the life of houses and people, the retention period of accounting files can reach more than 30 years, but for some special circumstances, such as retirement, the use of milk powder additives, the retention period is even longer [187]. With the progress of the times, the management of accounting files by enterprises has become more complicated. Therefore, effective measures must be taken to ensure the safety and integrity of the files, including purchasing necessary equipment, installing shelves, building file cabinets, building aisles, etc., and paying reasonable rental and depreciation expenses. By adopting digital storage technology, it is necessary to significantly reduce office space without the use of computers or other equipment. This approach helps reduce the cost of operating and managing the archive. By using electronic accounting files, it is advisable to avoid the risk of damage and decay associated with the long-term preservation of physical documents. Management and processing of documents, editing and printing of dissertation financial statements and other work usually require a large number of repetitive and inefficient manpower, which not only increases the economic burden, but also wastes valuable time. By

relying on electronic bill data files, It is recommended to manage accounting files more effectively and no longer need dissertation files for preservation. This not only improves the work efficiency, but also reduces the labor cost. Using electronic accounting technology, it is advisable to not only achieve automatic archiving, greatly improving business efficiency, but also complete a series of standardized and automated operations, including data collection, unified management, intelligent generation of vouchers and reports. This effectively prevents human error and further improves work efficiency [109]. When the workload is reduced, the demand for basic accounting personnel will be correspondingly reduced. By transferring a large amount of tedious and repetitive work to computers, enterprises can obtain huge economic benefits, thus achieving more efficient management and operation [110, P.51-55].

The application of blockchain technology can improve the security of accounting files. At present, electronic accounting files are mainly stored in magnetic media. Due to the complicated surrounding electromagnetic environment and the magnetic medium itself, the retention period of electronic accounting records is usually about 5 years, which is relatively short [188, P.3-21]. The distributed storage mode using blockchain technology can effectively realize multiple copies and automatic backup of electronic accounting files, thus improving information security. With the emergence of advanced CPU, blockchain technology can not only automatically reconstruct all recorded information, but also greatly enhance the security and stability of the system. If there is a problem with a blockchain node, it is recommended to quickly resolve it through the platform to return it to its normal working state and reduce unnecessary losses. By adopting the encryption algorithm of blockchain technology, it is advisable to effectively protect the electronic accounting documents and their metadata, thus greatly improving the security and integrity of the electronic archives and making them more reliable and credible. With advanced encryption technology, it is advisable to safely transmit the data to the blockchain system, and use digital signature algorithm to protect and control the data. Through the blockchain technology, all participants can establish a safe and reliable

cooperation environment, thus greatly improving the efficiency and reliability of file recording, management and borrowing. Compared with the traditional way of file management, the use of electronic accounting technology can greatly improve the efficiency of the use of files, and can better protect the security of information, which is particularly important in building a perfect information security system.

With the development of science and technology, traditional financial operations have been greatly simplified, thus reducing the burden on financial personnel and the outflow of funds caused by input errors or other human errors. The use of electronic accounting files can greatly reduce this risk. blockchain technology uses digital encryption technology to ensure the security of business transactions. After the public key encrypts information, only the private key holder can decrypt the file. This asymmetric encryption technology ensures the safe transmission of data in the blockchain. When the transaction is in progress, the enterprises of both parties will record the transaction data and send it to the blockchain after encryption using the private key to ensure the security and reliability of the data [60]. After both parties have received the data, the sender's SK can be used to unlock the information. By using blockchain technology, it is advisable to achieve higher security, and it is advisable to ensure the identity of both parties through asymmetric encryption technology. Without a public key, no transaction is possible. In this way, the financial workload is significantly reduced, and the financial error rate is also significantly reduced, thus greatly improving the safety of payment. Through the asymmetric encryption of blockchain technology, the transaction information of enterprises can be securely encrypted. Even a malicious attacker with SK cannot steal any information.

Case analysis of blockchain technology improving accounting electronic records. With the rapid development of «internet plus» and other IT, the government actively invests to support the development of universities and promote the expansion of the economic scale of the universities. With the continuous enrichment of sources of income, the pressure of financial work is also increasing, a large amount of data needs to be processed, the accounting business becomes more complicated, and the

signing and approval procedures are more complicated. All these have brought great challenges to the financial management of colleges and universities. M University is a public university located in China. Its financial department is committed to managing the general ledger as its core task. The specific operation steps are as follows: 1. Collect relevant original credentials; 2. Prepare accounting vouchers. 3. Registration schedule. 4. Register the general ledger account. 5. Prepare the report.

1. Due to human intervention, the accounting results become inaccurate. The original credentials of M University are very important because they are the foundation of all work. However, some managers may forge or tamper with these credentials for personal purposes, such as printing electronic invoices multiple times and making multiple claims, which will result in blurred accounting records and increase the risk of financial fraud.

2. The accounting documents are leaked due to the abuse of power. M University allows anyone to easily access the school's financial information with their username and login password without any authorization. If the financial personnel fail to use the financial system correctly and lack safety awareness, they may encounter the theft of passwords, creating a good environment for the lawless elements, which will lead to a large amount of leakage of accounting information.

3. The large number of dissertation documents makes management extremely difficult. Although «safekeeping for safekeeping» and «you check me out» both provide effective methods of managing accounting files, there are still some differences between them. With the development of science and technology, more and more universities begin to adopt advanced electronic file management system, which can effectively improve the accuracy, integrity and reliability of accounting files. The shortcomings of dissertation documents are obvious: high cost, inefficient management and limited storage conditions. (1) With the continuous development of colleges and universities, management costs are also increasing. With the continuous improvement of accounting technology, the number of accounting vouchers has also increased significantly, far exceeding previous years. As dissertation-based original vouchers and bookkeeping vouchers must be prepared for each reimbursement, this

greatly increases the expenses of office supplies. Table 2.2 shows the number of dissertation-based reimbursement vouchers of M University in the past 5 years. The number of accounting files in M University has increased sharply, and the printing amount of vouchers is also increasing continuously, which poses a severe test for the traditional file management methods, because they consume a large amount of manpower, material resources and financial resources, and also consume a large amount of inventory space, which makes them unable to meet the increasing workload. With the progress of technology, the traditional printing process is no longer applicable, they become more simple, improve work efficiency, and bring positive impact to the development of universities. The traditional file management method of M University is no longer suitable for today's intelligent and digital campus. They need a large number of dissertation files for inquiry. Such work efficiency and quality are very low. This approach is far from the status quo of dissertationless office.

Table 2.2

Summary of Number of Reimbursement Vouchers in Universities from 2015 to 2019

Year	Accounting document	Documents and Attachments	Accounting statement
2015	569611	1072568	9601
2016	724907	1114117	9973
2017	766477	1070878	10055
2018	958705	2288555	12504
2019	981183	2748886	17001
total	4000883	8295004	59134

Source: M University's Annual Financial Report for 2015-2019

The blockchain technology under the M university electronic accounting archives construction. With the help of blockchain technology, M University's electronic accounting archives feasibility framework model consists of three levels: operation level, application level and analysis level, which are closely related, as shown in Figure 2.1, forming a complete system.

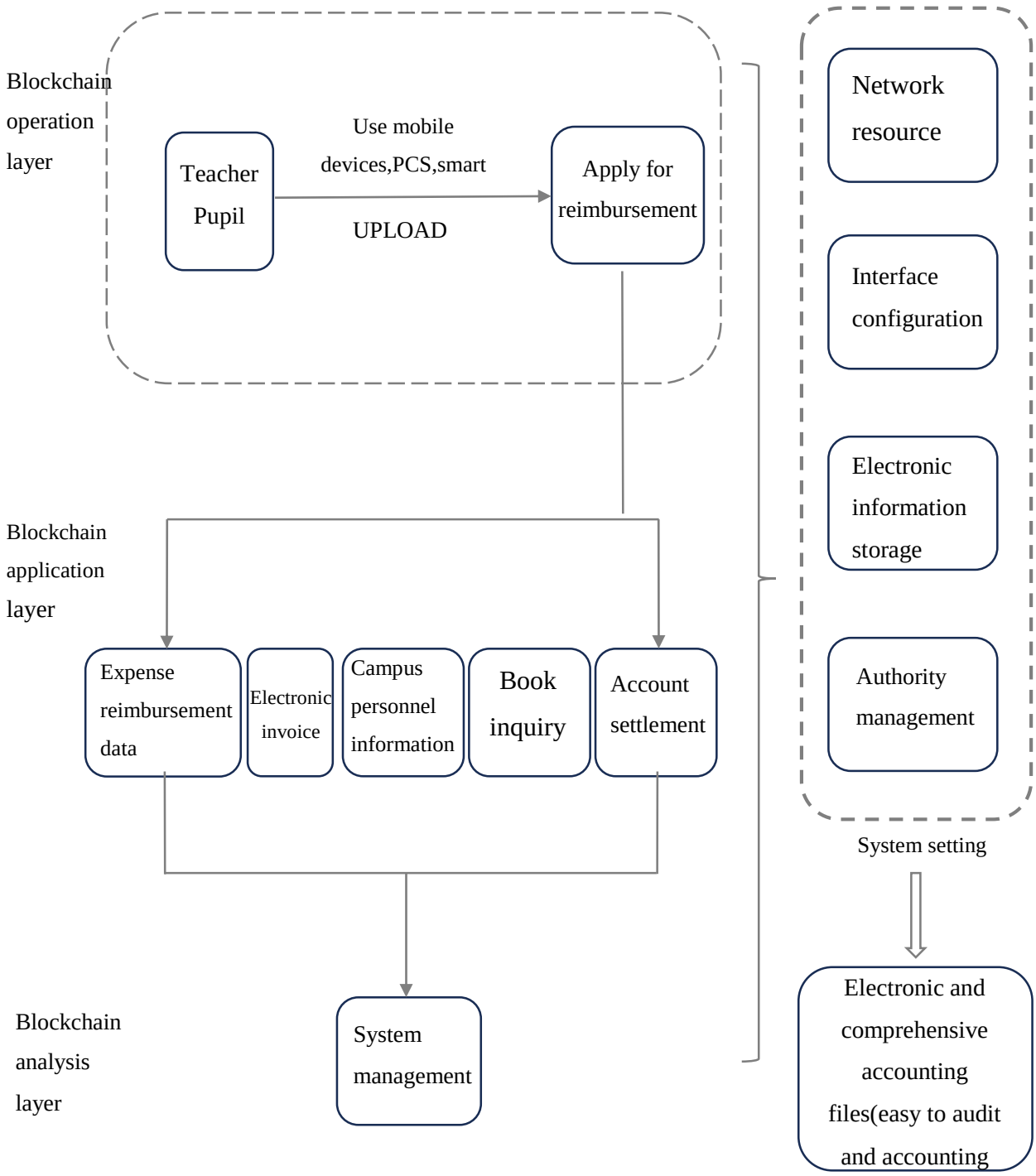


Fig. 2.1. Feasibility Framework Model of University Accounting Archives

Source: systematized by the author

By using the blockchain technology, users can transmit financial information to the blockchain network in real time, and finally store the information in the blockchain database after negotiation between both parties, so that the real-time exchange of financial information can be realized, and at the same time, the financial

information can be connected with application layer data, thus greatly improving the efficiency of financial management. blockchain technology has been widely used in many different fields, such as payment, electronic transactions, human resources management and account inquiry. These are important components of translating financial data into technologies that can be used in practice. By using the blockchain technology, it is advisable to quickly and accurately collect, analyze and integrate huge amounts of data, so as to better meet the needs of different types of consumers.

According to Figure 2.1, every student and teacher in M University has the right to record information. Whether on the mobile phone, PC or intelligent device, the system can be accessed easily as long as the student number and title code of the individual are entered; At school, the system automatically generates a electronic certificate if the student has already paid for accommodation and other related expenses. Then, the teachers need to upload the reimbursement data according to the system prompt, and record the date and details of each expenditure. Eventually, the information will be uploaded to the back office for more rigorous review. By applying the blockchain technology to the management of electronic accounting files, it is advisable to convert all the data into original data that cannot be tampered with. In this way, it is advisable to convert all electronic accounting files into complete electronic management, and use big data technology to analyze the financial information of universities, including the increase or decrease of capital investment and the proportion of structure. By collecting and analyzing useful information in a timely manner, it is necessary to greatly improve the management level of electronic accounting files at the decision-making level in colleges and universities. Management level of electronic accounting files.

Application of M University Electronic Accounting Files under blockchain Technology. Protecting the information security is very important for the management of university electronic accounting files. Two public and private keys are used to encrypt and decrypt the information. M University has adopted the blockchain technology to manage the electronic accounting files. By «encrypting,» it is necessary to effectively protect financial raw data from tampering or loss.Using the

blockchain technology of M University, it is necessary to protect the digital information safely. Only authorized users can use the public key to unlock and access the accounting records, thus greatly improving the security and integrity of the information. Through the blockchain technology, users can use the private key and the public key to manage the electronic accounting files, thus realizing the safe sharing of data and effective security protection, effectively preventing illegal access. By using blockchain technology, finance personnel can complete tasks faster and their workload can be saved. At the same time, the technology can also solve the difficulties of the managers in time and place, so that they no longer have to worry about waiting or losing the original bills. With the progress of science and technology, the management of accounting files has changed from the traditional entity model to the virtual model. In this way, the central organization can classify, arrange, regroup, analyze, query and retrieve the files flexibly through systems such as data warehouse, and can export and share the data in many aspects. Experiments prove that the use of electronic accounting files can greatly reduce the consumption of 87% of dissertation files, and can also make better use of storage space, thus relieving the pressure of inventory, which is far better than the traditional dissertation file archiving method; According to the forecast, the adoption of the electronic accounting file system in 2021 can significantly reduce the number of printed dissertation documents to 7.5 million, and at the same time, the price of each printed dissertation will also drop by 0.18 yuan, thus bringing an economic income of 1.35 million yuan to m university, and at the same time effectively reducing the indirect cost of inventory management. By using the blockchain technology, it is necessary to make more effective use of resources, reduce operating costs and significantly improve the management level of electronic accounting files in schools.

The structured chain block of accounting data streamlines the storage process. The decentralized certificate repository needs integration into a linked cloud service framework for user access to file details. Storing electronic records on a network of linked servers in the cloud ensures continuous access, security, and preservation. Upon request, various sets of archived accounting data are extracted and reassembled

for stakeholders, including internal users (such as accounting or management professionals) and external regulatory or financial entities.

«To access digital files, a digital signature system is employed, widely utilized in finance and government services» [134]. «The process involves two key phases: creating initial files and retrieving them from a dispersed database» [134]. «Once the records are gathered, individuals in charge of creating the initial documents should digitally sign them to verify the author's identity» [134]. «Subsequently, the accounting data is fragmented and encrypted, then reassembled back to its original state upon reaching the intended recipient» [134]. «To gain access, users restoring data must employ a unique digital signature, serving as proof of data handling» [134]. «Limiting stakeholders' entry to the voucher database can be achieved by imposing time constraints on digital keys» [134]. Regular rotation of staff digital signatures is essential for network security. «Updating security protocols is prompted by the necessity to reissue digital signatures» [134]. «Users must request new electronic keys from the provider, ensuring ongoing oversight of stakeholders» [134]. «Company management effectively regulates the use of electronic formats to authenticate individuals seeking confidential data access» [134]. «Through electronic key systems, users can retrieve extensive information from the open document repository» [134]. The proposed blockchain-based open document management system is depicted in Figure 2.2.

«Blockchain technology, coupled with electronic file implementation and management based on data openness principles, serves as the primary organizational model for network security across enterprises of varying ownership and size» [134]. «Rejecting isolation is crucial in facilitating information exchange within enterprise environments and fostering an open national economy» [134]. «The flow of accounting information acts as a catalyst for advancing new technologies in finance and economics, enhancing both internal and external network security effectiveness» [134]. «Advancements in information network security and efficient methodologies, alongside increased utilization of computer and communication technologies, are instrumental in overcoming barriers to the continued growth of the digital economy

and information society» [134].

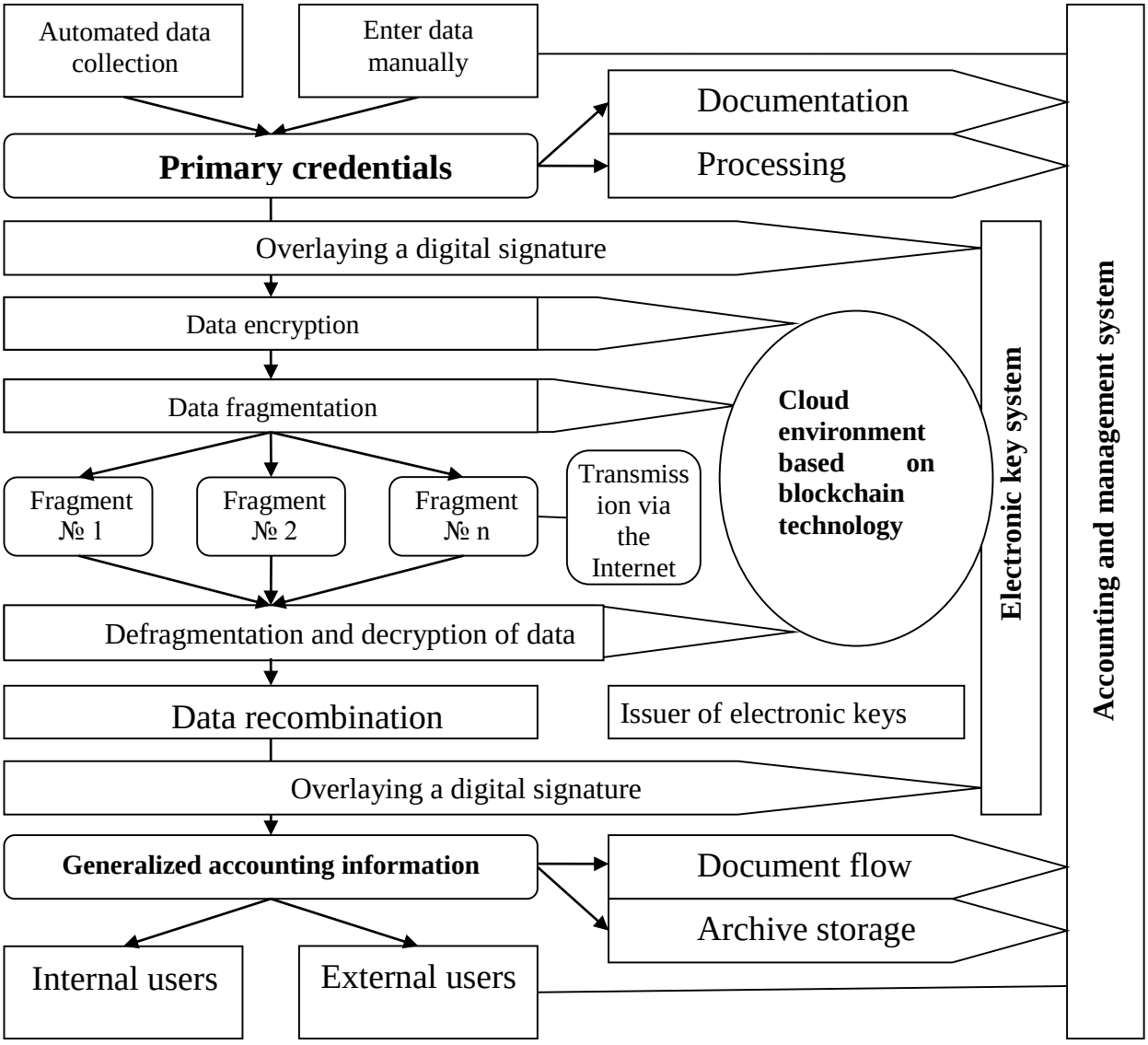


Fig. 2.2. Information scheme of open document flow based on blockchain technology

Source: improved by the author on the base [134]

«The conventional management of electronic accounting documents has various functional limitations, leading to vulnerabilities in enterprise network security» [134]. «To enhance both internal and external electronic communications effectively, integrating blockchain technology into file management is recommended as it aligns with contemporary enterprise network security standards» [134]. «The initiation of the subsequent flow of accounting information processing and dissemination stems

from the collection of original data» [134]. «Based on the information needs and confidentiality levels of proprietary information, blockchain-recorded data is partitioned, encrypted, and disseminated to internal and external users in a controlled manner. Implementing a licensing mechanism for accounting information processing involves deploying a digital signature system and distributed databases via cloud infrastructure» [134].

«Blockchain technology enhances electronic file and file management by offering fragmentation, complementarity, expansibility, reproducibility, timing, confidentiality, distribution, accessibility, and openness in processing accounting information» [134]. «This is crucial for ensuring robust network security in enterprises» [134]. «The structured and distributed accounting information framework within network security organizations fosters document circulation openness, diminishing the necessity for segregating information» [134]. «Leveraging blockchain technology encourages information exchange openness in network security, reducing organizational constraints in digital economy formation, and fostering an environment conducive to incremental innovation and social form evolution» [134].

2.3. Accounting cloud processing and storage on blockchain

In recent years, cloud computing and blockchain have become essential in the accounting IT field, with their influence growing steadily. Blockchain technology is a transformative tool that revolutionizes traditional digital structures. Through blockchain, accounting data records can be securely maintained using a novel «Block» method. This technology enables real-time monitoring and analysis of economic transactions, facilitating effective management and prediction of financial data through a consensus mechanism in distributed ledgers. Consequently, financial transparency, traceability, and comparability are enhanced. Blockchain technology, rooted in the realms of the Internet and accounting, upholds principles such as

information exchange, security, transparency, fairness, sustainability, and data sharing, devoid of commercial motivations.Cloud accounting, a novel accounting approach, enhances enterprise accounting efficiency, cuts costs, and streamlines financial management. The convergence of cloud storage, third-party computing, and advanced technologies like blockchain has significantly advanced blockchain technology, ensuring robust technical backing. The integration of big data and blockchains will drive societal progress and establish a holistic ecosystem.

By using accounting information, it is necessary to better control economic activities and the operation of capital markets. Through accounting, it is necessary to communicate important information to all parties. As a brand-new accounting service, cloud accounting will have a far-reaching impact on modern accounting information and data theory, which will come from the diversification, reliability and operability of modern systems, as well as the optimal application of computer accounting information and data. «In September 2015, JPMorgan Chase and other major financial institutions in the world signed an important agreement to promote the application of technologies within the cluster and formulated a series of brand-new industry standards» [59]; Technology is changing from abstract concepts to practical applications, and the chain is changing. Expanding the departmental chain will bring more competitive advantages to large enterprises, making it easier for them to transfer accounting information to the cloud, thus improving the financial management efficiency of each large group.

1. **Comparison between cloud accounting and blockchain technology.** «The research and development concepts of centralization and distribution are different. Research shows that with the increase of the concentration of decision-making, the efficiency will also increase accordingly, i.e. the more centralized the decision-making, the higher the efficiency» [146]. With the decentralization of decision-making, democracy will also be improved, thus making the decision-making process more democratic. «Cloud accounting uses cloud computing technology to provide new and reliable accounting services for enterprises, thus effectively improving the financial management level of enterprises

and realizing the automatic processing of financial data» [184, P.47-50]. «Blockchain technology's fundamental concept is to decentralize financial data management, transforming it into self-operating data» [147, P.22]. «To enhance decision-making efficiency, one must assess the company's needs and management goals, making optimal decisions by balancing all stakeholders' interests» [147, P.22]. «Cloud accounting technology implementation aids small and medium-sized enterprises in better financial cost control and significantly enhances decision accuracy» [147, P.22]. By adopting cloud accounting, such enterprises can more easily complete complex accounting tasks. In large and medium-sized, administrative affairs and international enterprises, accounting information is crucial to management decisions, and each organization has its own unique management style. As a result, it may be more appropriate to centralize accounting information on a private cloud, while centralizing accounting information on third-party services may have adverse effects.

Different degrees of competition in accounting. The emergence of cloud accounting has greatly reduced the workload of accounting personnel, but at the same time it has also led to more and more intense competition within the accounting industry. With the popularity of cloud accounting model, accounting entities can obtain virtual services at any time without employing professional accounting personnel. Instead, one accounting personnel is responsible for managing multiple accounts. With the development of cloud accounting technology, the audit between enterprise directors becomes more convenient, which is not only helpful to the overall planning of the enterprise, but also can greatly improve the efficiency of internal audit. By using the blockchain technology, each party can realize the real-time transmission and management of financial data on the data chain. By comparing the work efficiency and accuracy of different participants, it is necessary to determine who can complete accounting records faster. After the records are completed, it is necessary to distribute the data to the entire system for information sharing. On the blockchain platform, all accounting entities should participate in competition to improve efficiency and competitiveness. In addition, each accounting entity should have professional accounting personnel to ensure the accuracy and reliability of

accounting.

There are differences in the saving points of accounting costs. The use of cloud accounting technology can help small and medium-sized enterprises to reduce initial investment and later maintenance costs, and at the same time, it can also save the manpower needed to hire professional technicians for software maintenance. On the other hand, cloud accounting is more affordable, can obtain the best service at a very small cost, and has extremely high cost performance. By introducing the blockchain technology, the efficiency of accounting can be greatly improved, and more convenient services can be brought to all parties, so that each accounting entity can easily copy the account book, thus greatly reducing the accounting cost; In addition, the adoption of encryption technology ensures consistency between backup data. By using blockchain technology, it is necessary to protect the data security through distributed records without human verification.

Different outstanding technical advantages and characteristics. Cloud accounting and blockchain are both accounting technologies with great potential, but their respective characteristics and advantages are also different. The popularity of cloud accounting technology makes it one of the most influential accounting methods in the world today. It not only penetrates into all walks of life, but also has an advantage in competition. blockchain technology has many unique advantages, the most prominent of which is its integrity, encryption, seamless connection, traceability, anonymity, security, sustainable data processing and strong sense of social responsibility. Using blockchain technology, it is necessary to combine finance and accounting closely, effectively eliminating the information imbalance caused by the gap between transaction and accounting.

2. Blockchain and cloud accounting integration. «Achieving comprehensive development of cloud accounting and blockchain involves integrating multiple levels» [190, P.280-283]. «To fully utilize blockchain technology and enhance information security, integrating it with big data, artificial intelligence, and accounting is essential for optimal outcomes» [190, P.280-283]. «This optimization not only presents fresh opportunities and challenges but also enables the

amalgamation of diverse technologies» [190, P.280-283]. With the development of the times, the blockchain has become an important tool, which can integrate various information technologies together to achieve a more efficient allocation of resources and promote coordination and integration of economic, social, cultural and other aspects. In recent years, the development of cluster chain technology has become a kind of multi-level comprehensive application. It organically integrates cloud computing, artificial intelligence, big data, intranet and other cutting-edge science and technology, and provides a brand-new solution for traditional accounting information processing. One of the most important links is the effective application of cloud accounting technology to cluster chain system, thus greatly improving the efficiency and accuracy of accounting information processing.

The blockchain has evolved into a crucial tool in contemporary times, facilitating the integration of diverse information technologies to enhance resource allocation efficiency and foster coordination across economic, social, and cultural domains. Cluster chain technology advancement represents a sophisticated multi-level application that seamlessly merges cloud computing, artificial intelligence, big data, intranet, and other state-of-the-art technologies, offering a fresh approach to conventional accounting information processing. A key aspect involves leveraging cloud accounting technology within the cluster chain system to significantly enhance the precision and efficiency of accounting information processing. The definition of intelligent contract is put forward in the blockchain technology. Because the blockchain protocol is a shared database and can digitally verify, execute and control «transactions», the «intelligent contract» is completed through specified operations agreed in the network. Assuming that Company A needs to report and pay taxes, the original data of the Company was originally at the private end of the chain. The original data was processed by the intelligent contract according to the format and standard required by the tax bureau, encrypted by the private key, and retrieved when the tax bureau issued the instruction. The information is processed according to the information released by the tax bureau through public key encryption, i.e. the format and standard required for release on the public chain,

which is convenient for all companies that sign «smart contracts» to obtain, and then the information is verified by means of network-wide broadcasting. if the verification is passed, the information is packed and compressed into a certain block for storage with a «time stamp» and can also be saved on the public chain; If it does not pass the verification, it is directly returned to the private chain end. When the tax bureau issues an order requiring each company to file tax returns, the compressed block information can be automatically transferred to the tax bureau's private chain. If Company A has also signed an agreed «smart contract» with the bank, the bank can directly read the company's tax return information on the public chain through the public key when the private chain end of the bank also needs the company's tax return information. Such real-time data sharing is not only efficient but also safe and reliable, which avoids the cost of obtaining information and communication, but also does not cause waste of resources.

The adoption of new accounting governance methods can more effectively supervise enterprises, such as improving the registration quality of enterprises, enhancing the professional ability of accounting personnel, strengthening the annual inspection of enterprises, improving preferential tax policies, enhancing the social responsibility of enterprises, and perfecting the financial audit system. By strictly controlling accounting personnel, accounting organizations and corporate leaders, it is necessary to effectively monitor corporate behavior and economic activities to achieve the desired objectives. The application of blockchain technology makes the accounting platform run automatically, which completely subverts the «man-led» way in traditional accounting and makes accounting more selective. Accountants are people with professional skills who are dedicated to collecting, integrating and analyzing various kinds of information to meet the needs of enterprises. With the development of cloud accounting and blockchain technology, accounting organizations and accounting personnel no longer need tedious basic work, and can expand their functions to more fields, thus improving work efficiency and quality.

The theory of accounting extinction suggests that as science and technology advance, accounting responsibilities evolve, new functions emerge, and the scope of

work is influenced by the economic environment and enterprise management needs. Over time, the focus has expanded beyond traditional accounting to include forecasting, decision-making, management, internal control, strategic analysis, and practical advice for enterprises.According to Tulloch's political profit theory, regulators have great potential for development, but their expansion is limited due to their wide range of public spending and control by interest groups. With the continuous strengthening of audit, the cost of financial statements of enterprises is also rising. With the popularization of blockchain technology, the cost of accounting information processing in enterprises has been greatly reduced, thus replacing the tedious procedures that required manual audit by auditors. With the support of blockchain technology, all nodes can carry out data verification, thus ensuring the authenticity of accounting information and greatly improving the efficiency of external audit and internal audit conducted by certified public accountants. In view of the non-falsifiability of cloud accounting data, blockchain technology is adopted to update and secure the data. The advancement of blockchain technology enhances the detection of cloud accounting information distortion due to its irreversibility and timestamp function, emphasizing the significance of research in this area. This technology also enhances the security, integrity, and traceability of accounting data, allowing corporate and accounting executives to conceal financial information more efficiently, thereby preventing financial irregularities, avoiding audits, and assuming legal responsibilities. Blockchain technology development has enabled a potent deterrent against false transactions, malicious collusion, and improper financial operations. Enterprises enhancing input information reliability necessitate continuous enhancement and optimization of external audit supervision by cloud accounting service providers. Leveraging blockchain technology is crucial in phasing out traditional audit methods, thereby cutting audit costs for cloud accounting businesses. Furthermore, blockchain facilitates swift and secure recording and storage of cloud accounting data to better cater to user requirements.

Cloud management is crucial for data security and ethics. To safeguard «cloud accounting» products, providers must advance data security technology and

implement a rigorous data management system. This is essential to protect personal information of small enterprises and individual users from viruses and maintain their privacy. Utilizing coding and multi-level storage can ensure the integrity and accuracy of financial accounting data. Although accountants may encounter ethical difficulties when dealing with data that is of personal interest, it is advisable to more effectively address the ethical challenges involved in cloud reporting with the help of cluster chain technology.

3. Specific Application of BlockChain Technology in Enterprise Financial Data Storage. Blockchain technology enhances data chain security in modern online storage systems, improving financial data reliability and accuracy by introducing structural features. Its attributes of non-tampering, complete preservation, and traceability have led to widespread adoption in enterprise financial management. In essence, distributed storage is a new type of storage. It can store complex information on multiple computers, which is different from the traditional centralized storage. It uses a scalable architecture to split storage resources into smaller parts and store them in a wider space. Advances in blockchain technology allow ledgers to be performed in more scenarios. This approach enables ledgers to be managed and used on more nodes. By using the blockchain technology, the real-time monitoring of the whole network can be realized, and at the same time, data can be exchanged between different users, so that the financial information of an enterprise can be stored and transmitted safely and efficiently in a variety of different channels, such as platforms, partners, formats, etc. blockchain technology is a revolutionary database technology, which can effectively record the source, value, traffic and other information of products, and can realize distributed collaboration, effectively protect financial data, prevent data loss and distortion, and also can effectively prevent fraud in the audit process. With the advanced API interface, password consensus mechanism and shared file network transmission protocol, it is advisable to more efficiently and accurately complete the financial management of the enterprise, thus more accurately checking the income and expenses of the main business and accounting for debts more accurately [191].

By using blockchain technology, it is advisable to store all our financial data in a database and keep it shared. In this way, the staff can check the required information at any time. All data is tightly encrypted and only employees with specific permissions can access, change, or modify the data. This means that any input and output must be strictly encrypted. Through the use of blockchain technology, enterprises can quickly and accurately cooperate with other merchants, thus realizing the real-time information sharing between the two parties without relying on tedious dissertation documents. With the development of blockchain technology, enterprises can more finely select suppliers to meet their needs, and can conduct effective data analysis from multiple partners, so as to obtain more accurate and objective investment suggestions. When a new supplier appears in the market, it is advisable to immediately send an alert so that timely action can be taken. Once all nodes have agreed, all data of this supplier will be recorded in the system. At the same time, the data of other blocks will also be recorded, and the system will provide the latest data analysis report at any time. Enterprises should not only maintain close communication with customers and sales side, but also conduct regular financial verification to ensure the accuracy of financial information such as cost of main business, accounts receivable, bad debt reserve, etc., and provide timely financial analysis services for managers. Blockchain technology constructs a database that securely stores and manages historical data, ensuring the accuracy, security, and timeliness of financial information. This technology allows real-time storage of transaction documents and data without traditional paper-based methods.The establishment of an instant database can more effectively support the financial work of enterprises, thus meeting the needs of information indexing, transmission and sharing. blockchain technology not only ensures security and sharing, but also strictly encrypts all data information, which makes the encryption algorithm difficult to crack [189]. Compared with ordinary networks, the security of blockchain technology has been significantly improved. In this way, it is advisable to ensure that the database is not attacked and destroyed by hackers. Although some nodes are severely damaged, most nodes can still keep good records, so there is no need to worry about missing

data. In addition, in the blockchain technology, the data writing method is very secure. Through the distributed audit mechanism, it is advisable to effectively prevent the input of false information, and at the same time make it meaningless to change the accounts without permission. According to Figure 2.3, the advantages of the Rubik platform are obvious [192, P.1224-1226]. Enhancing data security and reliability is crucial for the Rubik platform's decentralized financial system. By reducing capital operation costs and thwarting external attacks, it safeguards against human errors. Unauthorized access is prevented, and robust encryption secures all stored data effectively. To ensure data reliability during inter-company transactions, a network linking both enterprises, Party B, and the bank is essential. This network facilitates the exchange of necessary documents like agreements, receipts, and bank account vouchers.This enables enterprises and customers to access the documents and utilize the contained date as a timestamp, guaranteeing the precision and entirety of data. During trade transactions, companies typically must furnish diverse documents like contracts, receipts, bank records, etc. To uphold data reliability, a network linking two enterprises, Party B, and the bank has been set up. This setup allows enterprises and customers to retrieve the documents and employ the date as a timestamp, thus assuring data accuracy and completeness.

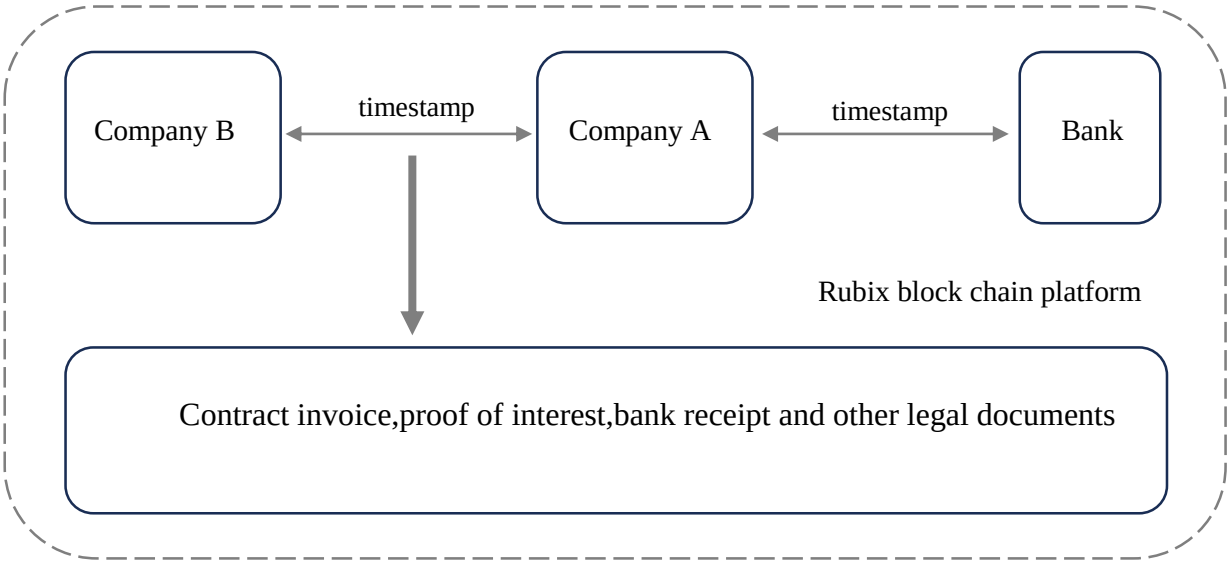


Fig. 2.3. Enterprise Private Chain Data Storage Flow Chart

Source: improved by the author

Although the blockchain technology can effectively protect the integrity and non-tampering of data, in order to improve the processing efficiency, each transaction must be packed into a block, and the hash value needs to be calculated to establish a complete Merkle tree to store the transactions in the block [61]. Although this approach can improve the security and integrity of the data, it will lead to a significant decrease in processing speed. With the development of technology, the Bitcoin system has been able to handle more than 7 transactions, which greatly improves its efficiency and can meet the growing business demand. Although there are many different technologies to solve the performance problems, such as lightning network and graphene, most of them are still under development and verification, therefore, they still need a period of time before they can be truly put into practical application. In addition, the efficiency and scalability of the blockchain are limited. blockchain technology makes transactions no longer need to be carried out in sequence, but can synchronize the transaction results and payment records of the entire network in real time, thus greatly improving the efficiency of the system. When the number of users increases rapidly, the network layer will face tremendous data pressure and cannot verify and record information in time, which will lead to system performance degradation and affect the scalability of the blockchain.

On the blockchain platform, access restrictions can be implemented. Individuals with specific identities have access to the company's financial position, the transactions they participate in, and the information they collect. Commercial transactions between Company A and Company B typically involve contracts, cheques, and other pertinent documents. The network facilitates the connection between the enterprises and banks of both parties to verify the accuracy and reliability of the transaction information, thereby finalizing the assessment of the entire trade process. Upon adding a new transaction record to the blockchain, a broadcast message is disseminated, prompting the remaining nodes to promptly update their records. However, these records are not subject to arbitrary modifications due to storage limitations. This model enables the financial database on the platform to precisely depict the business status of the company, thereby enhancing the

enterprise's value proposition.

Blockchain technology is vigorously promoting information transparency, and is expected to completely subvert the traditional way of information disclosure. Although the existence of a centralised market makes it extremely difficult to have a fully transparent financial system, the process of moving towards a more transparent financial system should still be advanced on the basis of weak centralisation. By using blockchain technology, enterprises can realize the transformation from traditional manual audit to distributed system audit. By reducing the related workload, the control effect was not only improved, but the regulatory requirements were also met. The advancement of blockchain technology will greatly diminish false accounting, enhancing transparency in financial data to better serve businesses' operational requirements.

2.4. Electronic communication in accounting based on blockchain

At present, accounting computerization and ERP have become the main means of accounting business process [193, P.222-234]. Their application scope and purpose are basically the same, that is, through a series of steps, accurate and efficient accounting financial statements can be achieved. For staff on business trips, it takes a lot of time and energy from preparation to reimbursement, but it can effectively improve the efficiency. Moreover, this is only a basic financial operation that an internal accounting staff must complete. In daily operation, an enterprise should not only handle its internal business, but also cooperate with other units and conduct transactions with related parties. In this series of processes, each unit inside and outside the enterprise is in an independent state. Therefore, accounting personnel need to spend a lot of energy and time to audit and verify transactions, information, brokerage and other activities inside and outside the enterprise. In order to ensure the accuracy of production, procurement and marketing, a rigorous review of relevant corporate departments must be conducted to obtain reliable data; accounting firms are

committed to auditing and overseeing the transactions of the cooperating banks to ensure their transparency and accuracy.Efforts will continue to be made to maintain close contact with government agencies to jointly resolve issues such as taxation, social insurance and business registration; re-audit the debt amount and maintain close contact with relevant departments. In order to ensure the accuracy and completeness of the financial statements, strict examination and inspection must be carried out on all relevant data. The financial department of an enterprise is usually separated and managed and supervised by professional accountants. In this case, financial data are usually stored centrally, and accountants play an important role in the management and supervision of these data. Although the current accounting system is known for its high degree of centralization and specialization, it still has many disadvantages, such as the arbitrariness of the accounting process and possible fraud. Due to the objective or subjective errors in the traditional accounting business process, as well as the non-openness and non-transparency of information, the transmission of information is limited to a certain extent, which cannot ensure the accuracy, timeliness and reliability of economic business.

1. Problems in Information Communication. In the 1970s, Eugene F. Fama proposed the theory of information asymmetry, which greatly influenced the development of information economics. It stressed that when a person has enough information, he can realize his own interests through effective communication, so as to avoid being violated by others [63].

With the emergence of information asymmetry, people may make two choices: one is reverse actions, the other is decisions based on moral principles. «adverse selection» reveals that some people may try to cover up their own defects in order to gain the approval of others and thus achieve the purpose of the transaction; Moral hazard means that when a person or organization comes into contact with valuable information, he/she may make decisions that are harmful to others or organizations. Due to the timeliness of information, the timeliness of access to information is crucial to future economic decisions.Therefore, if both parties to a transaction obtain information slowly, they will face an unfavorable situation and even cannot make

correct economic decisions. Therefore, it is undoubtedly crucial for both buyers and sellers to obtain the latest transaction information in a timely manner.

According to the asymmetry of information, it is advisable to divide it into two categories: one is the potential lack of knowledge, the other is the potential lack of action. The implicit difference in knowledge means that excellent people do not realize their own knowledge, which leads them to make opposite decisions. When there is a clear imbalance in the information between the two parties, one party's behavior may exceed the other party's expectations, thus causing the other party to suffer moral losses. Because of the information inequality, adverse decision-making and moral hazard may arise. These factors may seriously damage the operation of the market, resulting in a significant decrease in the work efficiency of both parties. When both people have the same information, the difference between them is often obvious. In this case, one person can often obtain more advantages from another person, which leads to the inequality of information transaction; through the case of mobile communication companies such as China Telecom, it was found that because the information sources of the two companies have a considerable share and position, their customer information is not completely symmetrical, as the management can easily access all the communication records [197]. Therefore, in this case, the information between the corporate customers and the corporate management is not completely symmetrical.

In 1962, Princeton University Press put forward a new view, that is, the distribution of prices has obvious information asymmetry, which leads to the distribution of prices [151]. In order to eliminate the price difference caused by information asymmetry, market participants will adopt effective information search strategies in order to expect to obtain the best goods or services and thus realize the maximum economic benefits. Price changes affect search costs and revenue. With a balanced distribution of prices, the probability of obtaining the lowest price will increase significantly [152, P.880-890]. Figure 2.4 shows how price changes affect the marginal cost and marginal revenue of a search, where U and C represent the expected effect and cost (or frequency), respectively [198, P. 29-36]. Under the

condition that the marginal cost MC remains unchanged, the marginal revenue curve will move from MR to MR' with the price fluctuation, even if the search cost will increase from c1 to c2, the increase in search utility will be more significant than the increase in search cost. When the marginal cost matches the marginal revenue, a better result can be obtained by using a minimum number of searches, as shown in Figure 2.5. The search is effective when n is less than or equal to n*, and ineffective when n is greater than or equal to N>n*.

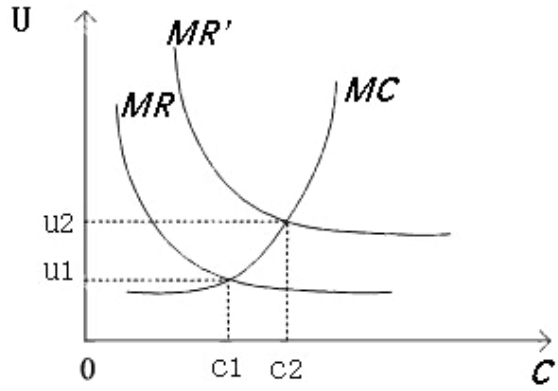


Fig. 2.4. Search Cost and Search Utility

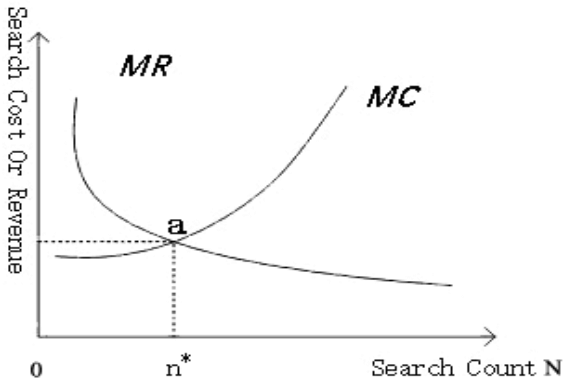


Fig. 2.5. Optimal Search Times

Source: [198]

After in-depth analysis, it was found that information asymmetry leads to moral hazard and adverse selection problems, which affect the efficiency of transaction settlement.

First, information asymmetry exists between enterprises. In today's business environment, many people may face the risk of being eliminated due to information inequality. This results in information asymmetry, i.e. participants with similar or missing information may be more likely to win than those without such information, thus making the market more chaotic. Transaction information cannot be transmitted evenly among all operating entities, which is reflected in the limitations and differences of different participants' access to information. For example, in the financial market, when a financial institution provides financial services, the information of the reporting entity is far less than that of the reporting entity itself. Financial institutions often only rely on relevant statements, such as balance sheets

and profit statements, to understand the operating conditions of the enterprise and conduct credit evaluation. However, this approach does not truly understand the actual repayment ability of the reporting entity and the related repayment risks. The occurrence of such information asymmetry may lead to adverse selection before the loan business occurs and moral default risk after the business occurs.

Second, due to the lack of timely and accurate communication between various departments, there is an obvious imbalance in information transmission. Both external customers and internal teams must obtain valid data through the system when making decisions, but these data are difficult to be accurately detected.

Third, Information inequality exacerbates tensions between company shareholders and management. In the contemporary corporate framework, ownership and operational control rights are distinct, with managers holding the control rights. As the de facto company controller, management possesses comprehensive insights into the company, while owners rely primarily on one-sided financial data disclosed in statements. Yet, management's subjective discretion influences information disclosure in financial reports, rendering it unreliable.The existing information asymmetry between enterprise operators and owners suggests that the design of remuneration and incentive systems in listed companies primarily revolves around senior executives' pay and company earnings levels. Consequently, in times of declining performance, managers may exploit their informational advantage to alter financial statements. This information gap enables managers to manipulate earnings discreetly, making detection challenging for owners who rely on managers and are incentivized by lucrative compensation packages. To mitigate information asymmetry, enterprise owners typically establish oversight departments to monitor business operators.

Fourth, there is information asymmetry between enterprises and tax authorities. In the tax field, both the drawer and the payee are the main participants in the transaction, and they can directly understand the details of the transaction, which gives them a greater advantage; Relatively speaking, the tax authority is obviously inferior to other departments. Both parties hope to obtain the maximum profit in

business activities, so they are not willing to disclose the true business information, but tend to fabricate false transaction records, hide some income, and increase transaction costs in order to reduce their own tax burden; The tax authorities strongly require taxpayers to fill in invoices accurately according to the actual transactions, so as to ensure the legitimacy and effectiveness of tax revenue and avoid tax loss. Although the tax authorities have taken a series of measures to strengthen the supervision over the use of invoices, there is still an information asymmetry phenomenon, which results in taxpayers abusing their information advantages to cover up, falsely declare, fail to report or refuse to provide income, which is still not effectively managed.

Fifth, information asymmetry exists within the tax authorities. Because the information sources of each tax authority may be different, if the lower level department can timely and accurately provide the true status of the tax, the higher level department can better evaluate and supervise the tax information, so as to ensure the correct implementation of the policies at the higher level, and further improve the efficiency and quality of tax collection and management.

2. Financial information island phenomenon. In order to achieve long-term development, collaboration between various departments and cross-sectoral collaboration is crucial. The marketing department should conduct a comprehensive assessment of the sales of the customers and combine the collection cycle to identify possible business opportunities; By applying advanced internet technology, the finance department can manage and analyze financial data more effectively;To safeguard the company's industry position, the information management department must conduct a thorough evaluation aligned with the company's business scope. Nevertheless, a challenge known as the «isolated island of financial information» has arisen due to inadequate inter-departmental communication and collaboration. The evolution of production methods, the escalating external economic challenges, and intensifying industry competition contribute significantly to this information isolation. To address the mounting market competition, enterprises need to continually expand their organizational structure to meet customer demands.

However, despite ongoing efforts, the newly formed department has not yielded substantial economic gains for the company.Simultaneously, communication barriers among various departments have notably raised the Company's operational expenses, leading to disarray in its management framework. Additionally, the conventional labor division model constrains each employee within the organization, compelling them to make potentially erroneous decisions without sufficient oversight, impeding their autonomy. Furthermore, this authoritarian management approach obstructs interdepartmental information exchange, fostering an «information island» scenario that significantly undermines the practical utility of financial information.

With the development of science and technology, more and more enterprises begin to use internet technology to collect and analyze their customers' information, thus eliminating the phenomenon of information island. Enterprises should make full use of the platform to collect more information about customer behavior, purchase habits, transaction records, search preferences, etc. However, due to the asymmetry of resources, these data are scattered among different Internet companies, making information sharing difficult, thus forming a state of information isolation. Due to the centralized management of data, the risk of data leakage is increasing. However, there is currently no legal provision on the legality of personal data on the Internet, which makes it easy for companies with large amounts of data to abuse such information.

3. Financial process optimization and business process reengineering. Establishing an advanced and efficient financial management mechanism is undoubtedly the key for an enterprise to achieve sustainable development and increase revenue, which will greatly increase the market share of the enterprise and create greater value for investors. By establishing sound financial processes, it is advisable to ensure the accuracy and timeliness of financial information. By establishing a reasonable financial process, it is advisable to effectively monitor the use of corporate funds and provide accurate financial information support for managers. The accounting supervisor is committed to deeply exploring and accurately grasping the accounting system and financial policies, and applying them

to the daily operation of the enterprise, making them an important support for the development of the enterprise and realizing the sustainable development of the enterprise. If there is a problem in the financial process of an enterprise, this will cause its financial information to become inaccurate, thus making the decision-maker unable to correctly judge and take effective measures, which may put the enterprise in a disadvantageous position. As other enterprises are unable to obtain effective guidance from financial information, this will lead to extremely optimistic or extremely pessimistic expectations of the capital market, which will affect the development prospects of enterprises. If no timely action is taken, this situation may lead to losses for the enterprise and may affect its relevant upstream and downstream supply chains, which in turn may lead to turmoil and uncertainty in the capital market. In order to win in today's increasingly fierce market environment and realize the sustainable development of an enterprise, it is very important to perfect its financial management system.

If a company can continuously improve its financial process with a problem-solving orientation, it will gain huge profits. The optimization of corporate financial process must be based on scientific theory to ensure its effectiveness and sustainability. Without the guidance of the core theory, designing the financial process from a single business perspective will not be able to meet the actual needs of the enterprise, which will seriously affect the financial management level of the enterprise and even damage the operation efficiency and coordination of financial management of the enterprise. In order to achieve effective financial management, the company should fully understand the future development direction and carefully study the financial management measures adopted at present in order to better achieve its business objectives. After in-depth analysis, it was found that information asymmetry leads to moral hazard and adverse selection problems, which affect the efficiency of transaction settlement. Optimizing financial processes not only requires meticulous management of each link, nor does it require all processes to be deleted. Instead, effective measures should be taken according to the actual situation of the enterprise in order to improve the financial management level of the enterprise and

keep it consistent with the development goals of the enterprise. Through the optimization of financial processes, it is advisable to innovate and analyze the actual value of each process, thus bringing real improvement to the enterprise.

Professor Michael Hamme proposed the business process reengineering theory for the first time, and this theory has been widely accepted by the Massachusetts Institute of Technology [183]. Through the adoption of financial sharing system, the enterprise's business process is comprehensively reformed to reduce operating costs and improve management efficiency, which is the so-called business process reengineering.

The redesign of business processes aims to break down organizational boundaries and establish a process-centric organizational structure by optimizing and integrating resources. When an enterprise redesigns its business process, it should fully consider the coordination of various internal components, so as to greatly improve the operation efficiency and work quality; If these challenges cannot be effectively addressed, the performance of enterprises will deteriorate sharply and even face the risk of bankruptcy. By re - engineering the business processes, the efficiency and stability of business operations are aimed to be improved, and a lasting impetus for its future growth is provided. See below for details:

Pay attention to the optimization of the overall process to achieve the best results. By comprehensively optimizing the internal processes of the company and re-examining the existing working model, ineffective or non-valuable behaviors are minimized to maximize the value of each link, and the focus is placed on the external business processes, including the company, customers and suppliers, to improve the overall performance.

Emphasis on customer satisfaction. In the process of corporate business restructuring, the channels of information exchange should be expanded to shorten the communication time. The employees of the company should put the satisfaction of customers first, and measure the performance of each employee. Through timely review and decision - making, it is possible to respond quickly to the needs of the market and customers, thus improving operating efficiency.

Pay attention to teamwork and participation of all members. The enterprise should strongly encourage and cultivate the team cooperation spirit, not only requiring every member to actively participate, but also organizing an implementation team led by senior personnel. In addition, every member of the team should participate in the whole operation process of the enterprise, and should concentrate all his energies on team cooperation, and at the same time, should attach great importance to every task.

Reduce the management position. To improve efficiency, the decision was made to adopt the most advanced business processes. In this way, a high degree of transparency can be maintained while providing employees with more freedom to help them realize their full potential and maximize their personal value.

Take advantage of IT and give full play to its role. Using advanced information technology, it is advisable to transform complex processes into more efficient and convenient data exchange, which greatly improves the business processing efficiency, and can effectively share various data, thus promoting coordination between systems and flexibility of enterprise organizations.

Generally speaking, business process reengineering can be carried out in two different ways: first, process optimization is adopted, i.e. the current process is adjusted and improved from different perspectives, different levels and different dimensions. Through process optimization, enterprises can continuously accumulate experience, thus obtaining higher efficiency and greater revenue, and at the same time can effectively reduce risks and ensure the normal operation of enterprises. Although it has some shortcomings, it is still based on the existing procedures. By rethinking and adapting, it is advisable to abandon old processes and develop more efficient and flexible business processes. With a new design approach, traditional assumptions can be abandoned and the possibilities of business implementation explored in depth to achieve more efficient and accurate results. The adoption of entirely new designs may result in significant changes not being achieved. Generally speaking, the risk is high, and if the new process is too different from the previous process, it may be difficult for employees to adapt.

4. Blockchain technology to strengthen financial integration of enterprises. At present, in order to give full play to the advantages of blockchain technology, enterprises should go beyond the traditional management model of a single financial department and establish a multi-party joint governance mechanism to achieve comprehensive business, financial and tax control. With the development of technology, the trend of de-trust has changed significantly, that is, the traditional professional accounting method has been changed to a consensus mechanism algorithm based on blockchain. Decentralization means that the accounting information system needs to realize network-wide backup and distributed accounting, so as to promote the equality of rights and obligations of all parties.

Financial management is crucial for enterprise growth and is essential for daily operations. It is integral to strategic planning, execution, and future achievements. The accurate assessment and interpretation of financial data rely on various business units. The proper functioning and efficiency of an enterprise's financial status hinge on the rigorous oversight and management of these units. Nonetheless, inadequate financial expertise among department staff and their workload pressure can lead to erroneous evaluations of current financial strategies.The finance department's work faces challenges due to inadequate support, leading to significant repercussions. To achieve comprehensive financial management in a company, integrating various business and financial processes closely is essential. This integration ensures that financial staff not only gather data retroactively but also embed financial management throughout the business development process, thereby achieving a seamless fusion of business and finance. The industry-finance integration model effectively addresses this issue.

By adopting the theory of integration of industry and finance, enterprises can effectively deal with the challenges in financial management, and use this theory to optimize the allocation of resources and improve the cooperation efficiency between the financial department and other departments, so as to better grasp the financial information and realize the efficient operation of financial management. At present, many enterprises are making great efforts to realize the organic combination of

finance, business and management. The most important link is to establish an enterprise financial information base. By adopting this measure, not only the operating cost of the enterprise can be greatly reduced, but also the financial personnel can know the business development situation in time, greatly improve the management level of the financial department, and realize the efficient integration of financial data and business information. With the integration of industry and finance, financial experts can quickly identify potential risks and quickly formulate effective response strategies to ensure the safe and efficient operation of funds. In this way, enterprises can not only better predict possible risks, but also improve efficiency. By integrating the financial information into the business process, the data ultimately presented to the management can be ensured to be more complete and accurate, so as to better meet the needs of decision makers and make the decision-making more operable and targeted. By effectively integrating the application layer and consensus layer of the blockchain technology into the business and capital activities, not only the integrated management idea can be realized, but also an important operation mode can be provided for the integration of industry and finance. Through the blockchain technology, the effective integration of business flow, capital flow and information flow can be realized, thus greatly improving the management efficiency and benefit. Based on the real data of the blockchain, the method has the characteristics of low cost and high efficiency, and can realize the optimal allocation of resources. In the construction of the industry-finance integration platform, a platform including an information layer, a capital layer and a business layer is constructed by applying the blockchain technology, as shown in Figure 2.6, wherein the information layer mainly includes financial and non-financial information; The capital level includes various capital revenue and expenditure activities, such as production and sales; The business level includes multiple process activities such as production and supply. The application of blockchain in the integration of industry and finance makes the data information more refined, which can meet the information needs of enterprises and has the characteristics of integrity and efficiency in the transmission of business and financial related information.

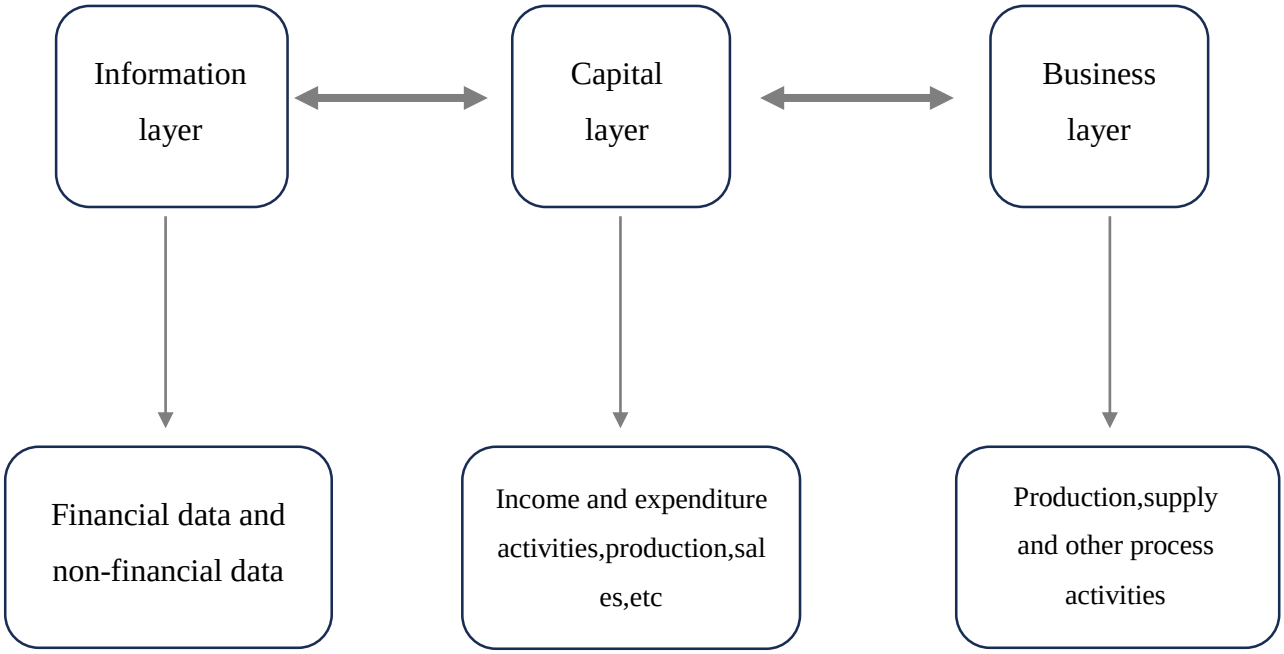


Fig. 2.6. Business Financial Integration Platform Based on blockchain Technology

Source: systematized by the author

5. Distributed technology to solve the problem of information asymmetry. Blockchain is a kind of distributed account book based on information technology. It can realize seamless connection between multiple nodes, and each node can use its own key to access the data of other nodes, thus forming a safe and efficient information exchange platform. With the continuous development of technology, blockchain technology has developed into three different forms: alliance chain, public chain and private chain. Each form has its own unique advantages and can meet different needs. In this common blockchain system, all nodes can freely access and exit the network, and can also access and store blockchain data. The public chain is a point-based network structure in which the nodes are strictly separated and completely decentralized. The reliability of public chain usually depends on consensus algorithm, however, this approach will consume a lot of manpower, material resources and time; The characteristic of the private chain is that all nodes must be authorized and the permissions of each node are strict, which leads to its high centralization. In addition, the consensus algorithm used in the private chain can also

be adjusted according to the actual situation; In the alliance chain, participants must be authorized through a strict audit mechanism, in order to prevent the activities of malicious nodes and ensure the security and reliability of transactions. With the continuous development of institutions and alliances, the alliance chain has formed a multi-center structure with strong expandability. By using the alliance chain technology, a plurality of carefully screened nodes can cooperate to complete the generation of each block, while the rest of the nodes can complete the transaction independently without worrying about the tedious steps of recording and clearing. Such a design not only helps to improve the operation efficiency of the organization, but also helps to reduce the waste of resources.

Through the use of blockchain technology, it is advisable to store the data equally, and each transaction needs to be audited by multiple nodes to confirm its authenticity. When a node's data is damaged due to the operator's negligence, the blockchain technology will automatically recover the relevant information from the database, so as to effectively prevent the intervention of other nodes and provide a more secure and reliable financial management model for the enterprise. In addition, the blockchain technology can also make the financial information exchange between enterprises and the public more transparent and timely, so that both parties have the opportunity to obtain valuable information and effectively monitor the transmission of such information.

6. Optimization of financial information processing technology path. At present, enterprise financial information processing adopts intelligent information technology, generates accounting vouchers by inputting original data, and the accounting information system can automatically complete financial processing according to predetermined procedures, thus generating various account books and statements. In this process, the reliability and accuracy of the information from the original sources are of paramount importance. By applying the blockchain technology, it is advisable to effectively manage and maintain the data on the original vouchers, thus greatly improving the accounting process and greatly enhancing the security of financial information. Using the blockchain technology, it is advisable to

achieve synchronization between nodes, data sharing and more strict verification in the financial field, thus greatly reducing the isolation of information and enhancing the accuracy and comparability of financial information. By adopting advanced technical means, the original vouchers can be effectively fixed. By re-encoding the original credentials, it is ensured that the data therein will not be tampered with in any way. As a first step, it is necessary to establish an external and reliable mechanism that enables relevant departments such as the government, industry and commerce, and taxation to have confidence in the company. The adoption of alliance chain technology can effectively improve the process efficiency. By releasing the detailed information of the enterprise to the alliance chain of the regulatory authority, the enterprise can obtain registration after strict review, thus obtaining certain authority in the alliance chain. At the same time, the regulatory authority will also conduct a comprehensive inspection on the enterprise data to ensure its legitimacy. The second step is to establish an internal management system based on the private chain, so as to ensure that when both parties sign the agreement, they can implement comprehensive control in accordance with the specified process, from procurement to warehousing, collection, sales, transportation and revenue and expenditure records. Under the strict supervision, the data information becomes more authentic and reliable, and the acquired data becomes more extensive, including not only financial information but also other non-financial information.

7. Implementation of financial sharing. Through financial sharing services, enterprises can more effectively optimize their financial organization structure, so as to achieve more efficient business objectives. Through the use of advanced information technology, it is advisable to effectively implement standardized management of financial and business processes, thus significantly improving work efficiency, reducing operating costs, maximizing enterprise value, and better meeting the needs of internal and external customers in the enterprise. The adoption of centralized management and coordination can significantly reduce the adverse impact of a single department, thus greatly improving the operation efficiency of the organization; By using the technology of resource sharing and information exchange,

enterprises can know the status of customers in real time, so as to make correct decisions faster and effectively prevent and control risks. Through the establishment of information platform, to promote the exchange and cooperation between enterprises, to achieve the effective integration of information resources, to provide a strong support for the development of enterprises. Through the use of blockchain technology, it is advisable to achieve financial sharing, i.e. real-time transmission of transaction information through distributed accounts, thus eliminating the isolation of information. According to Figure 2.7, in order to achieve financial sharing, the participants in the blockchain need to be first identified and then a common value needs to be established among them. By adopting the blockchain technology, various services are integrated together, and the initial steps of the services can be more effectively managed and supervised according to the key distribution mechanism granted by users. In the final stage, the identified business process needs to be combined with the financial management process. Through the carefully designed process, the transaction information and financial information have been successfully shared effectively. This enables the information flow and value flow to be synchronized, providing more comprehensive support for data collection, analysis and utilization, and greatly improving the reliability and operability of financial information.

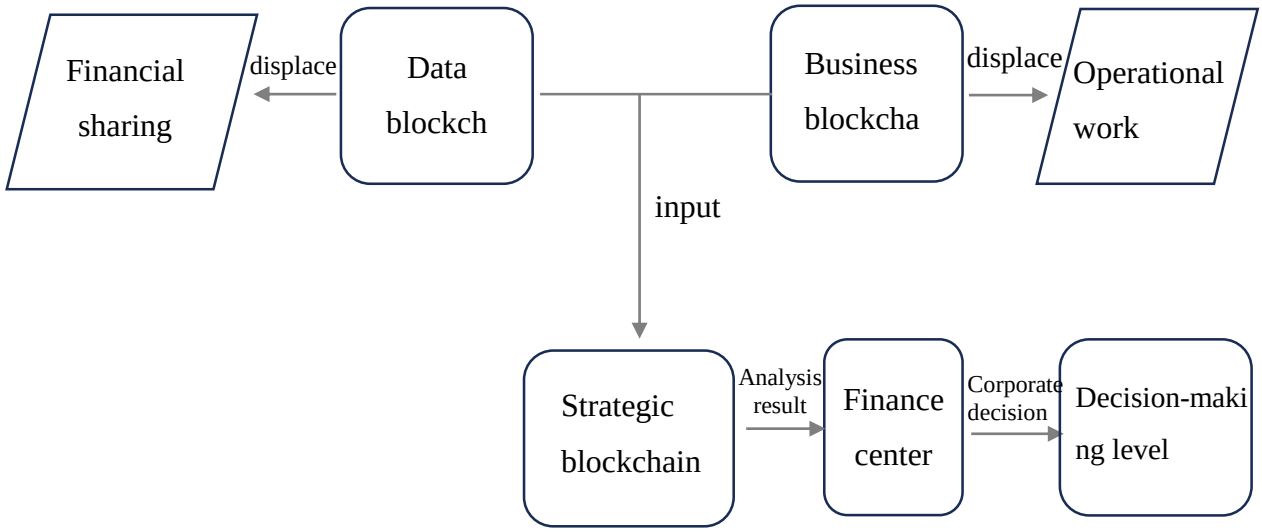


Fig. 2.7. Financial Sharing Center Framework

Source: systematized by the author

8. Controlling the formation of financial reports. With the support of blockchain technology, the generation of financial statements can be regarded as the generation of distributed books. By adopting effective signature technology, the third party can be effectively prevented from interfering, thus greatly improving the security and reliability of the transaction. Next, a private key must be obtained and an asymmetric encryption algorithm used to build a secure and reliable blockchain account. Only when the two hash values are exactly the same can this information system be utilized for financial records, thereby ensuring the accuracy of the accounts of both parties involved in the transaction. In the asymmetric encryption algorithm, the hash value of the public key is irreversible. Therefore, even if malicious third parties attempt to crack these passwords, they cannot find the plaintext in them, thus ensuring the security of the data. By using distributed storage technology, it is advisable to create a distributed account book. It is recommended to ensure the authenticity of transactions by establishing appropriate regulatory mechanisms within the blockchain network. In the process of data processing, any possible changes must be strictly prohibited, even in the final accounting results, otherwise, the blockchain technology will automatically discover the falsity of these financial information; If the nodes in the blockchain achieve 51% recognition, the contents can be updated. Effective measures are taken to manage and supervise financial information to ensure its safety and reliability, thus greatly improving the efficiency and accuracy of financial management.

9. Rebuilding the credit system. Through the blockchain technology, the credit resources of each entity can be effectively shared, thus greatly improving the efficiency and quality of accounting daily business. In the traditional financial accounting methods, there are often false related party transactions. The unique feature of blockchain technology is that it can be decentralized, thus establishing an alliance chain between various businesses, and can realize the sharing of information, thus eliminating the impact of information asymmetry, and ultimately solving the problem of credit qualification. With the development of blockchain technology, it can greatly reduce the bad debt rate of the company, eliminate the financing difficulty

caused by information asymmetry, and can help the enterprise to better control the interest cost, at the same time, it can more accurately obtain the operating conditions of the partners, so as to avoid signing non-market agreements. In order to ensure the normal operation of the company, more valuable information should be collected when selecting partners.

Using the blockchain technology, it is recommended to make everyone's personal information more public, and at the same time, it is recommended to record the details of the transaction for future reference and analysis. In addition, due to the high reliability of the Company's credit report, this will greatly increase the Company's financing amount; By using the blockchain technology, it is recommended to effectively protect everyone's privacy and ensure the security and integrity of their personal information without any infringement. With the development of blockchain technology, both supply and demand sides of capital can directly conduct transactions without any intermediary institutions, making financing channels more convenient. By using the blockchain technology, the enterprise can make the profit distribution rules in advance and record them on the blockchain. If these rules are met, the profit distribution is performed automatically.

Conclusions to the Chapter 2

The adoption of blockchain technology could profoundly influence accounting practices by providing numerous advantages, including strengthened data protection, reduced errors, and enhanced operational efficiency. By incorporating blockchain into accounting frameworks, many issues linked to conventional accounting techniques−such as discrepancies in information access and fraudulent activities−can be mitigated. Although obstacles remain, successfully embedding blockchain within the accounting domain has the potential to produce more dependable and open financial disclosures. Ongoing studies should aim to delve deeper into the possible uses of blockchain in accounting and devise approaches for its seamless incorporation into existing systems.

The use of blockchain technology holds the promise of greatly improving the handling and protection of electronic accounting documents. By applying blockchain to electronic invoicing and accounting records, organizations may experience lower expenses, enhanced data safety, and greater operational effectiveness. Despite the challenges involved in adopting blockchain, such as the necessity for staff training and adequate technical assistance, these issues can be resolved with well-designed strategies. Further investigation should concentrate on uncovering additional ways blockchain can be utilized in accounting, along with creating practical methods for integrating it into current systems. Successfully incorporating blockchain could result in more dependable and streamlined accounting procedures, ultimately supporting the long-term sustainability and expansion of businesses.

Combining blockchain technology with cloud accounting could substantially boost the efficiency, security, and transparency of accounting operations. The decentralized and immutable characteristics of blockchain offer solutions to many of the constraints found in conventional cloud accounting systems, delivering a more robust and effective approach to financial data management. Real-world applications of blockchain in enterprise financial data storage highlight its capacity to enhance data handling and cut down on operational expenses. Although hurdles remain, such as enhancing transaction speed and system scalability, the effective adoption of blockchain technology can result in more secure and streamlined accounting processes. Ongoing research should emphasize advancing and perfecting blockchain technology to overcome these challenges and unlock its full potential within the accounting industry.

Implementing blockchain technology in electronic communication within the accounting sector could greatly enhance transparency, lower transaction costs, and strengthen data security. By tackling problems like information imbalance and the «financial information island» issue, blockchain can streamline financial operations and restore trust in credit systems, resulting in more efficient and dependable accounting methods. Although challenges persist, such as the ongoing need to advance and refine blockchain technology, its effective adoption in accounting has

the potential to bring about substantial advancements in financial management and decision-making processes. Further research should concentrate on uncovering the complete capabilities of blockchain technology in accounting and devising practical approaches for integrating it into current accounting frameworks.

The results and proposals presented in the second chapter of the dissertation have been published in [137; 138; 144]

CHAPTER 3.

IMPROVEMENT OF ACCOUNTING WITH BLOCKCHAIN TECHNOLOGY USING AND ITS EFFECTIVENESS ANALYSIS

3.1. Accounting for electronic money and cryptocurrencies

With the development of blockchain technology, it can effectively solve the problem of financial authenticity, completeness and timeliness brought by Internet informatization, so it has attracted extensive attention from the global financial community. In January 2016, Pricewaterhousecoopers launched a new initiative to build a team of blockchain experts to meet the needs of clients, while it will further expand the size of the team at the end of the year [141]. Ernst & Young is launching a personal authentication system based on blockchain technology in Australia, which will allow users to create and maintain personal authentication information according to their personal needs, while also distributing this information to all trusted partners [67]. The application of blockchain technology in the accounting field can greatly reduce financial risks, eliminate information asymmetry, and effectively save transaction costs. The implementation of online digital asset transactions has changed the way accounting information is transmitted. The previous peer-to-peer transmission has been replaced by a distributed network so that data can be maintained, updated and audited at different nodes. Through this major shift, it is recommended to not only save costs, but also effectively suppress individual biases and subjective assessments, thus improving the accuracy of values. Therefore, the use of blockchain technology is very important for the accounting industry.

Money is an important commodity that acts as a bridge in the whole society. Money, as a unique commodity, has the same value as other ordinary commodities. Generally speaking, an equivalent is a commodity that can reflect the actual value of a particular commodity and can be exchanged with it. As an important tool, money has played an irreplaceable role in the economic trade of human society and made

great contributions to social development. In recent years, electronic money, as an emerging financial technology, has been transformed from a string of encrypted digital codes to a peer-to-peer transmission mode of asset rights and interests, while blockchain technology, as the basis of bitcoin, has made a major breakthrough in the field of currency issuance and become one of the most mature applications in the financial 1.0 period, greatly changing the traditional mode of currency issuance. Has greatly changed the traditional mode of currency issuance and brought revolutionary changes to the financial market.

Electronic money is a new type of financial instrument, which combines modern technology with financial services, and realizes the convenience of online shopping and payment through the form of electronic symbols. As science and technology continue to advance, the form of electronic money has experienced remarkable transformations. From its early stages involving electromagnetic waves, magnetic media, and PU processor electronic pulses, it has evolved to incorporate a wide range of modern technologies for issuance and usage. The circulation of electronic money relies on the proper functioning of associated equipment, which in turn drives the development of new technologies and devices. The security of electronic money is not solely dependent on traditional anti-counterfeiting methods but also involves diverse approaches such as password protection, software and hardware encryption, decryption systems, and network infrastructure for effective supervision and management.

Cryptocurrency represents a specific type of electronic money that operates based on cryptographic principles and achieves decentralization through distributed consensus mechanisms. In simpler terms, cryptocurrency consists of a series of electronic codes without any physical manifestation, enabling direct transactions between senders and receivers. However, cryptocurrency is frequently conflated with related concepts like electronic money, virtual currency, and digital currency. To clarify the research focus, this dissertation distinguishes these monetary terms: broadly speaking, electronic money encompasses all forms of non-physical currency. Narrowly defined, electronic money, virtual currency, and digital currency all fall

under the broader category of electronic money. Specifically, in a narrow sense, electronic money refers to the electronic representation of legal tender, including stored-value cards, bank cards, and electronic funds in third-party payment platforms.Virtual currency can be obtained by exchanging with legal tender, and used in some scenarios, such as game currency. Digital currency is a currency guaranteed by digital technology, depending on whether the issuer is a legal digital currency or a cryptocurrency. The relationship between these four currencies is as shown in Figure 3.1.

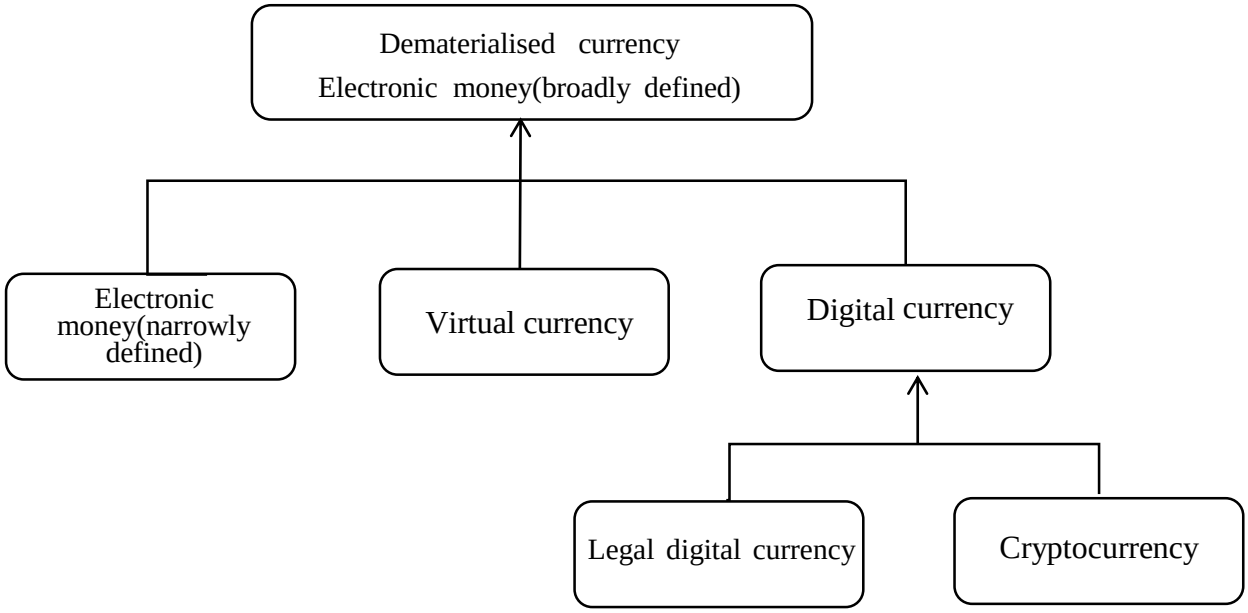


Fig. 3.1. Relationship of Various Currencies

Source: systematized by the author

Cryptocurrency is special in that it is not issued by any central bank, but based on the algorithm specified in its white dissertation, as well as more efficient technology, so that they can control the value of the currency autonomously, and through the sharing of multiple nodes, all transaction information can be distributed to record, thus ensuring the accuracy and reliability of transaction data. Using advanced cryptographic technology, it is recommended to achieve secure control of data, so as to ensure the continuous transmission, transfer and expenditure of data, and enable users to obtain the integrity of data, so as to achieve complete privacy of data. Unlike traditional centralized forms of money, encryption offers a completely

different, non-centralized way of moving money around. Over time, many financial institutions have started to use digital tools that are capable of replacing the traditional centralized financial system. For example, these financial tools can improve the efficiency of financial services by issuing digital currencies, adjusting bank reserve requirements and digital bank ledgers. In this decentralized cryptocurrency system, all participants can have the same rights, the system will implement transactions according to strict rules, and any form of malicious operation, as well as any form of tampering is prohibited.

As cryptocurrency continues to evolve rapidly, national and regional standard-setting bodies, along with prominent professional groups and organizations within the accounting field, have increasingly focused on establishing accounting treatment standards for cryptocurrency. According to research by Fomina et al. (2019), cryptocurrency is not considered a valid payment instrument in several developed economies, such as Japan, China, Bolivia, and Switzerland. This exclusion is primarily due to the price volatility, risks, and uncertainties inherently linked to cryptocurrency. In contrast, countries like Ukraine have introduced legal frameworks to regulate cryptocurrency and monitor its potential impacts. Additionally, they explored varying perspectives on how cryptocurrency is classified in Ukraine, emphasizing the need to define and harmonize the criteria for recognizing and reporting cryptocurrency transactions within national accounting standards [209].

This dissertation investigates the classification and valuation of cryptocurrency assets from two primary dimensions and incorporates diverse industry viewpoints. According to the definition provided by the International Accounting Standards Board (IASB), an asset is a resource acquired as a result of past events or transactions, expected to yield future economic benefits, and under the control or ownership of the entity [218, P.180‑191]. Under this framework, cryptocurrencies held by both corporate entities and individuals are generally categorized as assets. This view is widely recognized by international accounting standards authorities and major professional accounting bodies.However, the categorization of cryptocurrencies within the financial statements remains complex. Due to the varied

nature of asset classes and the corresponding differences in their measurement and accounting treatment, considerable debate persists in the accounting community regarding the appropriate classification of cryptocurrency assets. This issue has emerged as a focal point in discussions on digital asset accounting [219, P.40‑50]. From an accounting standpoint, the function of cryptocurrencies as a medium of exchange has not been comprehensively examined. Given that cryptocurrencies are not governed by any specific legal framework, lack identifiable issuers or responsible institutions, and exist solely in a decentralized digital environment, they do not consistently meet the criteria to be treated as conventional currencies or financial assets under current accounting principles.A review of existing literature reveals a range of divergent opinions regarding the accounting measurement of cryptocurrencies. Some scholars consider cryptocurrencies as speculative investments and support accounting treatments aligned with IAS 32. Others argue for their treatment as financial instruments or inventory under IAS 2, particularly when held for sale. Another group finds that certain cryptocurrencies share characteristics more closely associated with cash equivalents, thus favoring classification under IAS 7. These differing interpretations underscore the ongoing debate and the need for more precise accounting guidance in this evolving area.

In financial reporting, cryptocurrencies may be classified under several accounting standards depending on their nature and intended use. Specifically, they can be reported as financial instruments under IFRS 9 (applicable from 2018), as inventories pursuant to IAS 2, as cash or cash equivalents in line with IAS 7, as financial instruments under IAS 32, or alternatively, as intangible assets under IAS 38. A detailed analysis of the International Financial Reporting Standards (IFRS) reveals the following insights:

Currently, the accounting treatment of cryptocurrencies primarily involves their recognition as one of the following asset types: «cash or cash equivalents», «financial instruments», «inventory», or «intangible assets». This dissertation will focus on an in-depth examination of these four asset classifications.

Table 3.1

Summaries the Accounting Treatment of Crypto-asset in Financial Reporting

Assets	Explanation
Cash	At present, cryptocurrencies have yet to achieve broad recognition as a mainstream method of payment. Their market value is highly volatile, and they lack official endorsement or issuance by any sovereign authority.
Cash Equivalents	The market value of cryptocurrencies has exhibited pronounced volatility, introducing considerable risk for holders. Unlike highly liquid assets, these digital currencies cannot be swiftly converted into cash, which increases their exposure to liquidity risk. Furthermore, they are not suitable for long-term saving purposes, as they fail to provide the stability typically associated with traditional bank deposits. The limited compatibility of most automated teller machines (ATMs) with cryptocurrencies also hampers their accessibility and practical use in everyday transactions.
Financial instruments	Holders of cryptocurrencies do not possess any contractual rights to demand settlement in cash or other financial assets, nor are they required to fulfill such obligations. In addition, the derivatives market related to cryptocurrencies introduces a set of unique challenges that warrant further consideration.
Inventory	Inventory does not necessarily need to exist in a tangible form. However, in the context of routine commercial activities, it typically plays a crucial role in supporting sales operations. Given that cryptocurrencies are not traded with the same frequency as physical goods in day-to-day transactions, such trading generally does not represent a core business function. Therefore, cryptocurrencies like Bitcoin can only be classified as inventory when they are held specifically for resale as part of an entity's primary operating activities.
Intangible Assets	«Digital currencies are distinguishable by their unit-based structure, as they are typically traded in discrete quantities on exchanges» [8]. «Upon acquisition, an entity may derive economic benefits from these assets either through resale or by utilizing them as a form of payment – where such use is accepted» [8]. «If digital currencies are not yet recognized as «cash» or «money» under the scope of IAS 38, they should instead be treated as non-monetary assets» [8]. «These digital assets lack physical form and exist solely in electronic format, aligning with the characteristics of intangible items» [8]

Source: Adapted from Todorova (2019).

1. Cash or Cash Equivalents. At present, no country officially recognizes cryptocurrencies as legal tender. Their limited acceptance as a medium of exchange and the absence of a legal or institutional framework means they do not satisfy the criteria for legal tender, lacking the necessary statutory support [221, P. 89‑92]. In October 2021, Ernst & Young published a report titled International Financial

Reporting Standards for Cryptographic Asset Holders, which concluded that cryptocurrencies do not function effectively as a medium for exchanging goods and services and therefore should not be classified as cash or cash equivalents [8]. Similarly, the Australian Accounting Standards Board (AASB), in its December 2016 publication Digital Currency – A Case of Standard-setting, emphasized that digital currencies do not align with the definition of cash or financial assets as outlined in the International Financial Reporting Standards (IFRS) [105]. The publication Accounting Treatment and Auditing of Digital Assets, jointly issued by the American Institute of Certified Public Accountants and the Chartered Institute of Management Accountants in the UK, underscores that cryptocurrencies have not been formally recognized by regulatory bodies, lack sovereign backing, and fail to meet the definition of cash or cash equivalents as set out by the Financial Accounting Standards Board (FASB) [2]. «Similarly, the Chartered Professional Accountants of Canada observed that, in the absence of central bank endorsement, cryptocurrencies are considerably more restricted in their use as a «medium of exchange» when compared to traditional fiat currencies, and thus do not fulfill the criteria for classification as «cash equivalents» [15, P.20]. Furthermore, according to the guidance issued by the International Financial Reporting Standards Interpretations Committee, cryptocurrencies cannot be treated as cash, since they are not issued by official institutions such as central banks.

Consequently, although cryptocurrencies can be converted into legal tender and used to purchase goods and services on certain trading platforms, they are not widely accepted, which significantly undermines their practicality as a payment method. This prevents them from being used in transactions as widely as cash. Furthermore, due to their extremely volatile price fluctuations, cryptocurrencies are not appropriate as a means of value storage [16, P.422-430]. Additionally, without a widely accepted cryptocurrency serving as a pricing benchmark or value comparison, cryptocurrencies cannot effectively fulfill the role of a price yardstick. Therefore, the accounting community generally holds the view that «cryptocurrencies should not be regarded as cash or cash equivalents».

Table 3.2

Reasons for countries and organizations to recognize cryptocurrencies as «cash or cash equivalents»

Countries and organizations	Are recognized as «cash or cash equivalents»	Explanation
Salvador	Yes	Flat money
Ernst & Young（EY）	No	«Not accessible as a medium for the exchange of goods and services» [11]
Australian Accounting Standards Board（AASB）[118]	No	«The specified item fails to satisfy the prescribed criteria for classification as cash, cash equivalents, or financial instruments recognized within the framework's regulatory guidelines» [11]
American Institute of Certified Public Accountants	No	An asset fails to satisfy the FASB's criteria for cash and cash equivalents if it lacks endorsement from the administrative authority and is not backed by governmental support.
Chartered Institute of Chartered Management Accountants	No	Unless it has received authorization from the relevant administrative body and backing from the government, an asset cannot be considered as cash or cash equivalents according to FASB's definition.
Canadian Institute of Certified Public Accountants	No	Unlike traditional government-issued currencies, cryptocurrencies face significant constraints in functioning as a universally accepted «medium of exchange» due to the absence of formal endorsement or institutional support from centralized financial authorities.
The IFRS Interpretation Committee [37]	No	«Its issuance outside centralized monetary policy frameworks disqualifies it from recognition as sovereign-backed currency» [105]

Source: developed by the author

When a company adopts cryptocurrency as the payment means and promptly converts it into local currency on the exchange, it typically doesn't hold the cryptocurrency for an extended period to evade the risk of price fluctuations. In such circumstances, cryptocurrency effectively functions as a trading medium: only the confirmation of income or expenditure based on the exchange rate is necessary, similar to handling traditional foreign currencies [222, P.15-20]. As cryptocurrency is

mainly utilized as a medium for commodity exchange, cryptocurrency held for a brief period should be regarded as «cash or cash equivalent». Nevertheless, if cryptocurrency is held for a long time, this approach is not applicable because there is a higher risk of price variation. According to the regulations for dealing with foreign currencies, this might result in greater exchange gains and losses and have a substantial influence on financial statements. This method is appropriate to be contemplated in a short time. In reality, few companies hold cryptocurrencies solely for the purpose of being a trading medium, so in practice, this treatment is usually negligible [223, P.240-249].

2.Financial Instruments. The categorization of cryptocurrency as a financial instrument is still a matter under discussion, mainly because it is unclear whether owning cryptocurrency creates a contractual connection with another party [224]. According to International Accounting Standard 32 (IAS 32), a financial instrument is defined as a contract that leads to a financial asset for one party and a financial liability or equity instrument for the other. From this viewpoint, the mere holding of cryptocurrency does not definitely indicate the presence of a contract with other participants in the blockchain. Specifically, in cryptocurrency transactions and payments, holders have no right to demand cash or other financial assets from identifiable entities. Thus, considering the definition of IAS 32, cryptocurrencies usually do not meet the requirements to be classified as financial instruments or financial assets. Nevertheless, they do possess certain traits commonly related to such instruments, such as high price volatility and wide issuance to the public.

In line with accounting standards governing financial instruments, the operational model for cryptocurrencies is primarily oriented toward trading activities, which diverges from the conventional structure associated with contractual cash flows. As a result, cryptocurrencies differ significantly from standard lending instruments. Therefore, they should be treated as financial assets evaluated at fair value, with fluctuations in value directly affecting the current period's profit or loss. At the initial recognition stage, such assets are best measured at their fair value, and any transaction-related costs should be expensed immediately through the income

statement as part of investment gains or losses. In subsequent evaluations, variations in fair value are to be recognized in the current profit or loss, thereby capturing value changes promptly.

Table 3.3

Reasons for countries and organizations to determine whether cryptocurrencies are recognized as «financial instruments»

Countries and organizations	Are recognized as»financial instrument»	Explanation
Australian Accounting Standards Board	No	There are no corresponding contractual rights and contractual obligations.
The IFRS Interpretation Committee	As appropriate	Generally speaking, cryptocurrency is not regarded as a traditional financial asset. However, other types of encrypted assets might be defined as financial assets when certain conditions are met. Such conditions involve granting the holder the right to obtain cash in specific circumstances or being an equity instrument of another enterprise.
Canadian Institute of Certified Public Accountants	As appropriate	Some future contracts associated with the purchase and sale of cryptocurrencies, like forward contracts and options, as well as cash settlement contracts based on the variations in the value of cryptocurrencies, might be categorized as derivatives and be subject to the Regulations on Accounting Treatment of Financial Instruments.
Ernst & Young(EY)	As appropriate	Although the application of blockchain and distributed ledger technology will not promptly establish a contractual relationship between the two parties, if the holder is granted the authority to purchase goods, services, and financial instruments from other counterparties, these encrypted assets comply with the definition of «financial instruments».

Source: systematized by the author

3. Intangible Assets. Under International Accounting Standard 38 (IAS 38), intangible assets are defined as identifiable, non-monetary assets that an entity has control over and from which future economic benefits are expected to flow [58]. Based on this definition, if an enterprise can exert control over the utilization of cryptocurrency and derive economic returns from it, the asset meets the criteria of being under the entity's control. Given that cryptocurrency exists in the form of computer code and lacks physical substance, it inherently qualifies as a non-physical

asset. Additionally, the ability to acquire or dispose of cryptocurrency independently supports its identifiability. Since it does not represent cash nor is it intended to be received in predetermined or fixed amounts of currency, it is classified as a non-monetary item. Thus, it satisfies the criteria for recognition as an intangible asset. Both Australia and the United States have proposed accounting treatments that align with this classification. Nonetheless, enterprises may hold cryptocurrencies for purposes beyond «production or business operations.» These include using them to acquire goods or services, investing, or providing compensation to employees. Furthermore, intangible assets are generally recorded at cost, yet the highly volatile nature of cryptocurrency prices−along with the fact that many firms acquire them for speculative reasons or to benefit from trading spreads−raises concerns about the appropriateness of using cost-based measurement. Given the diverse motivations behind holding cryptocurrencies and the limitations of cost valuation, they may not fully conform to the concept of «intangible assets.»

IAS 38 outlines three possible methods for measuring intangible assets. For those with indefinite useful lives, the standard requires conducting impairment tests and recognizing impairment losses when the carrying amount exceeds the asset's fair value. These losses must be reflected in the current period's profit or loss. Importantly, if the market value recovers in a future period, prior impairment losses cannot be reversed. The third approach is the revaluation model, where assets are adjusted to fair value at the end of each reporting period. Any upward revaluation is credited to equity, while downward adjustments−within limits−are charged against profit or loss. Among these three, cryptocurrencies do not possess a definite service life, making the first method inapplicable. It remains a subject of further analysis to determine whether the impairment model or the revaluation model better suits the nature of cryptocurrency holdings.

4.Inventory. «According to International Accounting Standard 2 (IAS 2), inventory is defined as assets held primarily for sale in the ordinary course of business, or for use in the production process or supply of goods and services» [59].

This raises the question: does cryptocurrency align with the definition of inventory? A detailed analysis of IAS 2 reveals that intangible assets intended for sale in the normal course of operations may also qualify as inventory. Additionally, the standard emphasizes that adequate disclosure is necessary to reflect the economic substance of relevant transactions. Based on this interpretation, however, cryptocurrencies present classification challenges. Their lack of physical form complicates their categorization under either intangible assets or inventory. Valuation difficulties further hinder their treatment under IAS 2. «Consequently, encrypted digital assets generally do not meet the criteria for inventory recognition under standard business practices as outlined in IAS 2» [202, P.169]. Nonetheless, the intent behind holding cryptocurrency plays a pivotal role. When an entity clearly maintains cryptocurrency for resale, a case can be made for its classification as inventory, subject to further evaluative judgment.

When it is clearly demonstrated that an enterprise holds cryptocurrency for the purpose of sale, an initial classification of such assets as inventory is justified. In the presence of an active market, determining the fair value of cryptocurrencies is relatively straightforward, allowing for the calculation of their net realizable value [203, P. 659]. Based on the valuation principle requiring the use of the lower of cost and net realizable value, if the latter falls below cost, an impairment loss must be recognized and reflected in the current reporting period's loss. Should market prices rebound, the recoverable amount must be reassessed, and adjustments made to profit or loss, provided that any such adjustments do not exceed the total impairment losses previously recognized [9]. As speculative components in international cryptocurrency transactions are gradually reduced, market stability is expected to improve. The high volatility and inherent risk associated with crypto trading are likely to diminish the participation of speculative investors, thereby reinforcing the role of cryptocurrencies in more traditional investment portfolios. Digital currencies have already been viewed as investment-grade assets and employed as media of exchange. Moving forward, this classification is expected to become more definitive, allowing users to select cryptocurrencies according to specific objectives and anticipated returns. However, challenges remain in realizing their monetary functions, as highlighted in Table 3.4.

Table 3.4

Cryptocurrencies as money: modernity and prospects

No.	Function of money	The ability of cryptocurrencies to perform the functions of money	Further prospects
1.	Measure of value	Cryptocurrencies are freely traded in active markets, enabling the determination of their value and exchange rate. The price of the majority of cryptocurrencies, which are regarded as speculative investment items, is highly volatile, making it challenging to predict their value.	The further advancement of cryptocurrencies results in their utilization for payment transactions with value linked to fiat currency or stock assets.
2.	Means of circulation	Cryptocurrencies have already been employed as a form of payment for the purchase of goods (works, services). An increasing number of trading platforms are accepting cryptocurrencies, and nations are officially acknowledging them as a means of payment. Nevertheless, in some other countries, the use of cryptocurrencies is prohibited.	As time goes by, the number of countries that will legalize cryptocurrencies will rise. In countries with a regulated economy, it will be feasible to create their own cryptocurrencies or to guarantee the controllability of electronic transactions.
3.	Means of accumulation	The unpredicted emissions and significant fluctuations in exchange rates make the long-term accumulation of cryptocurrencies challenging.	Investors, upon obtaining the anticipated investment profit, attempt to sell high-risk crypto assets. With the enhancement of the control level over electronic transactions, the emission of cryptocurrencies and their value will become stable. The vigorous attraction of cryptocurrency deposits and loans will boost their long-term accumulation.
4.	Means of payment	In relation to substantial price fluctuations, counterparties view cryptocurrencies as an undesirable form of payment when there are significant time lags between the conclusion of contracts and their payment.	The active implementation of the practice of smart contracts, which automatically monitor the fulfillment of contractual terms and their payment, makes the use of cryptocurrencies acceptable. Once the value of cryptocurrencies stabilizes, their utilization for commercial purposes becomes feasible.
5.	World Money	Since electronic transactions carried out with cryptocurrencies are confidential, most countries impose restrictions on their usage to counter illegal activities. Some national governments and large international companies have already begun accepting cryptocurrencies in international export-import transactions.	Guaranteeing international control or independent auditing of electronic transactions will guarantee the credibility of cryptocurrencies as international means of payment.

Source: created by the authors

The challenge of identifying crypto-assets through a monetary lens in accounting and financial control is largely justified by the difficulty in affirming their role as a stable measure of value, as well as their functionality in circulation, accumulation, payment, and cross-border transactions. As Ya. Krupka and V. Okrenets observe, «International standards and their domestic counterparts were established prior to the widespread adoption of cryptocurrencies», and therefore did not account for their distinct economic characteristics» [121, P. 15‑27]. «Scholars have noted that, given the varying approaches to the legal regulation of crypto-assets around the world and the evolving practices surrounding their use» digital currencies are capable of partially performing several traditional monetary functions» [121, P. 15‑27].

As a result, substantial challenges remain regarding the global acceptance of cryptocurrency as a legitimate monetary instrument, particularly due to concerns over anonymity and the difficulty of exercising regulatory oversight−factors that hinder its function as a medium for international currency exchange. While price volatility of crypto-assets may serve to limit their use in activities such as money laundering or tax evasion, this alone is not sufficient. Therefore, it is imperative to strengthen international regulatory frameworks and oversight mechanisms for electronic transactions involving cryptocurrencies.

Therefore, in the near term, it becomes increasingly necessary to recognize cryptocurrency as a new class of assets, functionally comparable to monetary instruments in facilitating electronic international economic transactions. Scholarly research has proposed the introduction of a dedicated accounting account to record operations involving cryptocurrency in electronic form [143, P.44]. Within Ukraine's accounting framework, the optional Account No.32, titled «Electronic Money and Cryptographic Money,» has been suggested to reflect the ownership and management of such digital assets. The next logical step involves formalizing consistent accounting treatments for financial and business transactions that incorporate the use of cryptocurrency within foreign economic activities.

Leveraging blockchain technology, the integration of accounting databases with the digital currency systems used by banks and financial intermediaries can be optimized. For this purpose, ensuring seamless data synchronization between accounting automation software and information services provided by both traditional banks and cryptocurrency exchanges is essential. This multilevel integration−spanning digital communication tools such as "client-bank" and "online banking" platforms, banking and crypto-exchange portals, currency markets, and financial oversight systems−facilitates the creation of an advanced information infrastructure [143]. Within this environment, cryptocurrency operates as a medium of exchange in international electronic trade (Figure 3.2).

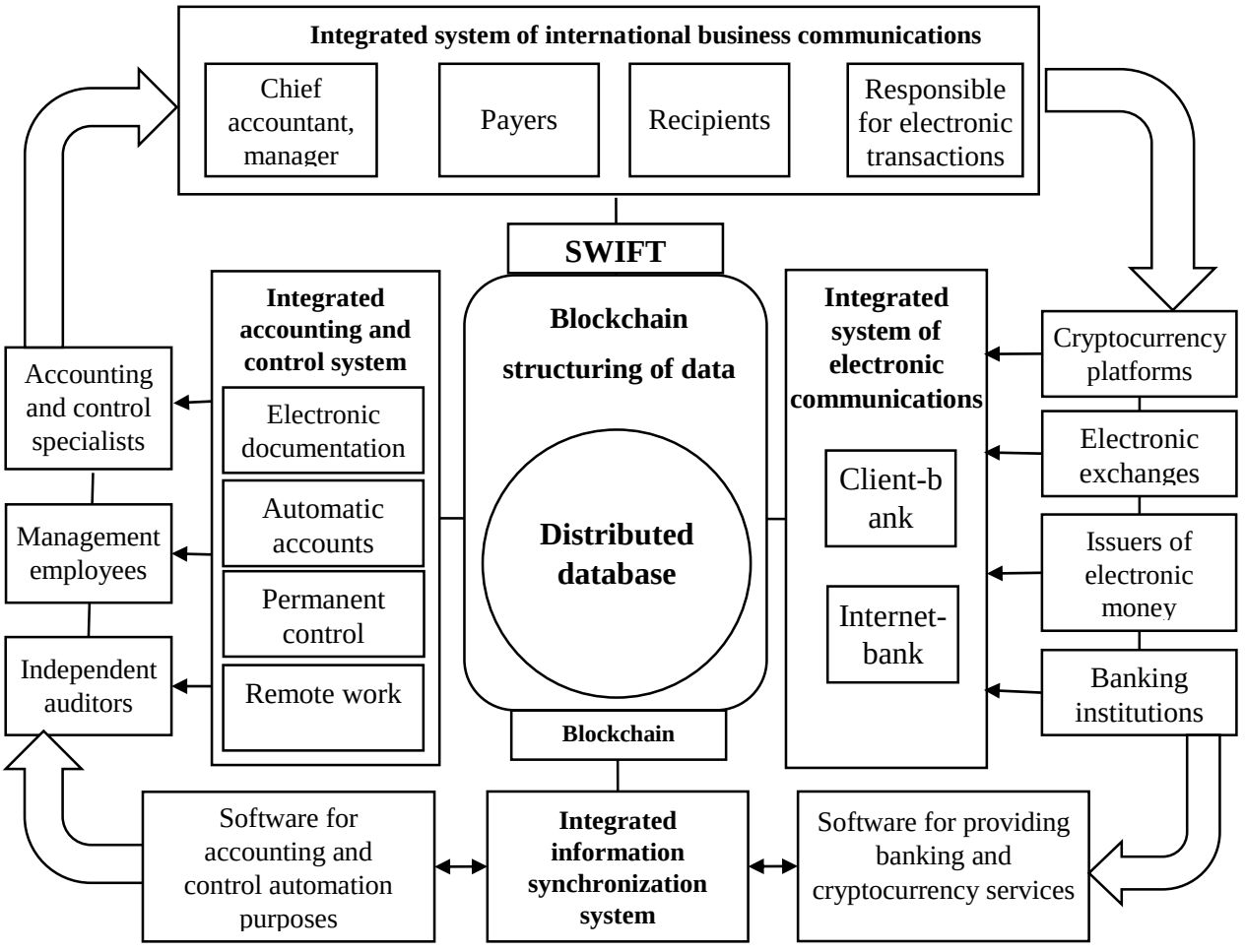


Fig. 3.2. The innovative information setting of foreign economic electronic transactions involving cryptocurrencies and the implementation of accounting functions.

Source: improve by the author based on [143]

The digital information infrastructure supporting international electronic trade transactions forms the foundational layer for the functioning of virtual metauniverses. These metauniverses emerge through an integrated network of electronic communication systems – linking "Client-bank," "Internet-bank," and blockchain-based accounting structures. Additionally, this environment encompasses a unified system for synchronizing banking data with accounting and monitoring software. It also includes a commercial communication network that consolidates transaction-related information from all monetary participants, as well as a centralized Accounting and Control System [143].

Within this framework of unrestricted data exchange, accounting and financial control professionals are empowered to manage currency operations in real time, 24 hours a day. Equipped with mobile communication tools and smart devices, authorized personnel can fulfill their roles irrespective of physical location – facilitating continuous operations even during emergencies, such as pandemics or wartime conditions. Approvals or rejections of digital transactions, including cross-border cryptocurrency payments, can be directed to relevant staff members without spatial constraints. Moreover, each transaction remains subject to ongoing oversight. Should irregularities be identified–particularly in international dealings– automated restrictions may be imposed until verified and released by a responsible authority [143].

This intelligent data environment enables the automatic establishment of relevant accounting records based on incoming electronic transaction information. Upon confirmation of inflows or outflows in digital accounts, it is advisable to generate the necessary source documents and record corresponding accounting entries. A key recommendation is for core financial documents related to capital movement–including those involving cryptocurrencies–to be auto-generated and distributed electronically to designated personnel, akin to digital bank statements. Accordingly, unified digital communication systems such as "Client-bank" and "Internet-bank" should be employed for transmitting transaction details and

associated account data. Thus, with the establishment of this innovative electronic infrastructure for cross-border transactions leveraging cryptocurrency as a medium of exchange, notable advances in accounting and control processes can be achieved− namely, automated document generation, real-time account creation, continuous transaction monitoring, and remote staff operations.

3.2. Accounting for settlements with counterparties.

With the development of science and technology, enterprises can realize automatic capital settlement through automated systems, without the need for tedious review by financial personnel, and can realize fast, safe and convenient capital payment through online or Unionpay mutual payment. Although the financial information system of enterprises can effectively improve the work efficiency and shorten the work cycle, there is still a certain risk, that is, even if the most advanced technology is adopted, the accuracy of financial data cannot be guaranteed. When financial personnel are faced with great work pressure, they may neglect some important income and expenditure information, and may even lead to errors in the sales and procurement information of the enterprise, which hinders the formulation of the adjustment statement and seriously affects the normal operation of other financial management and business processes. With the development of information technology, there are many challenges in the fund management process, which poses a great challenge to the financial situation of enterprises. Financial communication among various departments is hindered by the imbalance of information caused by the fact that financial personnel ignore the nuances of accounts. Because the company does not clearly stipulate the approval authority, and excessively centralize the approval authority, the fund approval process becomes chaotic, which seriously hinders the review progress of sales revenue and procurement expenditure, and ultimately reduces the efficiency of fund settlement. With the advancement of science and technology, it is recommended to easily obtain all kinds of information.

However, how to effectively use this huge amount of data and apply it to optimize the fund settlement process is still a challenge.

1. Application and risks of blockchain in transaction settlement. Blockchain technology provides a convenient and efficient payment method without central control. All computers are independent network nodes with the same rights and obligations. They can exchange information with each other and realize real-time transactions without the need to set up any central server or store large amounts of data. Blockchain technology uses its unique design advantages to greatly improve the efficiency of transactions and reduce transaction costs, thus greatly improving the efficiency of settlement. The central bank has launched a new financial model, which uses cutting-edge technologies such as digital currency and blockchain technology to greatly shorten the cycle of payment and settlement and reduce expenses [160]. With this technology, accounts can be connected to each other, greatly reducing the tedious steps of payment and settlement, and the advanced smart contract technology is also used to achieve comprehensive automation. Blockchain technology eliminates the need for payments to go through any intermediary, instead protecting each node's private and public keys through cryptography. This technology can also verify the identity of both parties through digital signatures, so it has the advantages of high security and high speed. By applying blockchain technology to transaction settlement, the cost of supervision and settlement can be greatly reduced, and direct payment between the two parties can be realized with very little or no fee, so the cost of cross-border transactions can be greatly reduced. By using blockchain technology to complete the settlement of funds, not only can realize the peer-to-peer payment, but also can greatly improve the efficiency of capital transactions, reduce the cost of transactions, and help to ensure the security of funds. By using blockchain technology, enterprises can conduct fund settlement more efficiently.

With the continuous development of blockchain technology, it has entered a new stage of exploration and practice, and there are more and more practical application cases. However, due to the lack of large-scale promotion, there is still a lack of awareness about it in various countries and industries. For this reason, there are some

serious challenges associated with the use of blockchain technology for transaction settlement.

First, industry standards are not yet perfect. As the development of blockchain technology is not yet perfect, its application in trade settlement may be limited. Currently, blockchain technology has not reached a unified industry standard, and there is a lack of an authoritative organization to ensure its security on the network. Due to the rapid development of blockchain technology, its ecosystem has become more and more solid. To be able to be widely used in the commercial field, the pace of R&D for blockchain trade settlement needs to be accelerated. If the expected results cannot be achieved in the short term, it will greatly hinder the continuous development and growth of this technology. With the progress of science and technology, the traditional trade settlement mode has made great progress in the past hundreds of years, which has been widely accepted and supported by all over the world. The most representative ones are the Uniform Rules for Documentary Collection and Uniform Rules for International Documentary Letters of Credit. In addition, the International Chamber of Commerce (ICC) has set up an arbitration panel to resolve possible disputes in international trade and help improve the efficiency of trade settlement [5]. Currently, blockchain trade settlement is facing many disputes due to the lack of a dedicated body to protect the technology. These disputes may be difficult to resolve, which is not conducive to the development of new technology and the smooth progress of trade settlement. Blockchain technology will play a key role when users use shared assets of record, so it is important for companies to jointly develop appropriate blockchain technology to ensure their internal security, rather than being exploited by competitors [216, P.146-155]. Different enterprise management models may bring challenges, therefore, enterprises must take effective measures to deal with the new responsibilities and obligations. To avoid controversy, a unified set of industry norms must be developed. With the continuous development of blockchain trade settlement, to achieve this goal, a complete international trade process system must be established, as well as a complete financial infrastructure must be built. With the advancement of this process,

a lot of social capital and public resources will be consumed, and the active participation of government agencies will bring great changes to the global economy, which needs to be further discussed and verified [217, P.200-202].

Second, the relevant laws still lack clear provisions. At present, there is still a lack of regulations on blockchain. The law is essential for maintaining order in the market, and without it, it can lead to economic chaos. Currently, blockchain technology is not officially recognized [218, P.174-188]. Despite the many advantages of blockchain technology, if there are no legal restrictions and norms, it may still cause harm to some people and lead to adverse consequences when disputes occur. Using blockchain technology to store digitized information is an unprecedented attempt, and it is not yet possible to determine who owns the information or where it is stored [219, P.40-50]. Whether blockchain technology can be used for cross-border transactions, and whether courts will accept the validity of smart contracts. When there is a coding error, the judicial authority should deal with it according to the relevant law. Due to the unreliable trigger data of smart contracts, various problems may occur in such cases. Therefore, it is very important to take interventions to address these issues [220, P.78-79]. An excessively centralized system will only lead to chaos in society, while rules and laws are the basis for maintaining the market economy. For this reason, blockchain technology has not yet achieved widespread commercial application.

2. Novel Blockchain architecture Decoupling consensus from transactions. Traditional blockchain technologies such as Bitcoin closely link consensus and transactions, and once an agreement is reached, it indicates that the transaction has been completed [221, P.89-95]. When an abnormal transaction occurs in a consensus block, due to the influence of other factors, the consensus of the block may not be reached, thus making the consensus invalid.

First, if a transaction is abnormal, the correlation between consensus and actual transaction will be seriously damaged, so that the current consensus block cannot complete any transaction, which will seriously hinder the efficient operation of the whole system [222, P.13-18]. Second, in order to comply with PFMI, all transactions

within the same block should be agreed upon rather than dispersed. PFMI is a financial transaction code that has been widely used for a long time, and its compliance is crucial to avoid risks in the financial system. To ensure the effectiveness of consensus, a new approach that combines consensus and trading is adopted [150]. However, since traditional blockchain technology lacks an effective regulatory mechanism, a peer-to-peer P2P protocol has to be adopted to resist government regulation. As blockchain technology has become an important financial tool, its regulatory issues are getting more and more attention. Blockchain technology can be used not only to process data, but also to supervise and control its use [223, P.240-250]. Due to the complexity of the consensus and transaction mechanism of blockchain technology, it may lead to severe crashes or even complete loss of function of the system. Solving these problems requires first identifying the root causes of traditional blockchain consensus failures [224]. Traditional blockchain technology assumes that as long as all nodes have the same data and transactions in the same block will reach consensus, however, due to this assumption, the actual situation is often problematic, for example, due to data asymmetry, and high-speed blockchains are prone to crashes. If a transaction fails in the blockchain, the block will no longer store any other transactions, and all failed transactions will be re-added to the blockchain system in order to re-establish consensus [225,P.30-33]; Currently, a large number of transactions are waiting for consensus to be reached, and the number of these transactions is increasing, so the capacity of the next block becomes larger. If consensus fails in the next block, then all transactions have to be rerun, which leads to a sharp increase in the number of transactions that need to be agreed upon, making the block even larger [226, P.40-56]. As block size increases, the number of internal transactions grows proportionally. However, under the assumption of a 0.01% per-transaction failure probability, a block containing 1,000 transactions would exhibit an aggregated failure probability of approximately 10%; When there are 10,000 transactions in a block, any one of them can cause the block's transactions to fail [165]. If a fast blockchain system is exposed to extreme risk, then it will cause huge losses. To prevent this from happening, swift measures must be taken to

strengthen the supervision of this network and deal with any abnormal situation in a timely manner. Even though blockchain technology has made great progress, there is still a risk of a crash [227, P.51-55]. The reason is simple: a poorly performing blockchain system may only be able to process 100 transactions per second, and when the probability of each transaction failing is 0.01%, the probability of failure is not high due to the small number of transactions processed by the system, but a good performing blockchain system may process 10,000 transactions per second, and then it will fail almost every time [153]. Therefore, it is not a wise choice to combine consensus with transactions.

In this brand new blockchain technology, the consensus principle is changed from individual nodes to it being lifted when the data is the same for all nodes and part of the transaction has already been reached; according to the «data inconsistency» rule, as long as there is one factor, the other factors will be ignored, so that the probability of consensus failure is greatly reduced, and the efficiency of the system is significantly improved, therefore, the avalanche phenomenon will no longer exist [154, P.2-40]; the data of each node is completely consistent, so each node can determine which operations are correct and which operations are wrong. Therefore, consensus and transaction decoupling is the key to the development of blockchain technology, which can not only improve the performance of the system, but also greatly improve the development efficiency [155, P.1074-1107]. With the development of blockchain technology, the connection between transaction, settlement and account has been completely disintegrated, and the reliability, monitoring ability and scalability of PFMI principle have been significantly improved, thus greatly improving the security and effectiveness of the whole process [73]. After the separation of consensus and transaction, the efficiency and stability of the system have been significantly improved, and the software architecture has become more compact, which can realize more functional expansion.

Unlike traditional blockchain technology, the latest blockchain architecture adopts the PFMI principle, which means that consensus needs to be reached several times to ensure the accuracy of each step when processing any transaction. After the

KYC verification is completed, the transaction will be agreed upon for the first time and uploaded to the network [161]. After strict supervision, any transactions that do not meet the regulations will be rejected, and all transactions will be re-uploaded through the consensus mechanism. In the third consensus, it will be ensured that all transactions that have been reviewed by regulators can be uploaded to the chain. In other words, the process of trading can be divided into several main links: submission, review, execution and settlement.

1. Through blockchain technology, it is recommended to query the information of all transaction parties to ensure that the funds and assets are real. This information will be recorded on the chain for future verification [228, P.88-100].

2. Once the on-chain consensus is reached, the transaction awaits transaction.

3. After the transaction is completed, all the transactions will be uploaded a second time. If the transaction does not achieve the expected result, or is rejected by the system, the transaction will be recorded and declared to have failed.

4. In the final result, the details of the transaction will be disclosed to everyone and a third uplink will be made. In cases where it is not necessary to disclose to the outside world, this step can be omitted [229, P.100-109].

According to Figure 3.3, using the new blockchain architecture for three uplinks enables real-time tracking of each transaction, thus avoiding failure, failure to complete, or rejection before settlement. These rejected transactions may involve a company or individual for some reason, such as suspected money laundering. By going up the chain three times, it is recommended to ensure that all the information can be retained so that it is possible to facilitate future audits. By adopting advanced blockchain technology, it is possible to achieve one-time, three-times consensus transactions, thus achieving more efficient management. With three-times consensus, it is possible to apply it to multiple different functions to achieve step-by-step supervision, and it can be implemented in multiple systems, thus greatly improving the efficiency of the system. By separating the individual functions, it is possible to develop, simplify and optimize them. In the future, the number of consensus three times can be adjusted to four or even five times through appropriate regulatory

measures, thus greatly enhancing the scalability and flexibility of the system. By establishing an effective regulatory mechanism, it is possible to effectively maintain the security and reliability of transactions. By adopting the latest blockchain technology, big data platforms can store transaction information in the form of a comprehensive digital table or image, thus greatly speeding up the process of query and monitoring.

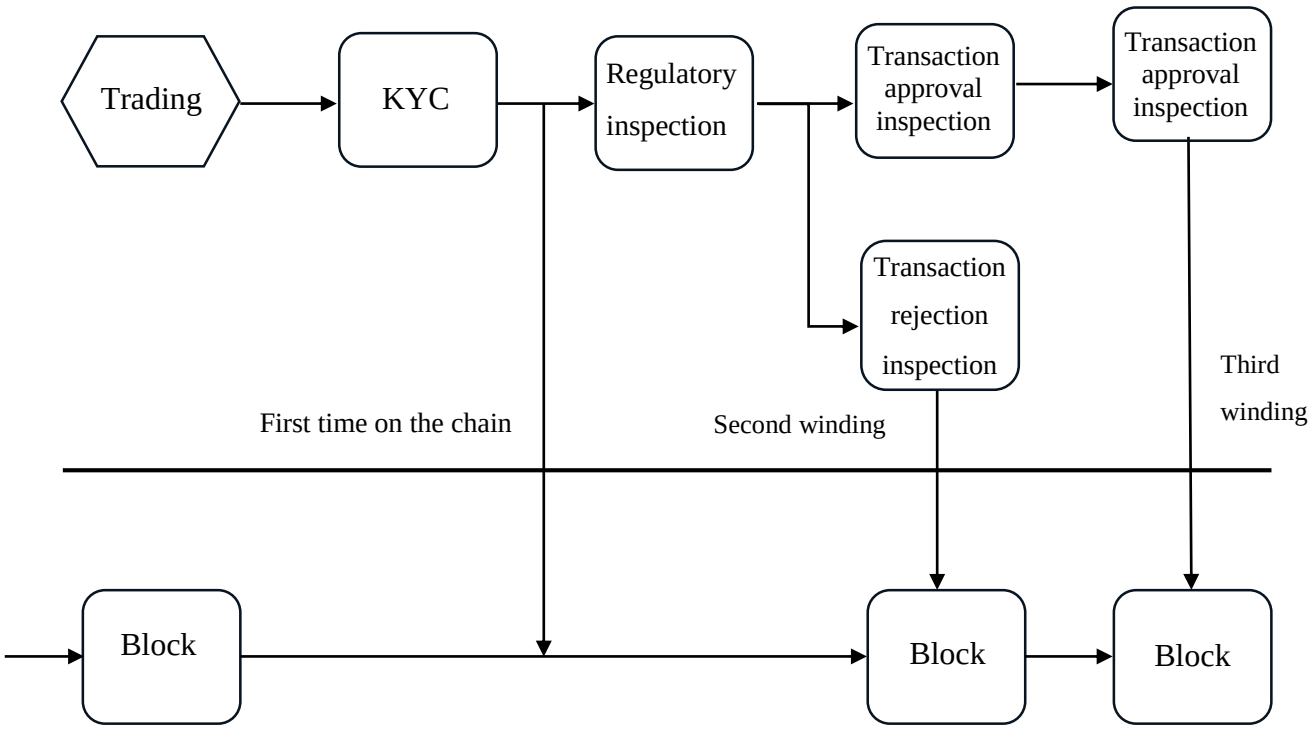


Fig. 3.3. Decoupling mechanism between consensus and transaction

Source: systematized by the author

By collecting and analyzing data through big data platforms, it is possible to better understand the current transaction situation and use it as the basis for regulatory decisions. Through the big data platform, users can collect, analyze and obtain effective regulatory information on their own, so as to better realize decision-making and execution. Using big data technology, it is possible to quickly analyze the current transaction and determine whether the transaction is acceptable based on the blacklist and other relevant information. Using big data analysis technology, it is possible to quickly upload the evaluation data to the blockchain system, so that it can accurately reflect the review opinions of the regulatory

authorities, thus ensuring the legality of the transaction. Through the consensus mechanism, transactions can be effectively isolated, so that no matter whether the transaction has been completed or not, all relevant information will be stored in the blockchain system and can be uploaded automatically. If any party is involved in money laundering, which ultimately leads to the failure of the transaction, the big data platform and blockchain technology will immediately provide effective reports to the regulatory authorities so that effective measures can be taken in a timely manner.

Using the technology of multiple consensus and multiple uplink, the new generation of blockchain architecture can perfectly isolate consensus, transaction and settlement, which can significantly improve the operation efficiency of the whole system. In this new blockchain architecture, consensus and transactions are divided into three parts, and each transaction can only take place once after being reviewed by regulators; From this point of view, consensus and transaction are completely independent, not affected by any external factors, no matter whether the transaction is successful or not, or whether it will be rejected by the regulator, the normal consensus state can be maintained, and this information will also be recorded in the blockchain. By introducing blockchain technology, it is possible to achieve comprehensive supervision of transactions and record relevant regulatory information, so as to ensure that all data will not be tampered with, so as to achieve security and reliability of the whole chain.

3. Application of blockchain technology in cross-border payment and settlement. In recent years, international payment has become a powerful driving force for the growth of cross-border trade and investment, and has made indelible contributions to the vigorous development of today's world economy [230, P.265-270]. Although cross-border payment accounts for only 1/6 of the global trade volume, the global international payment revenue has exceeded US $200 billion, of which transaction fees and foreign exchange gains account for 27% respectively, and they are rising at a rate of 6% every year [176]. According to the latest data, China's cross-border payment volume reached 28.39 trillion yuan in 2020, up 44.3 percent

from 2019, indicating that China is on track to become the world's third largest payment center [31]. Although current payment services have been digitized on a large scale, including wechat Pay, Alipay and credit cards, the development of cross-border payments is far behind, with many challenges, such as long processing time, high fees and opaque information [231]. This is mainly due to the excessive centralization of the current cross-border payment system and the lack of unified technical standards.

Over the past few decades, cross-border payments have grown rapidly as the international mobility of goods, services, capital and people has increased. The annual amount of cross-border payments globally has reached US $23.5 trillion, accounting for more than 25% of global GDP, and even during the global pandemic, cross-border payments have been growing at an annual rate of 10% [45]. Making individuals and businesses more dependent on cross-border payments. With the increasing market demand for cross-border payments, users want to be able to access more efficient and secure cross-border payment services, not just domestic services. As the scale of cross-border payment settlement continues to expand, traditional settlement methods can no longer meet the current demand [232].

At present, 90% of cross-border payment activities in international trade use B2B payment methods, most of which are provided by banks [166]. Banks must conduct strict identity verification on customers during the payment and origination process to ensure the legality of the use of their funds and monitor money laundering activities. SWIFT, as a cross-border financial service, allows banks to make payments with financial institutions around the world [90]. However, since swift itself lacks settlement functions, all wire transfer operations must go through strict approval procedures to ensure that all data is safe, accurate and reliable. At the same time, in order to ensure the accuracy of the data, all data transmission must be reviewed by multiple financial institutions, which have their own unique accounting systems and bookkeeping systems to ensure the security of the data. In addition, the participation of multiple intermediary institutions such as clearing bank, correspondent bank and receiving and paying bank is also required to ensure the

accuracy, reliability and security of data. In order to ensure the reliability, credibility and operability of the transaction, measures must be taken [233, P.142-150]. It requires a lot of manpower, takes a lot of time and is prone to mistakes. A bank wire transfer usually takes 3-5 working days, which may be extended due to time differences, different working hours in different countries and the fact that the SWIFT system does not work on weekends. «Western Union» is an international leading electronic exchange service provider, its electronic exchange financial network covers the whole world, and its cross-border payment speed is extremely fast, only 2-3 working days can be completed, while the traditional bank wire transfer takes 3-7 working days. Although some banks have adopted electronic payment methods, many customers still have to go to the bank branch in person and fill out cumbersome forms, which makes the process of cross-border payment for international trade more complicated [26]. SWIFT, as a global cross-border payment tool, requires both parties to have membership in order to provide fast, secure and reliable payment services . If both parties do not have membership, they must rely on intermediaries to collect payments, which greatly weakens the efficiency of payments.

By introducing blockchain technology, the advantages of cross-border payment become more obvious: not only can the transaction time be greatly reduced, but also the transaction fluency and convenience can be greatly improved [234,P.442-447]; Without any external intermediary, the transaction parties can fully exert their independence, thus achieving fast and efficient transactions, while also reducing the clearing costs. The application of blockchain technology can greatly speed up the process of cross-border payment and settlement business, and can significantly shorten the transaction cycle, which is of great significance [235]. By separating the processing of payment and settlement, the dependence on third-party settlement institutions can be greatly reduced, thus effectively reducing settlement costs and greatly improving the efficiency of settlement. By using blockchain technology, it is found that smart contracts have many advantages, such as programmability, automated execution, and following pre-established rules [236, P.205-210]. This

makes transactions much more convenient. By improving the efficiency of payment and settlement, the proportion of funds in transit is significantly reduced, thus greatly improving the liquidity of funds, thus effectively alleviating the problems of capital occupation and capital shortage [237].

At present, due to a variety of reasons, enterprises must bear considerable transaction costs when implementing traditional cross-border payment for international trade. The manifestations of such costs include:

Formalities fees. In the traditional cross-border payment business, clearing and settlement is usually done by multiple institutions, including the paying bank, clearing bank, clearing organization, receiving bank and receiving bank. These institutions must conduct strict review and record all transactions, and charge the client an appropriate handling fee before completing the clearing and settlement [238, P.214-235]. Through bank wire transfer, transactions between buyers and sellers incur some fees, which may include SWIFT call charges, remittance fees, collection fees, exchange rate conversion difference fees, etc. Currently, the total cost of cross-border payments is about 7%, which is higher than domestic payment and settlement rates [90]. If one party's bank is not a SWIFT member, it needs to be an intermediary agent of SWIFT member to complete the payment. In this case, it needs to pay an additional handling fee to the intermediary agent, and a transfer fee will occur for each transfer through an agent bank.

Time cost. With the progress of science and technology, the traditional cross-border payment mode has been unable to meet the growing demand for data processing and storage. Therefore, the use of advanced automation technology can more quickly complete the settlement of funds, greatly improving the liquidity of funds; As the traditional cross-border payment process becomes more complex, the recovery cycle of funds becomes longer and longer, which will not only lead to a waste of time, but also may bring greater economic losses and potential risks to enterprises. Currently, the payment settlement period on Tmall Global is 14 days [102]. However, if a consumer proposes, the merchant will receive the corresponding return within 10 days, thus increasing the time investment of the merchant.

Loss of exchange. The risk of cross-border payments is significant because it involves currencies from various countries. As the time of collection may fluctuate, if the exchange rate fluctuates, then the business will be exposed to the risk of loss due to exchange [239].

By applying blockchain technology to cross-border payments, it is necessary to significantly improve the efficiency of payment settlement and reduce the cost of settlement time, thus improving the utilization rate of funds. This is mainly reflected in the following aspects: First, the reduction of intermediate links. The decentralized nature of blockchain eliminates the need for trust endorsement through third-party institutions for cross-border payment, avoiding the retention and processing of funds and transaction information in third-party central institutions, which can effectively reduce transaction costs, intermediary costs, time costs and precipitation capital costs [240, P.30-40]. The consensus mechanism of blockchain reduces the management, verification, reconciliation and other costs of intermediary institutions, and at the same time reduces the cost of opening margin accounts in each intermediary institution to maintain credit. Through the smart contract technology of blockchain, when the conditions for the implementation of payment are set in the contract, all the data in the system can be automatically run, and the contract terms can be automatically verified and executed, avoiding the waste of resources caused by repeated authentication, reducing the cost of manual operation and reducing the cost of error investigation caused by manual operation. In addition to traditional cross-border payments, new market participants, such as bank money changers, are also planned to be introduced in order to better meet the needs of both sides of the transaction and promote foreign exchange circulation; through fierce competition with foreign exchange exchanges, the most suitable foreign exchange quotation can be found, so that it is necessary to effectively reduce the loss caused by exchange rate fluctuations. By improving the trading process, the efficiency of information transmission has been greatly improved. As the immutability of blockchain technology is increasingly valued, it provides a secure and reliable solution for today's online transactions, which has greatly promoted the progress and development

of society. With the development of blockchain technology, its immutable feature makes the transaction data cannot be changed or deleted, so as to realize the real-time traceability of the past transaction records, effectively prevent unilateral changes, and ensure the integrity of the data, thus laying a solid foundation for the construction of a secure and effective credit system. After accurate algorithm verification, it is necessary to safely transmit information to each node, so that the flow of value between different nodes can be realized, and can avoid information retention, thus greatly reducing the time and financial burden caused by too strict central control and centralized account management.

Traditional cross-border payment methods rely on personal information provided by customers, such as ID card numbers and account information, which must be reviewed at financial institutions. In addition to solving challenges in payment, logistics, customs clearance and other aspects, cross-border payment is also a complex task, which must strictly comply with local laws and policies as well as corresponding financial standards. As a large number of transaction records and user information are stored in banks or payment systems, once it is damaged by illegal elements and hackers, it may lead to serious data security risks such as accounts, bank cards, funds, transaction records and money laundering. Especially in the field of third-party cross-border payment, due to the involvement of various participants, such as merchants, consumers and platform banks, if any of the links go wrong, it may cause damage to customer privacy. In 2016, a hacker sent a fake check request via the SWIFT network to steal $81 million in cash from an account at the Central Bank of Bangladesh, resulting in severe financial losses [113]. With the popularity of cross-border payments, many disputes have followed due to trade activities that span multiple countries and geographies, resulting in numerous disputes. With the continuous development of science and technology, the traditional cross-border payment mode of international trade has been unable to meet the needs of today's enterprises for capital and property security, because many enterprises lack enough time and energy to resolve disputes, which leads to the freezing of funds and cannot be fully protected. With the development of technology, the traditional cross-border

payment has changed from the centralized data storage mode to the multilateral sharing mode, which greatly improves the security of cross-border payment.

Using blockchain technology, it is necessary to effectively solve various challenges and difficult problems. Using blockchain technology, it is necessary to effectively guarantee the security and transparency of fund flows. Through blockchain technology, each participant can be regarded as an independent bookkeeper, and their transaction information will be fully open and transparent, so that participants in cross-border payments of international trade can easily access, record and witness all the information, while personal information will be strictly protected. Adopting a fair and transparent transaction mode can fully protect the interests of all parties, effectively prevent and curb all kinds of illegal activities, and further enhance the security of cross-border payment in international trade. On the other hand, the uniqueness of blockchain technology lies in its complete anonymity and traceability. When making cross-border payments, it is necessary to organize all the data information according to a certain period of time, and after strict verification, these organized blocks can be combined with other blocks to build a complete blockchain, so that the data can be stored forever. Blockchain technology provides a large amount of raw data to ensure security, they are not interfered by anyone, only when more than 51% of the nodes reach a consensus, the transaction information is allowed to be updated [113]. In this way, blockchain technology can effectively prevent malicious attacks, thus effectively reducing the capital and transaction risks of cross-border payments. Through blockchain technology, relevant departments can supervise transactions in real time, thus improving transaction security, reducing regulatory costs and enhancing supervision. In addition, the regulatory authorities can also check the status of transactions at any time, so as to better manage and control trading activities. By adopting blockchain technology, it is necessary to realize distributed ledger, and transaction records can be stored in a complete way. In the network, each node can verify the identity of the customer and confirm the authenticity and integrity of the transaction by verifying with each other. In this way, it is recommended to better supervise the operation of the system and improve the

guarantee of trust security.

4. Case study of cross-border payments. In 2014, Deloitte led the establishment of Rubik, which aims to combine advanced blockchain technology with perfect infrastructure to meet the needs of innovative companies and mature enterprises, and solve the conflict between the rapid development of blockchain and the complexity of enterprises. Rubik is a development platform focused on enterprise-level blockchain applications. Through continuous efforts and improvements, Rubik provides a reliable solution for many enterprises to help them make better use of blockchain technology . Rubik is an open-source software based on the Ethereum protocol, which has been continuously improved and refined to provide a variety of application services for enterprises to meet their diverse needs. Deloitte Rubik is committed to providing an efficient and flexible blockchain application architecture that aims to achieve the perfect combination of collaboration, scalability and security to meet the needs of customers [66]. Rubik platform provides enterprises with a wide variety of blockchain solutions, from control panel, network status monitoring, security audit, data mining, data analysis to data alarm, which can help enterprises better achieve their security goals;by using blockchain technology, specific blocks, transaction records, and addresses can be easily found for effective data management and analysis; using the node monitor, it is recommended to check the working status of each node in real time and completely; With the contract editor, efficient smart contracts can be easily built and installed on the most advanced blockchain technology.

With Deloitte Rubik Enterprise blockchain technology, a fully open financial management system has been built that enables users to easily record, view and manage all transactions to ensure that transactions are safe, accurate and reliable [107]. The launch of Rubik has brought unprecedented changes to many enterprises by building a more secure, stable and reliable blockchain financial environment to meet their growing economic development needs . The Rubik platform's distributed ledger technology has revolutionized multiple industries, from payments to accounting bookkeeping, and from data storage to business auditing, with dramatic

improvements. This new ledger technology can significantly reduce operating costs and improve productivity, giving companies a greater advantage in the market. Enterprises can obtain great convenience through low-cost capital operation, but due to the existence of financial intermediaries, enterprises often need to pay high commission fees when allocating funds. When enterprises enter the overseas market, the complex process and high fees become extremely obvious, especially for small and medium-sized enterprises, these high fees may become an important obstacle for them to achieve overseas business. International trade using RMB is a complex activity that not only involves multiple participants, such as importers and exporters, banks on both sides, and their respective clearing houses, but there are also many other links to consider [134]. As a result, the cross-border payment process is complex and changeable, with different fees required for each step and long review time. Therefore, in general, the fee cost is very considerable.

According to Figure 3.4, cross-border payment activities of enterprises involve multiple links, including both importers and exporters, banks, and intermediate currency clearing banks. The cooperation between them is close and complex. Here is the corrected sentence:

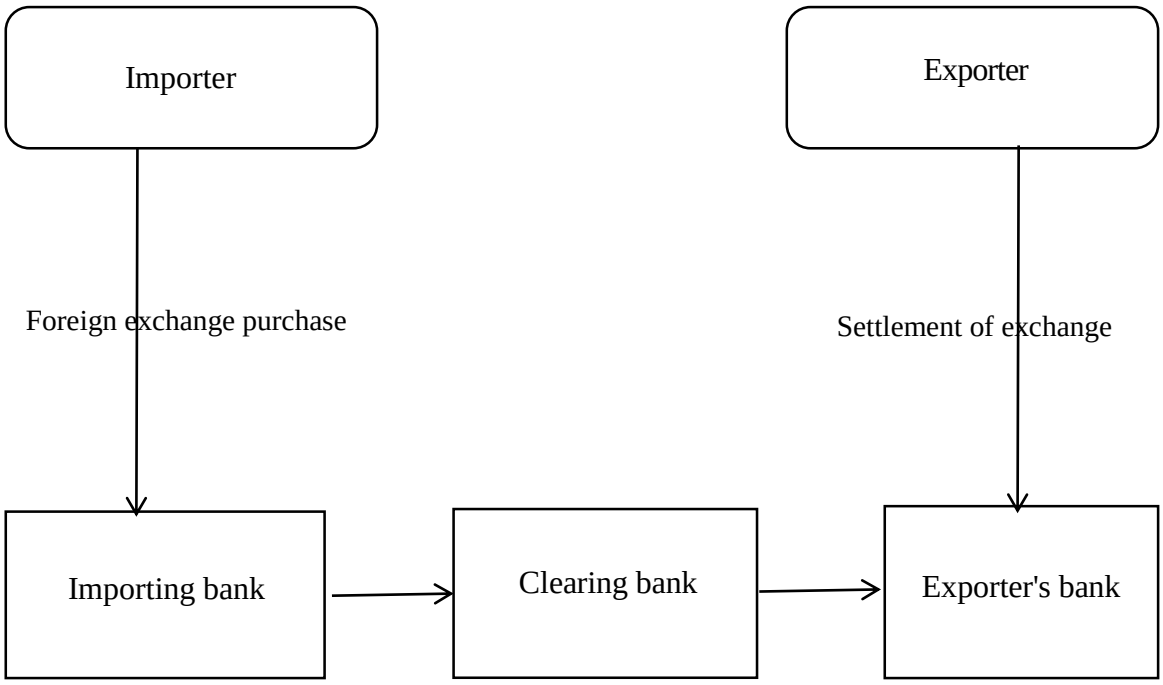


Fig.3.4. Flow chart of traditional cross-border payment

Source: systematized by the author

Through the complex foreign exchange purchase and settlement process, it is recommended not to focus on improving the efficiency of fund usage, and it cannot be ensured that the funds will arrive in the account on time. Generally speaking, the time required for cross-border payment is between 3-7 working days, while the time required for stock transaction is within 2-3 working days. Such a long waiting time not only seriously affects the capital flow of enterprises, but also increases a huge amount of time cost and formality fees.

Although SWIFT has become the go-to for cross-border payments, it has many shortcomings, such as security, reliability and potential risks. For example, fees for international transfer payments can be quite expensive on the network, sometimes as high as 7 percent; Wire transfers must be facilitated by multiple banks, including payment agencies, central banks, agencies and collection agencies. Each institution has its own unique financial management system to complete the payment of funds in a short period of time; As the cost of bank supervision keeps climbing, cross-border payment processes become more complex and involve more information data. Therefore, to achieve this goal, it is necessary to have stronger technical capabilities and sufficient financial support [95].

With the continuous development of the Rubik platform, remittance institutions, foreign exchange market makers and remittance institutions are all incorporated into it, forming a complete payment system, which enables the synchronization of transaction initiation and settlement, greatly improving the efficiency and security of transactions, as shown in Figure 3.5 [96]. By adopting this technology, the cross-border remittance business can be greatly simplified. It can not only effectively avoid the complex reconciliation process, but also reduce the transfer cost, greatly improve the security of cross-border remittance, but also greatly accelerate the speed of settlement and clearing, and it only takes 8 seconds to achieve efficient cross-border payment. Using blockchain technology, it is recommended to quickly and accurately update distributed records within 24 hours. The Rubik platform will completely replace the traditional intermediary mechanism. The Rubik platform provides a more flexible, efficient and economical financing channel for enterprises.

The Rubik platform's digital currency technology greatly simplifies the transaction process, allowing consumers to complete instant and accurate transactions online instead of having to go through complicated banking procedures [168]. By using cross-border payment technology, enterprises can easily complete transactions, greatly reducing transaction costs, while also greatly improving the efficiency of using funds.

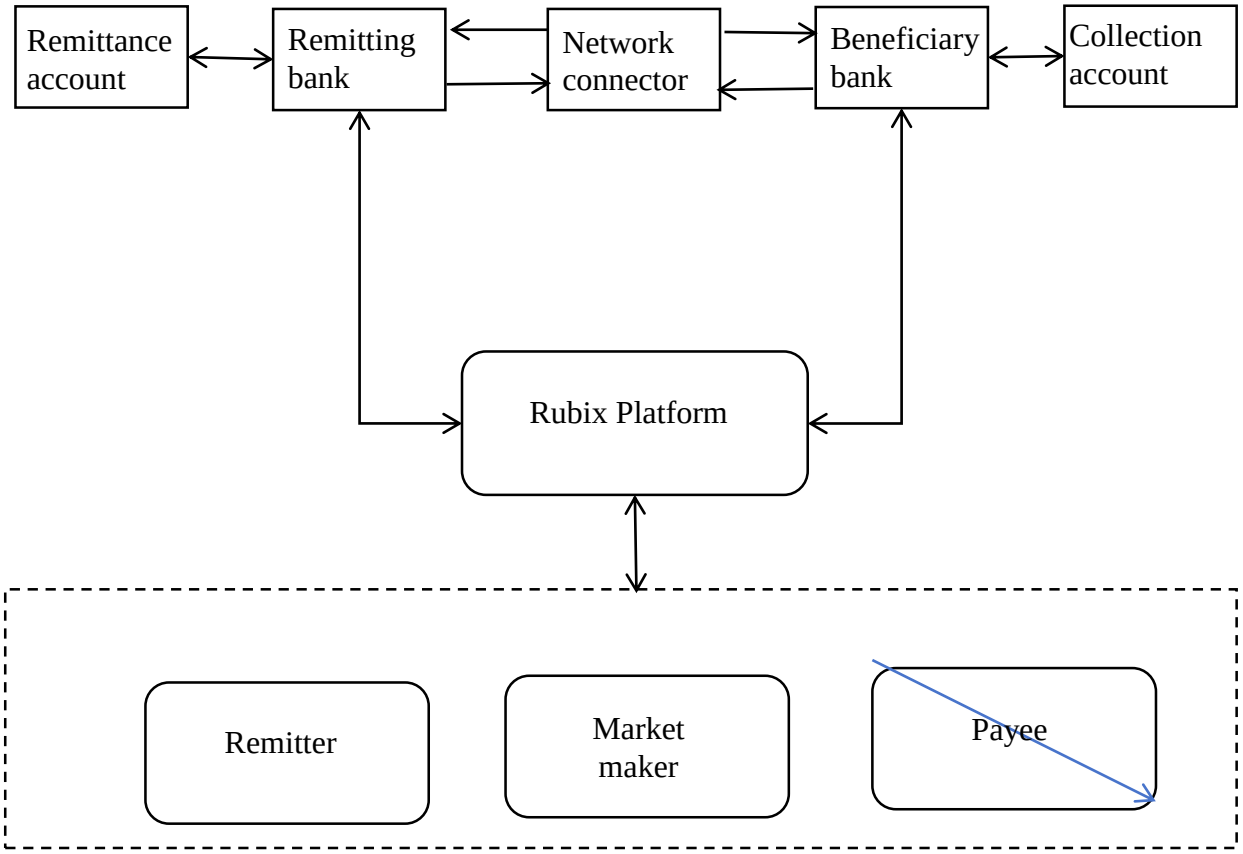


Fig. 3.5. Flow chart of cross-border payment

Source: systematized by the author

Rubik platform represents a great progress in the field of cross-border payments, and provides a more efficient, safer and more cost-effective alternative to traditional way. By further enhancing its security, expanding its global influence and popularizing blockchain technology, the platform can continue to promote innovation and provide greater value to its users. These suggestions aim to take advantage of the existing advantages of the platform, meet the main challenges, ensuring its long-term success and contribute to the development of the global financial system.

3.3 Efficiency for the implementation of blockchain technology in accounting

Using blockchain technology, the internal and external information systems of the enterprise have been effectively integrated, so that the financial accounting system can operate independently without any manual intervention, and overcome the limitation of authorization and centralization of ERP system. Through blockchain technology, transaction data can be updated, transmitted and stored in real time, so as to realize automatic connection and information transfer between enterprises. At the same time, it can also realize automatic certificate making and bookkeeping, so as to effectively trace the occurrence of events without manual intervention in the setting of approval authority.

By applying blockchain technology, enterprises can set up their own virtual networks and use unified social credit codes and digital certificates to effectively manage personal information and ensure its security. By adopting a complete business record block based on trust and consensus with digital signature function,it is recommended to control the electronic invoice system more efficiently, enable it to automatically execute the billing process, and at the same time collect a large amount of relevant data. In addition, it is advisable to connect these business record blocks and connect them to the original vouchers. By converting the external accounting original vouchers into vouchers in the blockchain system, the automatic bookkeeping review under the financial sharing mode can be realized to improve the efficiency and accuracy of financial management [65]. Due to the widespread use of blockchain technology, many originally tedious business processes have become more convenient, resulting in the loss of many original documents.Using blockchain technology, the financial department can realize the comprehensive control of inventory, according to the predetermined category and number, create an exclusive account book, so that all kinds of inventory can be recorded separately, and build a complete inventory. Warehouse managers should accurately record the number of items received on a daily basis in order to effectively control inventory. After the

transaction is completed, the tax authority will provide the corresponding invoice, which will be comprehensively managed by our finance department to ensure the accuracy of all data, records and logistics information. «Using blockchain technology, it is advisable to check and count inventory online, which can greatly simplify the process between departments and reduce the cost of inventory management» [24]. Different from the traditional accounting mode, blockchain technology makes a transaction can be carried out between two or more parties through distributed bookkeeping, thus greatly simplifying the bookkeeping process, not only can improve the efficiency of accounting, but also can ensure the accuracy of information, so as to reduce the enterprise's human and material input, and thus reduce the accounting cost of enterprises.

The adoption of distributed accounting can simplify the process. Using blockchain technology to realize point-to-point and region-to-region transactions can not only effectively reduce complex steps, but also greatly shorten the approval cycle and greatly improve the efficiency of accounting work. It is easy to check the authenticity by using distributed bookkeeping. By introducing blockchain technology, accounting can be automated, which greatly improves the accuracy of accounting information, and can effectively avoid the difference between objectivity and subjectivity caused by human operation. Taking this approach can greatly reduce the risk of financial errors, and can reduce the fraudulent behavior of financial personnel.The use of distributed ledger makes the data more secure and reliable. With the popularization of blockchain technology, participants can easily obtain information about various economic activities, which is open and transparent, and can be tracked in real time, so as to ensure the authenticity and integrity of data. Distributed ledger is compatible. By adopting distributed ledger technology, blockchain can connect businesses, tax authorities and consumers more effectively, thus avoiding collusion and information tampering among them. «In a blockchain system, the verification information of each node and user is unique, so anyone who wants to enter the system must be authenticated by multiple parties before being allowed to enter» [83]. By using distributed ledger, it is advisable to more accurately

reflect the real financial information.Based on the above analysis, this dissertation proposes the following assumptions.

H: Under certain other conditions, blockchain technology can help improve the efficiency of accounting work.

In this dissertation, the sample data is selected from 2013 to 2023, when the blockchain technology was introduced into the accounting work. On the basis of the initial samples, the samples with missing relevant data were eliminated, and finally the annual observation values of 1598 companies were obtained. Using Stata 17 to analyze the annual report of listed companies, the company's financial data comes from CSMAR database.

1. **Explained variables:** Efficiency improvement in enterprises should consider changes in both income and total assets. The ratio of income to assets indicates asset utilization efficiency, reflecting actual operational efficiency. Total asset turnover rate signifies the turnover of all assets within a specific period, crucial for analyzing factors affecting asset turnover. This study uses total asset turnover rate as a metric to evaluate the efficacy of blockchain technology in accounting. Pierre Du Pont and Donald from the American Du Pont Company developed the Du Pont Financial Analysis System through thorough research [194]. Efficient integration of financial research indicators was ensured through comprehensive research and layer-by-layer decomposition of ROE. The system primarily focuses on return on equity, breaking it down into net sales rate, total assets turnover rate, and equity multiplier. By decomposing various indicators, an indicator subsystem is developed to assess a company's solvency, asset operation ability, and profitability. This addresses the weak correlation of traditional ratio research, organizing scattered financial indicators into a cohesive system, and initiating comprehensive research. This study adopts the DuPont analysis method to calculate the total assets turnover rate, which signifies the management quality and efficiency in utilizing all assets. A higher ratio indicates better operational efficiency, while a lower ratio suggests inefficiency in asset utilization.

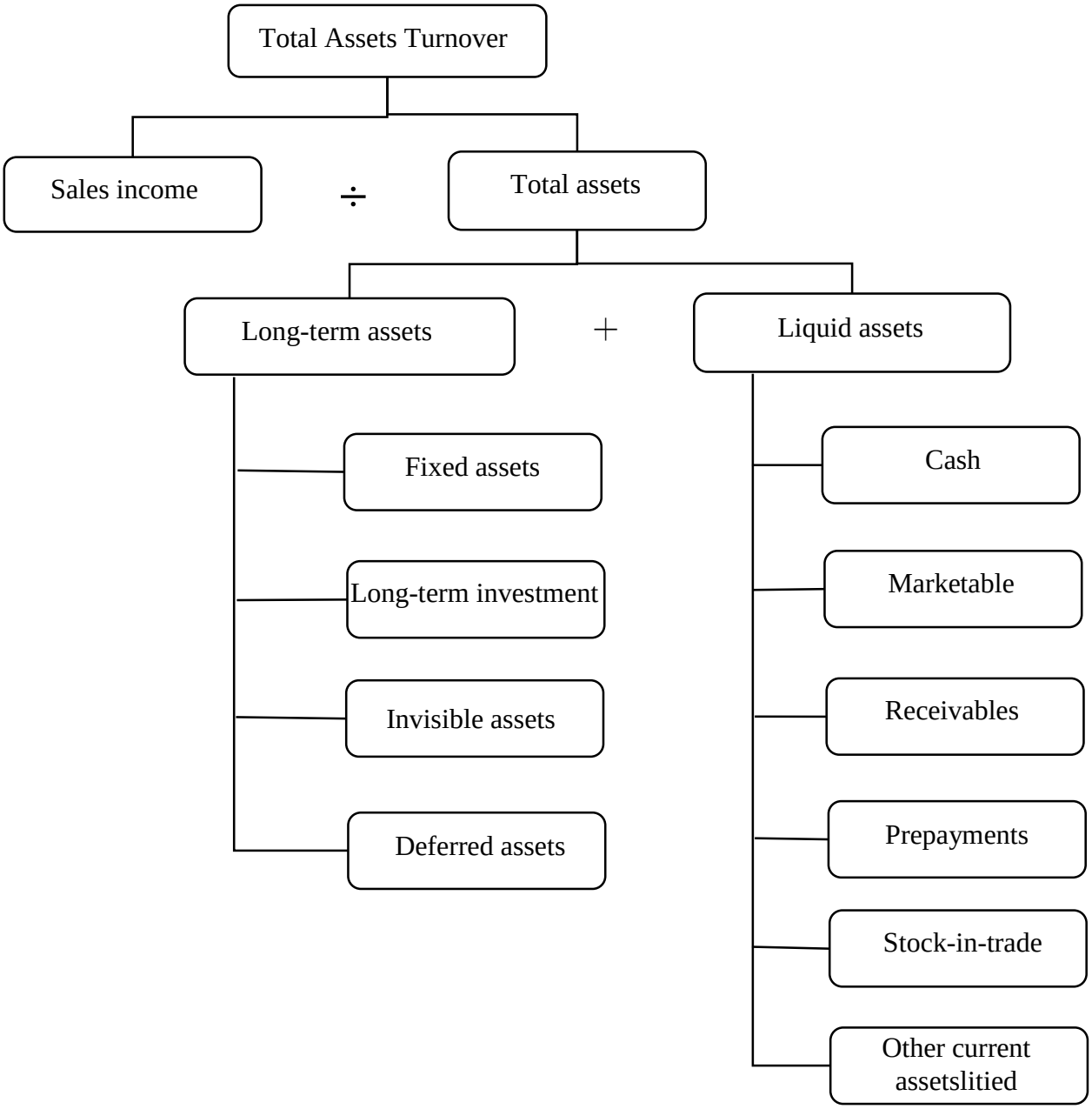


Fig. 3.6. Calculation formula of total assets turnover rate in DuPont analysis model diagram

Source: systematized by the author

2. Explanatory variables: the application effect of blockchain technology in accounting is hard to measure. Therefore, whether blockchain technology is applied in accounting is selected as a dummy variable, the year when blockchain technology is not introduced in accounting is recorded as 0, and the year when blockchain technology is introduced in accounting is recorded as 1, which is used as the

explanatory variable of the study. The total assets turnover rate is used as the explanatory variable.

3. Control variables: The capital structure represents the composition and proportion of various types of capital within a company, influencing its financing mix at a given time. It mirrors the capital makeup of a firm, with the balance between debt and equity significantly impacting capital expenses. This balance ultimately shapes a company's ability to repay debts, secure refinancing, and enhance future profitability, thereby influencing its overall worth. While an optimal debt ratio can enhance a firm's value and mitigate agency expenses, unfavorable debt ratios may escalate capital expenses or lead to missed investment prospects, hindering overall performance improvement.Enterprise scale reflects production materials, products, and labor concentration. Larger enterprises generally have greater value and can achieve economies of scale. However, the impact of enterprise scale varies across industries and properties. The net profit rate of total assets relies on enterprises' capacity to increase sales revenue and cut costs, assessing profit generation through sales. A higher ratio indicates enhanced profit-making ability via sales expansion. This study includes asset-liability ratio, current debt ratio, company size, and net profit margin of total assets as control variables.

See Table 3.5 below for details of specific variable indicators.

It is recommeded to study the influence of blockchain technology on accounting efficiency. In order to verify the research hypothesis, the following model are established.

$$TAT_{it}= \alpha_0+ \alpha_1 Blockchain_{it}+ \alpha_2 Control+\theta_i +\mu_j +\varepsilon_{it} \quad (3.1)$$

«In which: I and T represent the enterprise and year respectively, and TAT is the total assets turnover rate; Corporate; Blockchain measures whether an enterprise use blockchain technology in accounting. Controls are groups of control variables, including：Rate of Return on Total Assets（ROA), Company size（Size), debt to asset ratio（ALR), current debt ratio（CAR)» [201].

Table 3.5

Variable design table

Variable type	Variable name	Variable symbol	Variable declaration
Explained variable	Total Assets Turnover	TAT	«Use the total asset turnover rate as a measure of the application efficiency of blockchain technology in accounting work» [187]
Explanatory variable	Whether to use blockchain virtual variables in accounting work	Blockchain	«The year in which the sample enterprises use blockchain technology in accounting is recorded as 1, and the year in which blockchain technology is not used is 0» [194]
Control variable	Rate of Return on Total Assets	ROA	«The ratio of the total net profit of an enterprise to the average total assets of an enterprise» [197]
	Company size	Size	«Average total assets of enterprises in the current year» [213]
	Debt to asset ratio	ALR	«When the annual report lists the ratio of total liabilities to total assets» [201]
	Current debt ratio	CAR	«Proportion of current liabilities to total liabilities in the current year» [199]

Source: calculated by the author

According to the research hypothesis, this dissertation predicts that α_1 is significantly positive, that is, the more blockchain technology enterprises use in accounting work, the higher the efficiency of accounting work.

Table 3.6 is the descriptive statistical results of the main variables in this article.

Table 3.6

Descriptive statistics of the sample

Variable	Obs	Mean	Std. Dev.	Min	Max
TAT	1598	0.66	0.46	.009	3.18
Blockchain	1598	0.21	0.408	0	1
ROA	1598	0.052	0.097	-1.748	0.664
Size	1598	21.962	1.424	16.837	26.77
ALR	1598	0.374	0.22	0.02	2.471
CAR	1598	0.857	0.145	0.176	1

Source: calculated by the author

As can be seen from Table 3.6, the standard deviation of total assets turnover rate is 0.46, which is relatively small, indicating that the total assets turnover rate of listed manufacturing companies changed relatively smoothly from 2013 to 2023.

However, the minimum value of the total assets turnover rate is 0.009, and the maximum value is 3.18, which is quite different, indicating that there are still some gaps and changes in the total assets turnover rate of different companies in the past decade. The standard deviation of the virtual variable of blockchain is 0.408, which is relatively small, which indicates that there is a certain gap between the years when sample enterprises did not use blockchain technology in their accounting work from 2013 to 2023 and the years when they used blockchain technology in their accounting work. The total assets, net profit, company size, asset-liability ratio and current debt ratio of sample companies fluctuate relatively smoothly. Listed companies are supervised by securities regulatory agencies and need to abide by stricter regulations on financial disclosure and information disclosure, which makes listed companies more standardized and stable in financial management and business decision-making. At the same time, listed companies' financial status, operating conditions and other information will be more open and transparent, and investors and partners will be more likely to obtain relevant information about the company, which will help to enhance the credibility and stability of the company. Therefore, the selection of data in this dissertation is conducive to the experimental comparison, and the research hypothesis in this dissertation has certain practical significance.

Through the correlation analysis of the explained variables, explanatory variables and control variables, the research hypothesis is preliminarily judged. Table 3.7 shows the correlation analysis of the main variables.

Table 3.7

Correlation analysis of main variables

Variables	(TAT)	(Blockchain)	(ROA)	(Size)	(ALR)	(CAR)
TAT	1.000					
Blockchain	0.051**	1.000				
ROA	0.111***	-0.073***	1.000			
Size	0.162***	0.088***	-0.052**	1.000		
ALR	0.177***	-0.023	-0.393***	0.346***	1.000	
CAR	0.147***	-0.085***	0.125***	-0.279***	-0.204***	1.000
*** p<0.01, ** p<0.05, * p<0.1						

Source: calculated by the author

From the table, it is evident that the virtual variable of blockchain shows a positive correlation with the total asset turnover rate. This suggests that blockchain technology contributes to enhancing the efficiency of accounting tasks, thereby providing preliminary support for the hypothesis of this thesis. Additionally, there is a notable positive relationship between the total asset net profit margin, firm size, current liability ratio, asset-liability ratio, and total asset turnover rate.

4.Benchmark regression: Table 3.8 shows the regression results of blockchain technology's influence on accounting. Model 1 is the regression result without considering the control variables and fixed effects, and model 2 is a two-way fixed effect with increased control variables but controlling regions and years. The results show that the blockchain technology is significant at the level of 1% regardless of whether the fixed effect of provinces, years and control variables is introduced, so the model results are effective and reliable.

First of all, this dissertation chooses the turnover rate of total assets as a measure of accounting. From the regression results, it can be seen that the total assets turnover coefficient is significantly positive, and the coefficient is relatively large, indicating that after the introduction of blockchain technology in accounting work, its technical advantages have brought positive effects on enterprise accounting work and substantial benefits to enterprises. Sharma Asha pointed out that the three-type bookkeeping method under blockchain technology can eliminate the need for trusted intermediaries in enterprises transaction, simplify the accounting process and improve the accounting efficiency.

Huey Lin Lee proposed that transactional real estate under blockchain technology has a more streamlined and accurate accounting process, and changes in accounting data can be quickly reflected. PRNewswire has developed a financial software which combines blockchain technology. It will use distributed ledger technology to create an accounting system for real-time recording and sharing ledger, which will greatly improve the accounting efficiency. The blockchain dummy variable and total assets turnover rate are significantly positive at the level of 1%, which indicates that the improvement of blockchain dummy variable will promote

total assets turnover rate, that is, blockchain technology will help improve the accounting efficiency, and blockchain technology will improve the accounting efficiency by 0.156 percentage points per unit, which verifies the hypothesis of this dissertation. To sum up, blockchain technology is conducive to the development of accounting work to a certain extent, so assume that H is established.

Secondly, the regression results of net profit margin of total assets, asset-liability ratio and current debt ratio are also very significant. The company's scale coefficient is 0.042, which is significantly negative at the level of 5%, indicating that the growth of company's scale will reduce the total asset turnover. With the growth of the company's scale, management may face more complicated business operations and decisions, which may lead to the decline of operational efficiency. At the same time, with the growth of the company's scale, it may take more time to develop new markets, new products or new customer groups, which may lead to the extension of the sales cycle and thus reducing the total asset turnover rate.

Asset-liability ratio is positively correlated with the total assets turnover rate at the level of 1%, indicating that the increase of asset-liability ratio will promote the increase of total assets turnover rate, and the total assets turnover rate will increase by 0.397 percentage points for each unit of asset-liability ratio increase. By increasing the asset-liability ratio, the company can borrow more money to invest in business activities or asset improvement projects, and improve the efficiency of asset utilization. This will help to speed up the asset turnover rate, thereby improving the total asset turnover rate. In addition, increasing the asset-liability ratio may mean that enterprises are more inclined to use external funds to support business operations than to rely on internal funds. This may prompt the company to pay more attention to the improvement of operational efficiency, so as to ensure timely repayment of debts and interest, thereby promoting faster asset turnover.

Finally, the R square of the bidirectional fixed model is 0.080. Although the fitting value is average, the P value of the double fixed effect is significant, so hypothesis can be accurately verified: under other conditions, blockchain technology is helpful to improve accounting efficiency.

Table 3.8

Fixed effect regression result

	(1)	(2)
VARIABLES	TAT	TAT
Blockchain	0.138***	0.156***
	(5.431)	(6.275)
ROA		0.494***
		(4.441)
Size		-0.042**
		(-2.084)
ALR		0.379***
		(5.478)
CAR		0.555***
		(6.800)
Constant	0.728***	0.931**
	(18.287)	(2.125)
Observations	1,598	1,598
R-squared	0.029	0.080
Number of id	182	182
ID	YES	YES
YEAR	YES	YES
F	3.253	7.167

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: calculated by the author

Because there may be causality between the explained variables and other variables, the regression results are not robust enough, so this dissertation adopts the method of putting the explained variables in front of a period to test the robustness. It can be seen from the table that there is still a significant positive correlation between the block dummy variable and the total asset turnover rate after the explanatory variable are put forward for a period, which further verifies the hypothesis as shown in Table 3.9.

Table 3.9

Robustness test results of the first period of the explained variable

	(1)	(2)
VARIABLES	TATt+1	TAT t+1
Blockchain	0.069**	0.072**
	(2.244)	(2.348)
ROA		-0.168
		(-1.344)
Size		-0.017
		(-0.710)
ALR		0.201**
		(2.437)
CAR		0.318***
		(3.403)
Constant	0.721***	0.719
	(17.545)	(1.433)
Observations	1,416	1,416
R-squared	0.012	0.030
Number of id	173	173
ID	YES	YES
YEAR	YES	YES
F	1.281	2.361

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: calculated by the author

In order to eliminate the influence of particularity on the results during the epidemic period, this dissertation further tests the robustness by eliminating outliers, as shown in Table 3.10. The data from 2020 to 2023 are excluded, and the fixed effect regression is conducted. As can be seen from the table, after excluding abnormal values, there is still a positive correlation between block dummy variables and total assets turnover rate at the level of 1%, which verifies the assumption. To sum up, the conclusion remains unchanged after two different tests, which shows that

the model in this dissertation is robust and has passed the test. Blockchain technology helps to improve the efficiency of accounting.

Table 3.10

Robustness test

	(1)	(2)
VARIABLES	TAT	TAT
Blockchain	0.224***	0.209***
	(5.876)	(5.596)
ROA		0.275*
		(1.885)
Size		-0.047*
		(-1.845)
ALR		0.440***
		(4.961)
CAR		0.608***
		(5.896)
Constant	0.720***	0.981*
	(19.131)	(1.772)
Observations	1,084	1,084
R-squared	0.044	0.098
Number of id	152	152
ID	YES	YES
YEAR	YES	YES
F	4.265	7.143

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: calculated by the author

Based on the panel data of 1598 companies in World from 2013 to 2023, a two-way fixed effect model is constructed to measure the impact of blockchain technology on accounting results, and the following conclusions are drawn.

So, from 2013 to 2023, the turnover rate of total assets of manufacturing listed companies was relatively stable, but there are certain gaps and changes among different companies. The standard deviation of the virtual variables of blockchain is relatively small, which indicates that there is a gap between the years when the sample enterprises used blockchain technology in accounting and the years when they

did not use it. The fluctuation of other controlled variables are relatively stable. Blockchain, a virtual variable, has a significant positive correlation with the turnover rate of total assets, which preliminarily verifies the hypothesis. At the same time, the control variables is also positively related to the total asset turnover rate. It was found that the total asset turnover rate has been significantly improved after the introduction of blockchain technology in accounting work. This means that blockchain technology can simplify the accounting process and improve the accounting efficiency, thus bringing considerable benefits. At the same time, the analysis of control variables also show that the growth of company scale may reduce the total asset turnover rate, while the increase of asset-liability ratio will promote the total asset turnover rate. Therefore, the research results of this dissertation verify the positive role of blockchain technology in accounting work, which has certain practical significance for enterprise accounting work.

The regression results of this dissertation show that the influence of blockchain technology on accounting is at a significant level of 1%, regardless of whether control variables and fixed effects are introduced. Therefore, the model results support the hypothesis, indicating that blockchain technology has a positive impact on the efficiency of accounting work.

Conclusions to the Chapter 3

The accounting treatment of electronic money and cryptocurrencies remains a complex and debated issue, with various opinions regarding their classification and asset measurement. The unique features of blockchain technology, such as decentralization and immutability, further complicate the accounting processes associated with electronic money and cryptocurrencies. This dissertation underscores the need for standardized accounting practices and the potential for future developments in this area, including the establishment of a dedicated accounting account for transactions involving cryptocurrencies.

Blockchain technology holds significant promise for improving the efficiency

and security of accounting for transactions with counterparties. By decoupling consensus mechanisms from transactional processes, blockchain can enhance system performance and reliability, thereby reducing the risks inherent in traditional settlement methods. This research emphasizes the practical benefits of blockchain in cross-border payments and settlements, demonstrating its potential to reduce costs, speed up transaction processing, and improve data security. Although challenges such as the need for standardized industry regulations and comprehensive legal frameworks remain, the successful integration of blockchain technology could lead to more efficient and secure accounting practices.

Moreover, the incorporation of blockchain technology into accounting systems has proven to significantly improve the efficiency of accounting procedures. By integrating with enterprise information systems, blockchain enables real-time updates, automatic document generation, and enhanced data security. The research indicates that blockchain technology can reduce operational costs and increase the accuracy of financial reporting, making it a crucial tool for modern accounting practices. The empirical analysis confirms that blockchain positively impacts accounting efficiency, as evidenced by a marked improvement in the total assets turnover ratio.

The results and proposals presented in the third chapter of the dissertation have been published in [133; 135; 136; 143]

CONCLUSIONS

In the contemporary business landscape, the integration of advanced technologies into traditional practices has become imperative for enhancing efficiency and accuracy. The digital economy and blockchain technology have emerged as significant drivers of transformation, particularly in the field of accounting. The following discussion explores the impact of these technologies on accounting practices, highlighting their potential to revolutionize various aspects of financial management.

1. The concept of the digital economy emerged alongside the development of the global Internet network, which led to the generation of vast volumes of data and advancements in technologies for their processing and analysis. Since accounting is the primary generator of economic information, the digitalization of the economy has caused substantial changes in both the theory and practice of accounting. The digital economy has transformed accounting through the use of information technologies such as cloud computing, robotic process automation, and blockchain, which have optimized the efficiency of data storage and processing, enabled real-time collaboration, and facilitated remote access to financial information. –

2. Furthermore, the influence of advanced information technologies – Big Data, blockchain, artificial intelligence, mobile Internet, cloud computing, and the Internet of Things (IoT) – has enhanced electronic communication, automation, data-driven decision-making, and the transparency of accounting information. The progressive development of these technologies and methodologies for their application in accounting has triggered an evolution of the accounting system – from informatization to intellectualization – accompanied by improved cybersecurity, informational integration, and the sustainability of socio-economic processes.

3. One of the most significant foundational technologies of the modern era is blockchain, first introduced by Satoshi Nakamoto. Blockchain has revolutionized the method of recording and verifying electronic transactions. This chain-based system operates within a peer-to-peer (P2P) distributed network, ensuring the traceability and

immutability of transactional data through a combination of timestamp servers, proof-of-work consensus algorithms, asymmetric encryption, digital signatures, and decentralized networking. Blockchain comprises three core layers – data, network, and consensus – which have evolved into a seven-layer architecture including infrastructure, ledger, data consensus, smart contracts, and system governance.

4. Currently, three main types of blockchain technologies are relevant: public, consortium, and private blockchains. Their application is transforming the methodology and organization of accounting. Consortium and private blockchains, in particular, offer access control standards and authentication protocols that enhance data security, reduce fraud risks, and improve the efficiency of automated processing, making them especially valuable for digitalizing accounting operations in decentralized enterprise information environments.

Blockchain's functional capabilities – such as decentralization, immutability of records, and smart contracts – have addressed key challenges related to information asymmetry, financial fraud, and reporting errors. Its systemic impact on critical accounting elements – including entity identification, documentation, monetary valuation, recording in accounting ledgers, and reporting – has contributed to enhancing the relevance, reliability, timeliness, and objectivity of accounting information. Additionally, blockchain enhances the cybersecurity of enterprise information systems and the efficiency of automation processes.

5. Blockchain technology fundamentally transforms the management of electronic accounting documents by improving the accuracy and credibility of electronic invoice generation, while minimizing the risks of fraud and human error. The integration of blockchain ensures permanent documentation of all financial and economic operations (e.g., delivery notes, tax invoices), preserving the integrity of accounting data. The implementation of an advanced methodology for electronic document management based on blockchain's chain-structured data, with adherence to database fragmentation and recombination principles, ensures effective internal and external information exchange with counterparties. This improves the openness of document circulation while maintaining commercial confidentiality and aligning

with enterprise management interests. Moreover, encryption algorithms and distributed storage mechanisms enhance data protection by preventing unauthorized access and document tampering.

6. The integration of blockchain with cloud-based accounting has formed a powerful platform for enterprise management. Cloud accounting leverages cloud computing to deliver cost-effective and efficient accounting services, while blockchain guarantees the integrity and security of accounting data during outsourcing. This integration enables real-time financial monitoring, thereby supporting informed managerial decision-making. The practical use of blockchain for storing and processing enterprise accounting data optimizes organizational structure and minimizes operational costs. Despite existing challenges – such as the need to adapt to new virtual accounting objects and ensure scalability – the decentralized and immutable nature of blockchain overcomes the limitations of traditional cloud systems, offering a more secure and efficient solution for enterprise management.

7. Among the innovative accounting objects resulting from blockchain development are cryptocurrencies, which, from the perspective of accounting theory, can be recognized as enterprise assets. The introduction of a dedicated informational framework for recording electronic transactions enables the automation of documentation, valuation, and reporting processes related to cryptocurrencies. These may be sequentially classified as cash, cash equivalents, financial instruments, or intangible assets. The evolving treatment of cryptocurrencies in accounting reflects their progressive role in the modern digital economy and forms the basis for the creation of primary electronic documents, automated journal entries, continuous transaction monitoring, and oversight by accounting and management professionals. As blockchain technology continues to develop, so too will cryptographic assets, necessitating ongoing adaptation of accounting theory and practice to accommodate electronic transactions.

8. By separating the processes of validating electronic monetary operations and cryptocurrency transactions, blockchain enhances the productivity and reliability of payment systems, while reducing risks associated with traditional settlement

methods. Its decentralized nature eliminates intermediaries, thereby reducing the time and cost associated with electronic transactions, particularly in cross-border payments. Payment platforms like "Rubik" have demonstrated the ability to streamline electronic transactions by bypassing complex banking procedures and currency conversions. Although the need for standardized industry regulations and legal frameworks remains a pressing issue, electronic transaction systems are already achieving information synchronization with specialized accounting software for digital reporting and enterprise management.

9. The implementation of blockchain technology in enterprise activities ensures optimization across all accounting processes. Notably, a study based on data from 1,598 companies revealed an increase in the total asset turnover ratio following the adoption of blockchain, indicating improved asset utilization and operational efficiency. The study employed the DuPont model to analyze the effectiveness of blockchain application in accounting by assessing return on sales, asset turnover, and equity multiplier. This approach highlighted the positive impact of digitalization on accounting processes, especially for medium and large enterprises, through simplified business operations, increased automation, and improved accuracy of financial reporting. The findings confirm blockchain’s ability to optimize both the methodology and organization of accounting, as well as enterprise performance management.

REFERENCES

1. Abdelsalam, Omneya H., Pauline Weetman. Measuring accounting disclosure in a period of complex changes: the case of Egypt. Advances in international accounting. 2007. No20. P. 75-104.

2. AICPA. Accounting for and auditing digital assets. 2020. URL: https://us.aicpa.org/content/dam/aicpa/interestareas/informationtechnology/downloadabledocuments/accounting-for-and-auditing-of-digital-assets.pdf.

3. Akhter, Aziza, Reajmin Sultana. Sustainability of accounting profession at the age of fourth industrial revolution. International journal of Accounting and Financial reporting. 2018. No. 8.4. P. 139.

4. Al-Aidrous, Al-Hussein Mohammed Hassan, et al. Critical factors influencing inventory and procurement system of infrastructure projects. Journal of Civil Engineering and Management. 2022. No. 28.8. P. 634-645. URL: https://journals.vilniustech.lt/index.php/JCEM/article/view/16681/11099.

5. Almansour, Haneen Mansour, Mahmoud Ismail. RESOLVING BUSINESS CONFLICTS UNDER ARBITRATION PROCEDURES AT THE INTERNATIONAL CHAMBER OF COMMERCE. Corporate Law & Governance Review. 2024. No. 6.2.

6. Alexandersson A, Jansson A, Jonnergård K. Digitalization of Bookkeeping in Small Organizations: The Case of Sweden[M]//Handbook of Big Data and Analytics in Accounting and Auditing. Singapore: Springer Nature Singapore, 2023: 133-162.

7. Appelbaum, Deniz, et al. Impact of business analytics and enterprise systems on managerial accounting. International journal of accounting information systems.2017.No. 25. P. 29-44.

8. Applying IFRS accounting by holders of crypto assets. 2021. URL: https://www.ey.com/en_gl/ifrs-technical-resources/accounting-byholders-of-cryptoassets-updated-october-2021.

9. Atkinson, Robert D., Andrew S. McKay. Digital prosperity: understanding the economic benefits of the information technology revolution. 2007. URL:

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1004516.

10. Aujara, Shamsuddeen Musa. Documentary Letter of Credit Discrepancy and Risk Management in the Nigerian Crude Oil Export. Diss. University of Central Lancashire, 2019. URL: https://clok.uclan.ac.uk/30886/.

11. Australian Accounting Standards Board. Digital currency-A case for standard setting activity. A Perspective by the Australian Accounting Standards Board. 2016. URL: https://www.aasb.gov.au/admin/file/content102/c3/AASB_ASAF_DigitalCurrency.

12. Awasthi, Rajul, Michael Engelschalk. Taxation and the shadow economy: how the tax system can stimulate and enforce the formalization of business activities. World Bank Policy Research Working dissertation 8391. 2018. URL: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3153229.

13. Bagege, Medani, Nyanjige Mayala, Amembah A. Lamu Amos. Effects of Computerized Accounting Procedures on the Quality of Financial Reporting of Crop Boards in Kilimanjaro. International Journal of Business Management Research. 2024. No. 12.3. P. 66-74. URL: https://www.ijef.latticescipub.com/wp-content/uploads/papers/v4i2/B258404021124.

14. Ball, Ray. Infrastructure requirements for an economically efficient system of public financial reporting and disclosure. Brookings-Wharton papers on financial services. 2001. No.1. P. 127-169. URL: https://muse.jhu.edu/pub/11/article/26629/summary.

15. Ballou, Brian, Dan L. Heitger, Dale Stoel. Data-driven decision-making and its impact on accounting undergraduate curriculum. Journal of Accounting Education. 2018. No. 44. P. 14-24.

16. Baker R, Rennie M D. The creation and acceptance of public sector accounting standards in Canada. Accounting History. 2018. No3. P. 407-432. URL: https://journals.sagepub.com/doi/full/10.1177/1032373217748949

17. Ballwieser, Wolfgang. DEVELOPMENT OF ACCOUNTING AND FINANCIAL REPORTING LAW. Global History of Accounting, Financial Reporting and Public Policy: Europe. 2010. No.14. P. 59-88. URL:

18. Bassellier, Genevieve, Izak Benbasat. Business competence of information technology professionals: Conceptual development and influence on IT-business partnerships. MIS quarterly. 2004. P. 673-694.

19. Basu, Gautam. Concealment, corruption, and evasion: A transaction cost and case analysis of illicit supply chain activity. Journal of Transportation Security 7 2014. P. 209-226.

20. Beatty, Anne, Scott Liao. Financial accounting in the banking industry: A review of the empirical literature. Journal of accounting and Economics. 2014. P. 339-383.

21. Bellucci Marco, Cesa Bianchi Damiano, Manetti Giacomo. Blockchain in Accounting Practice and Research: Systematic Literature Review. Meditari Accountancy Research. 2022. №. 30. P. 121-146. URL: https://doi.org/10.1108/MEDAR-10-2021-1477.

22. Belke, Ansgar, Edoardo Beretta. From cash to central bank digital currencies and cryptocurrencies: a balancing act between modernity and monetary stability. Journal of Economic Studies. 2020. P. 911-938.

23. Beom-Soo, Hyun, Doh Deog-Hee. Visualization Techniques for Marine Engineering Research. Journal of the Korean Society of Visualization. 2003. No2. P. 3-12. URL: https://koreascience.kr/article/JAKO200302612875803.pdf

24. Bevis, Herman W. The accounting function in economic progress. Journal of Accountancy (pre-1986). 1958. URL: https://www.proquest.com/openview/ebc428bc8162ad21e1b48a6dc5b9d1f6/1.pdf?pq-origsite=gscholar&cbl=41064

25. Bhattarai, Narayan. Migrant Entrepreneurs and the Digital Economy in the UK. Royal Holloway, University of London. 2020. URL: https://pure.royalholloway.ac.uk/ws/files/40200086/2020bhattarainphd.pdf

26. Bhimani, Alnoor, Leslie Willcocks. Digitisation, ‘Big Data'and the transformation of accounting information. Accounting and business research. 2014. P. 469-490.

27. Blakely, Edward James. CRAFTINGINNOVATIVEPLACES for Australia's

KnowledgeEconomyForeword by Peter NewmanEDWARD. 2019.

28. Bolanowski, Marek, Andrzej Paszkiewicz, Andrzej Kraska. Integration of the elements of a distributed IT system with a computer network core using island topology. Enterprise Information Systems. 2021. P. 1354-1375.

29. Bonson E., Bednarova M. Blockchain and its Implications for Accounting and Auditing. Meditari Accountancy Research. 2019. №. 5. P. 725‑740.

30. Bose S, Dey S K, Bhattacharjee S. Big data, data analytics and artificial intelligence in accounting: An overview. Handbook of big data research methods. 2023. P. 32-51.

31. Buckley, Ross P. Implications for the Dollar of Central Bank Digital Currencies. UNSW Law Research. 2024. P. 24-6. URL: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4762368

32. Bukht, Rumana, Richard Heeks. Defining, conceptualising and measuring the digital economy. Development Informatics working dissertation. 2017. No68. URL: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3431732

33. Bushman, Robert M., Abbie J. Smith. Transparency, financial accounting information, and corporate governance. Financial accounting information, and corporate governance. Economic Policy Review. 2003. No1. URL: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=795547

34. Calvaresi, Davide, et al. The good, the bad, and the ethical implications of bridging blockchain and multi-agent systems. Information. 2019. No12. P. 363.URL: https://www.mdpi.com/2078-2489/10/12/363

35. Campos, Marcio Augusto Pereira da Silva. Digital economy and international taxation: the digital revolution and its impact on the discourse of international tax law. 2022. URL: https://theses.hal.science/tel-03697116v1/document

36. Canada Securities Administrators (CSA). CSA Comment Letter Response to IFRS Interpretation Committee Tentative Agenda Decision- Holdings of Cryptocurrencies. 2019. URL: https://www.securitiesadministrators.ca/uploadedFiles/General/pdfs/LECAC_Crypto

currency_HoldingsTADResponse.pdf.

37. Carlsson, Bo. The Digital Economy: what is new and what is not?. Structural change and economic dynamics. 2004. P. 245-264.

38. Centobelli Piera, Cerchione Roberto, Del Vecchio Pasquale, Oropallo Eugenio, Secundo Giustina. Blockchain Technology Design in Accounting: Game changer to tackle fraud or technological fairy tale?. Accounting, Auditing & Accountability Journal. ahead-of-print. 2021. URL: https://doi.org/10.1108/AAAJ-10-2020-4994.

39. Chen, Jiani. Strategic Financial Management: The Symbiosis of Accounting and Decision-Making in the Digital Age. 2024 International Conference on Applied Economics, Management Science and Social Development (AEMSS 2024). Atlantis Press. 2024. URL: https://www.atlantis-press.com/proceedings/aemss-24/126000254

40. Cheng, Long, Fang Liu, Danfeng Yao. Enterprise data breach: causes, challenges, prevention, and future directions. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery. 2017. URL: https://wires.onlinelibrary.wiley.com/doi/epdf/10.1002/widm.1211

41. Chou, Chi-Chun, et al. Using smart contracts to establish decentralized accounting contracts: An example of revenue recognition. Journal of Information Systems. 2021. P. 17-52.

42. Chua, Wai Fong, Habib Mahama. The effect of network ties on accounting controls in a supply alliance: Field study evidence. Contemporary Accounting Research. 2007. P. 47-86.

43. Chowdhury Emon, Stasi Alessandro, Pellegrino Alfonso. Blockchain Technology in Financial Accounting: Emerging Regulatory Issues. Review of Financial Economics. 2023. №. 21. P. 862-868. URL: https://doi.org/10.55365/1923.x2023.21.94.

44. Cortes, Gustavo S., Lucas Argentieri Mariani, and Vinicios P. Sant'Anna. Unleashing International Trade Through Financial Integration: Evidence from a Cross Border Payment System. Economic Research Southern Africa, 2024. URL: https://ersawps.org/index.php/working-paper-series/article/view/27/12

45. Crede, Andreas. Electronic commerce and the banking industry: the requirement and opportunities for new payment systems using the Internet. Journal of Computer-Mediated Communication.1995.

46. Crook, Richard, James Manor. Democratic decentralization. Making Development Work. Routledge. 2018. P. 83-104.

47. Da Xu, Li. Enterprise systems: state-of-the-art and future trends. IEEE transactions on industrial informatics. 2011. P. 630-640.

48. Dąbrowski, Marcin. EU cohesion policy, horizontal partnership and the patterns of sub-national governance: Insights from Central and Eastern Europe. European Urban and Regional Studies. 2014. P. 364-383.

49. Dashkevich N, Counsell S, Destefanis G. Blockchain financial statements: Innovating financial reporting, accounting, and liquidity management. Future Internet. 2024. No16. P. 244. URL: https://www.mdpi.com/1999-5903/16/7/244

50. Dai J., Vasarhelyi M. A. Toward Blockchain-based Accounting and Assurance. Journal of Information Systems. 2017. Vol. 31, No. 3. P. 5‑21. URL: http://dx.doi.org/10.2308/isys-51804.

51. Davis, Donna F., and John T. Mentzer. «Organizational factors in sales forecasting management.» International Journal of Forecasting. 2007. P. 475-495.

52. De Andrade Simões, Maervelym Pâmella, et al. Benefits of using Blockchain technology as an accounting auditing instrument. REVISTA AMBIENTE CONTÁBIL-Universidade Federal do Rio Grande do Norte-ISSN 2176-9036. 2021.URL: https://periodicos.ufrn.br/ambiente/article/view/23626/13665

53. Delias, Pavlos, Nikolaos Matsatsinis. A genetic approach for strategic resource allocation planning. Computational Management Science. 2009. No6. P. 269-280.

54. Desyatnyuk O., Muravskyi V., Shevchuk O. Oleksiiv M. Dual Use of Internet of Things Technology in Accounting Automation and Cybersecurity, 12th International Conference on Advanced Computer Information Technologies (ACIT). Spisska Kapitula. Slovakia. 2022. P. 360-363. URL: https://doi.org/10.1109/ACIT54803.2022.9913080.

55. Douglas, Tony. An investigation into the sales process practiced by Scottish-based food and drink SMEs. 2013. URL: https://napier-repository.worktribe.com/output/184125

56. Dudgikar, C. S., M. B. Kumthekar, S. R. Khot. Development of ERP module for quality management in construction industry. International Journal of Electronics and Communications (IJEC). 2012. P.29-40.

57. Dumas, Marlon, et al. Introduction to business process management. Fundamentals of business process management. 2018. P. 1-33. URL: https://link.springer.com/chapter/10.1007/978-3-662-56509-4_1

58. Emile Woolf Publishing. International financial reporting 2nd Edition. 2002. URL: https://www.emilewoolf.com/.

59. Erman, Can. Financial technologies effect on financial services from an open innovation perspective. 2017.

60. Erokhin, Vasilii, et al. Management accounting change as a sustainable economic development strategy during pre-recession and recession periods: evidence from Russia. Sustainability. 2019. No11. URL: https://www.mdpi.com/2071-1050/11/11/3139

61. Escobar C C, Roy S, Kreidl O P, et al. Toward a green blockchain: engineering merkle tree and proof of work for energy optimization. IEEE Transactions on Network and Service Management. 2022. No4. P. 3847-3857. URL: https://ieeexplore.ieee.org/abstract/document/9939185

62. Ezzamel, Mahmoud, Hugh Willmott, Frank Worthington. Manufacturing shareholder value: The role of accounting in organizational transformation. Accounting, Organizations and Society .2008. P. 107-140.

63. Fama, Eugene F. Efficient Capital Markets: a Review and Empirical Work. Journal of Finance. 1970. No25. P. 383‑417.

64. Fang, Bin, et al. Analysis of the perceived value of online tourism reviews: Influence of readability and reviewer characteristics. Tourism Management. 2016. No52. P. 498-506.

65. Fleischman, Richard, Tom McLean. Management accounting: Theory and

practice. The Routledge companion to accounting history. Routledge. 2020. P. 214-251.

66. Fogarassy C. Comparison of Rubik's Cube Solution Software with SWOT Analyses for the Input-Output Process Modelling. International Journal on Recent and Innovation Trends in Computing and Communication. 2014. No12. P. 4008-4015. URL: https://core.ac.uk/download/pdf/42934179.pdf

67. Fomina, O., Moshkovska, O., Avhustova, O., Romashko, O., & Holovina, D. Current aspects of the crypto currency recognition in Ukraine. Banks and Bank Systems. 2019. No2. P. 203-213.

68. Fortin, Mélissa. Blockchain Technology: Changes and Challenges for Accounting and Accountants. Concordia University. 2022. URL: https://spectrum.library.concordia.ca/id/eprint/991743/1/Fortin_PHD_W2023.pdf

69. Friedman, Nicola, Jarrod Ormiston. Blockchain as a sustainability-oriented innovation?: Opportunities for and resistance to Blockchain technology as a driver of sustainability in global food supply chains. Technological Forecasting and Social Change. 2022. No175. URL: https://www.sciencedirect.com/science/article/pii/S0040162521008349

70. Fu, Hsin-Pin, et al. Analysis of factors influencing hospitals' implementation of a green e-procurement system using a cloud model. International journal of environmental research and public health. 2019. No24. URL: https://www.mdpi.com/1660-4601/16/24/5137

71. Gao, Han, Botao Zhong, Lieyun Ding. A blockchain-based engineering design review service trading scheme for digital building permits. Automation in Construction. 2024. No165.

72. Gao, Jun. Analysis of enterprise financial accounting information management from the perspective of big data. International Journal of Science and Research (IJSR). 2022. P. 1272-1276.

73. Geroski, Paul A. Models of technology diffusion. Research policy. 2000. P. 603-625.

74. Gerovitch, Slava. InterNyet: why the Soviet Union did not build a

nationwide computer network. History and technology. 2008. P.335-350. URL: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=03b8e1727a668e914d46c864e24f89c7b785292d

75. Gharaibeh, Ammar, et al. Smart cities: A survey on data management, security, and enabling technologies. IEEE Communications Surveys & Tutorials. 2017. P. 2456-2501. URL: https://ieeexplore.ieee.org/abstract/document/8003273

76. Ghasemi, Maziyar, et al. The impact of Information Technology (IT) on modern accounting systems. Procedia-Social and Behavioral Sciences. 2011. No28. P. 112-116.

77. Giachetti, Ronald E. A framework to review the information integration of the enterprise. International Journal of Production Research. 2004. P. 1147-1166.

78. Godwin D R H G, Monrovia M C, Benjamin D R K J. Computerized Accounting Information System and banking System of Liberia.World Atlas Int'l Journal of Edu. & Mgt. 2019. No2.

79. Goldstone, Jack A. Efflorescences and economic growth in world history: rethinking the Rise of the West and the Industrial Revolution. Journal of world history. 2002. P. 323-389. URL: https://delong.typepad.com/efflorescences_and_economic_growth_in_world_histor.pdf

80. Gordon, Robert J. Why has economic growth slowed when innovation appears to be accelerating?. National Bureau of Economic Research. 2018. URL: https://www.nber.org/system/files/working_papers/w24554/w24554.pdf

81. Govindasamy, Chinnaraj, Arokiasamy Antonidoss. Enhanced inventory management using blockchain technology under cloud sector enabled by hybrid multi-verse with whale optimization algorithm. International Journal of Information Technology & Decision Making. 2022. P. 577-614.

82. Grabski, Severin V., Stewart A. Leech, Pamela J. Schmidt. A review of ERP research: A future agenda for accounting information systems. Journal of information systems. 2011. No1. P. 37-78.

83. Grasso, Lawrence P. Are ABC and RCA accounting systems compatible

with lean management?. Management accounting quarterly. 2005. No1. P.12.

84. Greiling, Dorathea, Katharina Spraul. Accountability and the challenges of information disclosure. Public Administration Quarterly. 2010. P. 338-377.

85. Hajkowicz, Stefan, et al. Australia's artificial intelligence ecosystem: The second update. 2023. URL: https://mpra.ub.uni-muenchen.de/121102/1/MPRA_paper_121102.pdf

86. Hamilton, Bob. Tax Administration 2021: COMPARATIVE INFORMATION ON OECD AND OTHER ADVANCED AND EMERGING ECONOMIES. Tax Administration: Comparative Information on OECD and Other Advanced and Emerging Economies.2021. P.1-228.

87. Han, Dongchu, Mianfang Liu. How does the digital economy empower green development? From the perspective of the division of labor in new classical economics. Sustainability. 2022. No23. URL: https://www.mdpi.com/2071-1050/14/23/15740

88. Han, Hongdan, et al. Accounting and auditing with blockchain technology and artificial Intelligence: A literature review. International Journal of Accounting Information Systems. 2023. No48. URL: https://www.sciencedirect.com/science/article/pii/S1467089522000501

89. Hanna, Nagy. Exploiting information technology for development. World Bank discussion paper. 1994.

90. Haoxun, Gong, Chuanchen Bi. Strategy of Cross Border E-Commerce Platform Operation Model-Case Study of Tmall Global. Technium Soc. 2023. P. 189.

91. Harpaz, Assaf. Taxation of the digital economy: Adapting a twentieth-century tax system to a twenty-first-century economy. Yale J. Int'l L.. 2021. No46. P.57.

92. Han Hongdan, Shiwakoti Radha, Jarvis Robin, Mordi Chima, Botchie David. Accounting and auditing with blockchain technology and artificial Intelligence: A literature review. International Journal of Accounting Information Systems. 2023. №. 48. 100598. URL: https://doi.org/10.1016/j.accinf.2022.100598..

93. Hayale, Talal H., Husam A. Abu Khadra. Evaluation of The Effectiveness of

Control Systems in Computerized Accounting Information Systems: An Empirical Research Applied on Jordanian Banking Sector. Journal of Accounting, Business & Management 13. 2006. P.39.

94. Haynes, Kathryn. Reflexivity and academic identity in accounting: Intersubjective reflexive identity work as a feminist academic. Accounting, Auditing & Accountability Journal. 2023. P. 1379-1395.

95. He, Wei-wei, Shao-ling He, Hai-lan Hou. Digital economy, technological innovation, and sustainable development. Plos one. 2024. URL: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0305520

96. Hekkert, Marko P., et al. Functions of innovation systems: A new approach for analysing technological change. Technological forecasting and social change. 2007. P. 413-432.

97. Helo, Petri, A. H. M. Shamsuzzoha. Real-time supply chain−A blockchain architecture for project deliveries. Robotics and Computer-Integrated Manufacturing. 2020. No63.

98. Herbert, Ian P., Will B. Seal. Shared services as a new organisational form: Some implications for management accounting. The British Accounting Review. 2012. P. 83-97. URL: https://www.researchgate.net/profile/Ian-Herbert/publication/257289665_Shared_services_as_a_new_organisational_form_Some_implications_for_management_accounting/links/5e934bf74585150839d95186/Shared-services-as-a-new-organisational-form-Some-implications-for-management-accounting.pdf

99. Hermanus, Sinoxolo Sisanda. Information system security vulnerabilities: Implications for South African financial firms in Cape Town. 2023.

100. Hla, Daw, Susan Peter Teru. Efficiency of accounting information system and performance measures. International journal of Multidisciplinary and Current research. 2015. P. 976-984.

101. Hla, Daw, Susan Peter Teru. Efficiency of accounting information system and performance measures. International journal of Multidisciplinary and Current research. 2015. P. 976-984. URL:

http://ijmcr.com/wp-content/uploads/2015/09/Paper11976-984.pdf

102. Hossain, Mohammad Ikbal, et al. Enhancing data integrity and traceability in industry cyber physical systems (ICPS) through Blockchain technology: A comprehensive approach. arxiv preprint arxiv. 2024. URL: https://arxiv.org/pdf/2405.04837

103. Hou, Heng. The application of blockchain technology in E-government in China. 2017 26th international conference on computer communication and networks (ICCCN). IEEE. 2017.

104. Huff, Howard R. From the lab to the fab: transistors to integrated circuits. AIP Conference Proceedings.American Institute of Physics. 2003. No1. URL: https://pubs.aip.org/aip/acp/article/683/1/3/1009242/From-The-Lab-to-The-Fab-Transistors-to-Integrated

105. IFRS: Accounting for crypto-assets. 2024. URL: https://eyfinancialservicesthoughtgallery.ie/ifrsaccounting-crypto-assets.

106. Imene, Friday, Japhet Imhanzenobe. Information technology and the accountant today: What has really changed?. Journal of Accounting and Taxation. 2020. P. 48-60.

107. Ito, Takatoshi. A new financial order in Asia: will a RMB bloc emerge?. Journal of International Money and Finance. 2017. No74. P. 232-257.

108. James J. Information technology and development: A new paradigm for delivering the Internet to rural areas in developing countries. Routledge. 2004.

109. Jänicke, Martin, Klaus Jacob. A third industrial revolution?. Long-term governance for social-ecological change. Routledge. 2013. P.47-70.

110. Jasim, Yaser Abdulaali, Manaf Basil Raewf. Impact of the information technology on the accounting system. Cihan University-Erbil Journal of Humanities and Social Sciences. 2020. No1. P. 50-57. URL: https://eprints.cihanuniversity.edu.iq/id/eprint/256/1/Article_CUEJHSS_05-06-2020.pdf

111. Jia, Yan. Design and Optimization of Accounting Computerization System for Small Firms. International Conference on Advances in Mechanical Engineering

and Industrial Informatics. Atlantis Press. 2015.

112. Jorgenson, Dale W. Information technology and the US economy. American Economic Review. 2001. P. 1-32.

113. Karajovic, Maria, Henry M. Kim, Marek Laskowski. Thinking outside the block: Projected phases of blockchain integration in the accounting industry. Australian Accounting Review. 2019. P. 319-330.

114. Katz, Raul, Pantelis Koutroumpis, Fernando Martin Callorda. Using a digitization index to measure the economic and social impact of digital agendas. info. 2014. P.32-44.

115. Kavanagh, Donncha, Martin Brigham. The Quakers and the Joint Stock Company: Uneasy Bedfellows. Quakers, Business and Corporate Responsibility: lessons and cases for responsible management. 2019. P. 111-128.

116. Kedah, Zulkarnain. Use of e-commerce in the world of business. Startupreneur Business Digital. SABDA Journal. 2023. P. 51-60.

117. Kee, Robert. Data processing technology and accounting: A historical perspective. Accounting Historians Journal. 1993. P.187-216. URL: https://egrove.olemiss.edu/cgi/viewcontent.cgi?article=1440&context=aah_journal

118. Key, Bill, Ralph Dickau, Bob Carlson. Mechanical seals with wavy SiC faces for a severe duty NGL/Crude pipeline application. Proceedings of the 21st International Pump Users Symposium. Texas A&M University. Turbomachinery Laboratories. 2004.

119. Khan, Neelam Saleem, et al. B-ERAC: Blockchain-Enabled Role-Based Access Control for Secure IoT Device Communication. Scalable Computing: Practice and Experience. 2024. P. 5649-5671.

120. Kobets, Dmytro. Development of Accounting: Challenges and Prospects in the Context of European Integration. Oblik i finansi. 2023. No99. P. 31-37.

121. Kravchenko Olena, Nebaba Nataliia, Aiyedogbon John. Blockchain technologies in accounting: bibliometric analysis. Accounting and Financial Control. 2023. №. 4. P. 14-29. URL: https://doi.org/10.21511/afc.04(1).2023.02.

122. Kshetri, Nir. The emerging role of Big Data in key development issues:

Opportunities, challenges, and concerns. Big Data & Society. 2014.

123. Kubota, Satoshi, Ichizou Mikami. Data model‑centered four-dimensional information management system for road maintenance. Journal of computing in civil engineering. 2013. P.497-510.

124. Laiu, Bianca, Sara Voicu. Personnel Management: Needs-oriented Recruitment Planning in Organizational Development. International Journal Papier Public Review. 2021. No1. P.1-8.

125. Lakatoș, Eugen Ștefan. 60 Years from the Invention of the Integrated Circuits. Electrotehnica, Electronica, Automatica. 2018. P. 1-9. URL: https://eea-journal.ro/ro/2018/art-2018_3-10-p072.pdf

126. Lee, David Kuo Chuen, Li Yan, Yu Wang. A global perspective on central bank digital currency. China Economic Journal . 2021. P. 52-66.

127. Li, Chan, et al. The consequences of information technology control weaknesses on management information systems: The case of Sarbanes-Oxley internal control reports. Mis Quarterly.2012. P.179-203.

128. Li, Feifeng, Gang Fang. Process‑Aware Accounting Information System Based on Business Process Management. Wireless Communications and Mobile Computing 2022.1. 2022. No1. P. 1-15. URL: https://onlinelibrary.wiley.com/doi/epdf/10.1155/2022/7266164

129. Li, Kai, et al. How should we understand the digital economy in Asia? Critical assessment and research agenda. Electronic commerce research and applications. 2022. No44. P. 1-17. URL: https://pmc.ncbi.nlm.nih.gov/articles/PMC7480531/pdf/main.pdf

130. Li, Li, Jiahao Wu, Wei Cui. A review of blockchain cross‑chain technology. IET Blockchain. 2023. P. 149-158.

131. Li, Liang, et al. Poverty alleviation through government‑led e‑commerce development in rural China: An activity theory perspective. Information Systems Journal. 2019. P. 14-952.

132. Li, Tinghui, et al. Has enterprise digital transformation improved the

efficiency of enterprise technological innovation? A case study on Chinese listed companies. Math. Biosci. Eng. 2022. P. 12632-12654. URL: https://www.aimspress.com/aimspress-data/mbe/2022/12/PDF/mbe-19-12-590.

133. Liu Chengyu. Accounting for cryptocurrencies in international practice. Herald of Economics. 2024. №3. P. 218-231. URL: https://doi.org/10.35774/visnyk2024.03.218.

134. Liu Chengyu, Volodymyr Muravskyi, Wenjun Wei. Evolution of blockchain accounting literature from the perspective of CiteSpace (2013–2023). Heliyon, 2024. Volume 10, Issue 11. e32097. URL: https://doi.org/10.1016/j.heliyon.2024.e32097.

135. Liu Chengyu. Cryptocurrencies in international accounting. Стан і перспективи розвитку обліково-інформаційної системи в Україні: матеріали VII Міжнародної науково-практичної конференції, присвяченій 55-річчю кафедри обліку і оподаткування та 85-річчю від дня народження д. е. н., проф. Б. М. Литвина (26-27 вересня 2024 р., м. Тернопіль). Том 1. Тернопіль: ЗУНУ, 2024. С. 288-289.

136. Liu Chengyu. Improvement of accounting for electronic money and cryptocurrencies. Актуальні аспекти розвитку науки і освіти: збірник матеріалів IV Міжнародної науково-практичної конференції науково-педагогічних працівників та молодих науковців (24 - 25 жовтня 2024 р., м. Одеса). Одеса: ОДАУ, 2024. С. 634-636.

137. Liu Chengyu. The integration of artificial intelligence and blockchain in tax audit. Стратегія розвитку України: фінансово-економічний та гуманітарний аспекти: матеріали XI Міжнародної науково-практичної конференції у 2-х частинах. (15 жовтня 2024 р., м. Київ). Частина 1. Київ: Інтерсервіс, 2024. С. 369-371.

138. Liu Chengyu. The role of blockchain in enhancing tax audit accuracy. Інформаційні технології і автоматизація – 2024: матеріали XVII Міжнародної науково-практичної конференції (31 жовтня - 1 листопада 2024 р., м. Одеса). Одеса: Видавництво ОНТУ, 2024. С. 150-151.

139. Mokyr, Joel. Editor's introduction: The new economic history and the Industrial Revolution. The British industrial revolution. Routledge. 2018. P.1-127. URL: https://uh.edu/~devollra/Mokyr%20-%201999.pdf

140. Moon, M. Jae. Can IT help government to restore public trust? Declining public trust and potential prospects of IT in the public sector. 36th Annual Hawaii International Conference on System Sciences, 2003. Proceedings of the. IEEE. 2003.

141. Morkunas V J, Paschen J, Boon E. How blockchain technologies impact your business model. Business Horizons. 2019. No3. P. 295-306.

142. Morozova, Galina A., et al. The impact of artificial intelligence on the socio-economic development of society in modern conditions. Current Problems and Ways of Industry Development: Equipment and Technologies. Cham: Springer International Publishing, 2021. P.406-414.

143. Muravskyi V, Pochynok N, Reveha O., Liu Chengyu. Accounting and control of foreign economic electronic transactions using cryptocurrencies. Herald of Economics. 2022. № 4. P. 44–60. URL: https://doi.org/10.35774/visnyk2022.04.044.

144. Muravskyi V, Khoma N, Khokhlova L., Liu Chengyu. Open document flow based on blockchain technology for cyber security of the accounting system. Herald of Economics. 2021. № 4. P. 156-170. URL: https://doi.org/10.35774/visnyk2021.04.156.

145. Nakamoto, Satoshi. Bitcoin: A peer-to-peer electronic cash system. Satoshi Nakamoto. 2008. URL: https://static.upbitcare.com/931b8bfc-f0e0-4588-be6e-b98a27991df1.pdf

146. Napier, Christopher J. Accounts of change: 30 years of historical accounting research. Accounting, Organizations and Society. 2006. P. 445-507.

147. Neal, William D. Satisfaction is nice, but value drives loyalty. Marketing research.1999. P. 20-23. URL: https://www.proquest.com/openview/cc0a5457f9329fad3a02bd13a364246f/1?pq-origsite=gscholar&cbl=31079

148. Ng, Poh Soon Joseph, et al. The Inclusive Innovation of Blockchain in Securities Issuance: Reduced Inequalities of Investors. Journal of Advanced Research

in Applied Sciences and Engineering Technology. 2025. No2. P. 188-212. URL: http://semarakilmu.com.my/journals/index.php/applied_sciences_eng_tech/article/view/4016/5146

149. Nguyen, Trung-Hieu. Investigating Driving Factors of Digital Transformation in the Vietnam Shipping Companies: Applied for TOE Framework. SAGE Open. 2024. URL: https://journals.sagepub.com/doi/full/10.1177/21582440241301210

150. Nørreklit, Hanne, Lennart Nørreklit, Falconer Mitchell. Towards a paradigmatic foundation for accounting practice. Accounting, Auditing & Accountability Journal. 2010. No6. P. 733-758.

151. Nussim J, Sorek A. Theorizing tax incentives for innovation. Va. Tax Rev. 2017. No36. P.25.

152. Nwaimo, Chioma Susan, et al. Evaluating the role of big data analytics in enhancing accuracy and efficiency in accounting: A critical review. Finance & Accounting Research Journal .2024. No6. P. 877-892. URL: https://fepbl.com/index.php/farj/article/view/1184

153. Oneshko, Svitlana, et al. Accounting and financial reporting in the it sphere of Ukraine: opportunities of artificial intelligence. Financial and Credit Activity: Problems of Theory and Practice. 2023. No52. P. 79-96.

154. Pacheco, Michael, et al. Is my transaction done yet? an empirical study of transaction processing times in the ethereum blockchain platform. ACM Transactions on Software Engineering and Methodology.2023. No59. P. 1-46.

155. Paech, Philipp. The governance of blockchain financial networks. The Modern Law Review. 2017. P. 1073-1110. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/1468-2230.12303

156. Palacios, Juan J. The development of e-commerce in Mexico: A business-led passing boom or a step toward the emergence of a digital economy?. The information society. 2003. P. 69-79.

157. Palamara, Pietro. Tracing and tracking with the blockchain. 2016. URL: https://www.politesi.polimi.it/bitstream/10589/139387/3/2018_04_Palamara.pdf

158. Pang Jian , Xinmin Z. Foreign digital economy development trends and digital economy national development strategies. Science and Technology Progress and Countermeasures. 2013. No30. P. 124-128.

159. Pan, Wenrong, et al. Digital economy:An innovation driver for total factor productivity. Journal of business research. 2022. No139. P. 303-311.

160. Paul, James L., Kofi Marfo. Preparation of educational researchers in philosophical foundations of inquiry. Review of educational research. 2001. P. 525-547.

161. Patil P, Sangeetha M. Blockchain-based decentralized KYC verification framework for Banks. Procedia Computer Science. 2022. P. 529-536. URL: https://www.sciencedirect.com/science/article/pii/S1877050922021263

162. Qadir Aram, Dolpamuee Rizgar. Blockchain Technology and Accounting: The Triple-Entry Affecting Transparency. 2023. №. 21. P. 20-22.

163. Qizhong, Y.A.N.G., M.A. Beili. Can Chinese Investors Absorb the Meanings behind the Executives' Words?−LSTM Deep Learning Analysis Based on Management Meanings. Collected Essays on Finance and Economics. 2019. P.63. URL: https://cjlc.zufe.edu.cn/EN/abstract/abstract1545.shtml

164. Rahmawati Mia. A Bibliometric Analysis of Accounting in the Blockchain Era. Journal of Accounting and Investment. 2022. №. 23. P. 66-77. URL: https://doi.org/10.18196/jai.v23i1.13302.

165. Rinard, Martin. Probabilistic accuracy bounds for fault-tolerant computations that discard tasks. Proceedings of the 20th annual international conference on Supercomputing. 2006.

166. Robinson, Gary, Sabine Dörry, Ben Derudder. Global networks of money and information at the crossroads: Correspondent banking and SWIFT. Global Networks. 2023. P. 478-493. URL: https://onlinelibrary.wiley.com/doi/full/10.1111/glob.12408

167. Ros,Francisco J.,Pedro M.Ruiz, Ivan Stojmenovic. Acknowledgment-based broadcast protocol for reliable and efficient data dissemination in vehicular ad hoc

networks. IEEE Transactions on Mobile Computing. 2010. P. 33-46.

168. Rotemberg J J, Woodford M. The cyclical behavior of prices and costs. Handbook of macroeconomics. 1999. P. 1051-1135.

169. Rouhani, Sara. Data trust framework using blockchain and smart contracts. University of Saskatchewan. 2021. URL: https://harvest.usask.ca/server/api/core/bitstreams/7b2b49f6-ea64-4d76-a14d-45630a65f767/content

170. Saraiva Helena, Vieira Paulo. Accounting Systems With Smart Contracts: Building Accounting Records in Blockchain Step by Step. 2023. URL: https://doi.org/10.4018/978-1-6684-7293-4.ch003

171. Schultz Jr, Joseph J., James Lloyd Bierstaker, Ed O'Donnell. Integrating business risk into auditor judgment about the risk of material misstatement: The influence of a strategic-systems-audit approach. Accounting. Organizations and Society. 2010. P. 238-251.

172. Selos, Erno. Management Accounting Systems Usefulness as a Union of Natural and Rational Perspectives: Analyses at the Interface of Sales and Procurement. 2013. URL:https://trepo.tuni.fi/handle/10024/114962

173. Shmatkovska, Tatyana, Paun Mykhailovych, Rostyslav Martyniuk. Modern information technology in the automation of the accounting and analytical process: implementation of foreign experience in the realities of Ukraine. Economic journal of Lesya Ukrainka Volyn National University. 2018. P. 145-151. URL:https://echas.vnu.edu.ua/index.php/echas/article/view/333

174. Singh Harmeet, Dubey Arjun. Electronic Payments based on Blockchain Technology. A Bibliometric Review. 3rd International Conference on Advances in Computing, Communication Control and Networking (ICAC3N). 2021. P. 1574-1577. URL: https:// doi.org/10.1109/ICAC3N53548.2021.9725363

175. Strandhagen, Jan Ola, et al. Logistics 4.0 and emerging sustainable business models. Advances in Manufacturing. 2017. No5. P. 359-369.

176. Su, Chang, Wenbo Lyu, Yueting Liu. The relationship between digital RMB and digital economy in china. arxiv preprint arxiv.2022. URL:

https://arxiv.org/pdf/2205.14517

177. Swan, Melanie. Blockchain for business: Next-generation enterprise artificial intelligence systems. Advances in computers. Elsevier. 2018. P. 121-162.

178. Sweeney, Breda, Bernard Pierce. Management control in audit firms: A qualitative examination. Accounting, Auditing & Accountability Journal. 2004. P. 779-812.

179. Szalachowski, Pawel. Password-authenticated decentralized identities. IEEE Transactions on Information Forensics and Security. 2021. No16. P. 4801-4810. URL: https://ieeexplore.ieee.org/abstract/document/9551934

180. Tachiki, Dennis, Satoshi Hamaya, Koh Yukawa. Diffusion and Impacts of the Internet and E-Commerce in Japan. 2004. URL: https://escholarship.org/content/qt2kg461gn/qt2kg461gn.pdf

181. Tan E, Lerouge E, Du Caju J, et al. Verification of education credentials on European Blockchain Services Infrastructure (EBSI): action research in a cross-border use case between Belgium and Italy. Big Data and Cognitive Computing. 2023. No7. P. 79. URL: https://www.mdpi.com/2504-2289/7/2/79

182. Teece, David J. Profiting from innovation in the digital economy: Enabling technologies, standards, and licensing models in the wireless world. Research policy. 2018. P.1367-1387.

183. Tegmark M. 7 The multiverse hierarchy Max Tegmark Department of Physics. Massachusetts Institute of Technology. Universe or multiverse. 2007. P. 99. URL:https://books.google.com.ua/books?hl=zh-CN&lr=&id=U_Jm2DT_AVAC&oi=fnd&pg=PA99&dq=7+The+multiverse+hierarchy+Max+Tegmark+Department+of+Physics&ots=JejzpxPrLt&sig=J8N2cDqmiQ5tYFmSjNmVNrvtleI&redir_esc=y#v=onepage&q=7%20The%20multiverse%20hierarchy%20Max%20Tegmark%20Department%20of%20Physics&f=false

184. Tenyukh, Zoryana, Ulyana Pelekh, Nadiia Khocha. Application of digital technologies in accounting and auditing at enterprises of Ukraine. Scientific Bulletin of Mukachevo State University. Series Economics. 2022. P. 46-55.

185. Trigo A, Belfo F, Estébanez R P. Accounting Information Systems:

evolving towards a business process oriented accounting. Procedia Computer Science, 2016. No100. P. 987-994. URL: https://www.sciencedirect.com/science/article/pii/S1877050916324334

186. Trigo, António, Fernando Belfo, Raquel Pérez Estébanez. Accounting information systems: The challenge of the real-time reporting. Procedia Technology. 2014. No16. P. 118-127. URL: https://www.sciencedirect.com/science/article/pii/S2212017314003028

187. Tsui, Eric. Technologies for personal and peer-to-peer (p2p) knowledge management. CSC Leading Edge Forum Technology Grant Report. 2002. URL: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=7ecb072d09f4e54ddad0ce6bbd02492c7074edd2

188. Vasarhelyi, Miklos, Marilyn Greenstein. Underlying principles of the electronization of business: A research agenda. International Journal of Accounting Information Systems.2003. P. 1-25.

189. Venter, H. Digital currency – a case for standard setting activity, Australian Accounting Standards Board. 2016.URL: www.aasb.gov.au/admin/file/content102/c3/AASB_ASAF_DigitalCurrency.pdf.

190. Vokshi, Berisha Nexhmie, Xhelili Florentina Krasniqi. Role of accounting information in decision-making process, the importance for its users. ENTRENOVA-ENTerprise REsearch InNOVAtion. 2017. No1. P.276-283.

191. Wang, Feng. Has the Metaverse caused the rupture of humanity?. Metaverse . 2021. No2. P. 10. URL: https://aber.apacsci.com/index.php/met/article/view/1788

192. Wang, Li Nan. Impact of information technology on accounting. Advanced Materials Research. 2011. P. 1224-1227.

193. Wang, Yingli, et al. Making sense of blockchain technology: How will it transform supply chains?. International Journal of Production Economics. 2019. P. 221-236.

194. Weddle, Kevin John. The Navy must be made efficient: Samuel Francis Du Pont, reformer and strategist. Princeton University. 2003. P. 1851–1863.

195. Westphal, Larry E. Technology strategies for economic development in a fast changing global economy. Economics of innovation and new technology. 2002. P. 275-320.

196. Wu, Jiapeng, Feng Xiong, Cheng Li. Application of Internet of Things and blockchain technologies to improve accounting information quality. Ieee Access. 2019. No7.

197. Wu, Binghui, Tingting Duan. The application of blockchain technology in financial markets. Journal of Physics: Conference Series. IOP Publishing. 2019. No4.

198. Wyly,Elvin. The new quantitative revolution. Dialogues in Human Geography. 2014. P. 26-38.

199. Xu, Yang. A Study on the Effectiveness of the Independent Director System on the Governance of Financial Fraud Phenomenon: Taking Kangmei Pharmaceutical as an Example. SHS Web of Conferences. EDP Sciences. 2024. URL:https://www.shs-conferences.org/articles/shsconf/abs/2024/08/shsconf_icdde2024_01024/shsconf_icdde2024_01024.html

200. Yan,Yinxin,et al. Blockchain technology in the internet plus: The collaborative development of power electronic devices. IECON 2017-43rd Annual Conference of the IEEE Industrial Electronics Society. IEEE. 2017.

201. Yu, Ting, Zhiwei Lin, Qingliang Tang. Blockchain: The introduction and its application in financial accounting. Journal of Corporate Accounting & Finance. 2018. P. 37-47. URL: https://onlinelibrary.wiley.com/doi/abs/10.1002/jcaf.22365

202. Zadorozhnyy Z.-M., Muravskyi V., Yatsyshyn S., Shevchuk O. Accounting of wages with the use of biometrics to ensure cybersecurity of enterprises. Financial and Credit Activity: Problems of Theory and Practice. 2021. №. 3(38). P. 162-172. URL: https://doi.org/10.18371/fcaptp.v3i38.237446.

203. Zadorozhnyi Z.-M., Muravskyi V., Shevchuk O. Management Accounting of Electronic Transactions with the Use of Cryptocurrencies. Financial And Credit Activity: Problems Of Theory And Practice. 2018. №. 3(26). P. 169-177. http://dx.doi.org/10.18371/fcaptp.v3i26.144368.

204. Zeng, Amy Z., Bhavik K. Pathak. Achieving information integration in

supply chain management through B2B e‐hubs: concepts and analyses. Industrial Management & Data Systems. 2003. P. 657-665.

205. Zhang J, Liang X J. Business ecosystem strategies of mobile network operators in the 3G era: The case of China Mobile. Telecommunications policy. 2011. No35. P. 156-171.

206. Zhang, Wenyu, Mengpu Zhu. Environmental accounting system model based on artificial intelligence blockchain and embedded sensors. Computational Intelligence and Neuroscience. 2022. No1. URL: https://onlinelibrary.wiley.com/doi/full/10.1155/2022/3803566

207. Zhu, Peng, et al. Using blockchain technology to enhance the traceability of original achievements. IEEE Transactions on Engineering Management. 2021. P. 1693-1707.

208. Zybery, Ilirjana, Lindita Rova. The role of the accountants in the framework of the modern technological developments and digital accounting systems. European Scientific Journal. 2014. No24. P. 30-48. URL: https://core.ac.uk/download/pdf/236408651.pdf

209. Вихристюк, А. Б. Дослідження впливу криптовалютних бірж на розвиток економіки Web 3.0. MS thesis. Сумський державний університет. 2024. URL: https://essuir.sumdu.edu.ua/handle/123456789/90805

210. Жекало Г І. Цифрова економіка України: проблеми та перспективи розвитку. 2019. URL: https://dspace.uzhnu.edu.ua/jspui/handle/lib/27376

211. Коляденко С В. Цифрова економіка: передумови та етапи становлення в Україні і у світі. Економіка. Фінанси. Менеджмент: актуальні питання науки і практики, 2016.Р. 105-112.

212. Кравченко, Олена Володимирівна, et al. Блокчейн-технології: стан та перспективи розвитку в Україні. 2023. URL: http://212.1.86.13/jspui/handle/123456789/6195

213. Марченко О Ю. Цифрова економіка в Україні: основні тенденції та перспективи розвитку. Галицький економічний вісник. 2020. No65. Р. 34-39. URL:https://er.chdtu.edu.ua/handle/ChSTU/1878

214. Балазюк О., Пилявець В. Технологія блокчейн: дослідження суті та аналіз сфер використання. Економіка та суспільство. 2022. № 43. https://doi.org/10.32782/2524-0072/2022-43-13.

215. Бардаш С. В., Грабчук І. Л. Цифрові технології в сфері бухгалтерського обліку: основні можливості та ризики. Ефективна економіка. 2021. № 9. URL: http://www.economy.nayka.com.ua/?op=1&z=9301. URL: https://doi.org/10.32702/2307-2105-2021.9.18.

216. Бруханський Р. Ф., Спільник І. В. Криптоактиви у системі бухгалтерського обліку та звітності. Проблеми економіки. 2019. № 2. С. 145–156. https://doi.org/10.32983/2222-0712-2019-2-145-156.

217. Ілляшенко К. В. Перспективи застосування технології блокчейн в бухгалтерському обліку. Інфраструктура ринку: науково-практичний журнал. 2020. № 40. С. 198-202. URL: http://elar.tsatu.edu.ua/bitstream/123456789/10377/1/8.pdf. https://doi.org/10.32843/infrastruct40-35.

218. Іонін Є. Обліково-аналітичне забезпечення бізнес-процесів в умовах цифрової економіки. Економічний аналіз. 2023. Том 33. № 1. С. 172-191. URL: https://doi.org/10.35774/econa2023.01.172.

219. Зварич, Р., Дудник, Ю., Гомотюк, В., & Боднар, С. (2022). Ризик-менеджмент цифрової трансформації в умовах пандемії. Вісник Економіки. № 1. С. 38-53. URL: https://doi.org/10.35774/visnyk2022.01.038.

220. Єршова Н. Розвиток бухгалтерського обліку в умовах переходу до цифрової економіки. Вісник Національного технічного університету “Харківський політехнічний інститут” (економічні науки). 2020. № 2. С. 75-80. URL: https://doi.org/10.20998/2519-4461.2020.2.75.

221. Королюк Т., Співак С., Ратинський В. Облік в управлінні підприємством в умовах цифрової економіки. Галицький економічний вісник. 2023. Том 85. № 6. С. 88–96. URL: https://doi.org/10.33108/galicianvisnyk_tntu2023.06.088.

222. Кравченко І. Й. Перспективи впровадження інструментів цифрової

економіки в систему статистичного аналізу, бухгалтерського обліку та аудиту. Облік і фінанси. 2022. № 3 (97). С. 12–20. URL: https://doi.org/10.33146/2307-9878-2022-3(97)-12-20.

223. Крупка Я., Окренець В. Криптовалюта як об'єкт обліку і джерело екномічних вигод. Вісник Тернопільського національного економічного університету. 2020. Вип. 3. С. 238–251. URL: https://doi.org/10.35774/visnyk2020.03.238.

224. Легенчук С. Ф., Захаров Д. М., Денисюк О. М. Діджиталізація обліку на основі застосування засобів штучного інтелекту: неоінституційні аспекти. Актуальні питання економічних наук. 2024. №5. URL: https://doi.org/10.5281/zenodo.14534654.

225. Мельниченко О. В., Новак О. С., Фоміна О. В. Проблеми та перспективи розвитку оподаткування операцій з криптовалютами. Проблеми теорії та методології бухгалтерського обліку, контролю і аналізу. 2022. Вип. 3(53). С. 28-33. URL: http://dx.doi.org/10.26642/pbo-2022-3(53)-28-33.

226. Муравський В., Шевчук О. Глобальна трансформація ролі бухгалтерського обліку і контролю в умовах цифрової економіки. Світ фінансів. 2024. Вип. 1. С. 39-58. URL: https://doi.org/10.35774/SF2024.01.039.

227. Назарова І. Я. Еволюційний розвиток обліково-інформаційних систем в Україні. Вісник ЛТЕУ. Економічні науки. 2024. № 77. С. 50-56. URL: https://doi.org/10.32782/2522-1205-2024-77-07. URL: https://journals-lute.lviv.ua/index.php/visnyk-econom/article/view/1599.

228. Нашкерська Г. В. Технологія блокчейн у бухгалтерському обліку: переваги та обмеження. Фінанси України. 2023. № 3. С. 88-102.

229. Орлик О. В. Сучасні тенденції та напрями використання підприємствами інформаційно-комунікаційних технологій. Вісник соціально-економічних досліджень. 2021. № 2 (77). С. 98-110. URL: https://journals.uran.ua/vsed_oneu/article/download/248526/245843.

230. Орлов І. Організація бухгалтерського обліку в умовах цифровізації економіки. Acta Academiae Beregsasiensis. Economics. 2022. № 1. С. 264-273.

URL: https://doi.org/10.58423/2786-6742/2022-1-264-273.

231. Правдюк Н. Л., Обнявко М. В. Впровадження блокчейну в облікову систему: кроки назустріч. Ефективна економіка. 2022. № 1. URL: http://www.economy.nayka.com.ua/?op=1&z=9913. URL: https://doi.org/10.32702/2307-2105-2022.1.12.

232. Осмятченко В. О., Шевчук С. В., Ізмайлов Я. О. та ін. Бухгалтерський облік та оподаткування в умовах застосування інформаційних технологій: теорія і практика. Ірпінь: Вид-во Університету ДФС України, 2020. 389 с.

233. Пуцентейло П. Р., Довбуш А. В. Основні вектори розвитку бухгалтерського обліку в умовах цифрової економіки. Інноваційна економіка. 2021. № 3-4 (87). С. 140-151. URL: https://doi.org/10.37332/2309-1533.2021.3-4.20.

234. Реслер М. Вплив цифрової економіки на обліково-аналітичну систему. Acta Academiae Beregsasiensis. Economics. 2024. № 5. С. 441-450. URL: https://doi.org/10.58423/2786-6742/2024-5-441-450 URL: https://aab-economics.kmf.uz.ua/aabe/article/view/180/177.

235. Семанюк В. З. Інформаційна теорія обліку в постіндустріальному суспільстві: монографія. Тернопіль.: ТНЕУ, 2018. 392 с.

236. Семанюк В., Мельник Н. Вплив цифрових технологій на інформаційне середовище бізнесу в умовах п'ятої промислової революції. Вісник економіки. 2022. Вип. 3. С. 203–212. URL: https://doi.org/10.35774/visnyk2022.03.203.

237. Тесак О. В. Облікова політика підприємства: аналіз ризиків використання технології блокчейн в бухгалтерському обліку та аудиті. Академічні візії. 2022. № 13. URL: https://academy-vision.org/index.php/av/article/view/76. URL: http://dx.doi.org/10.5281/zenodo.7331052.

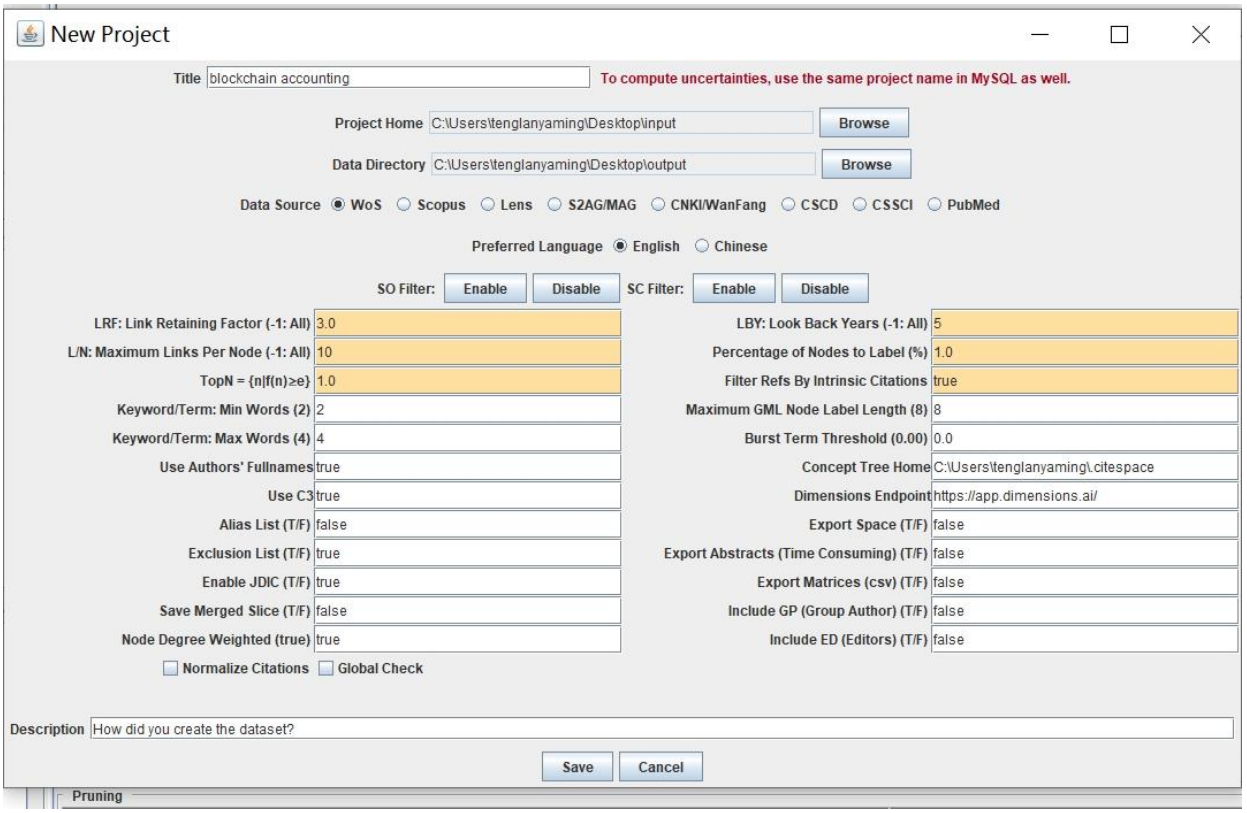
238. Шевчук О., Муравський В. Блокчейн та електронні трансакції в обліку. Вісник Економіки. 2023. Вип. 3. С. 212–237. URL: https://doi.org/10.35774/visnyk2023.03.212.

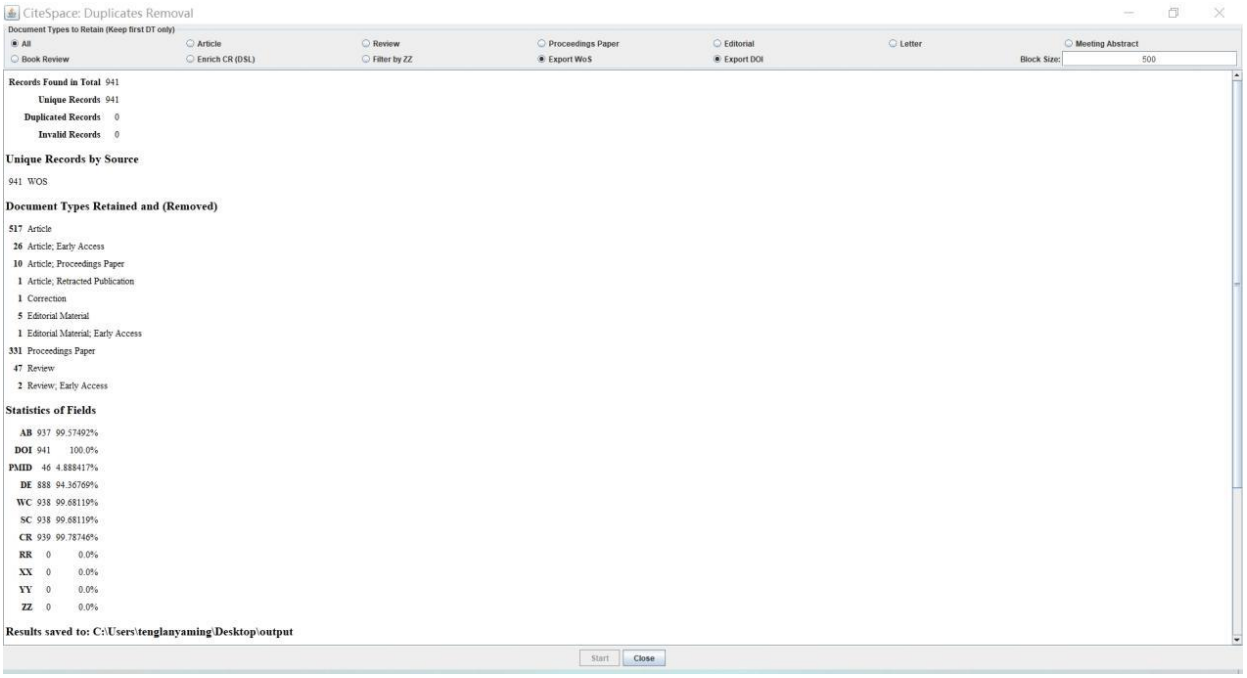
239. Фоміна О., Ромашко О. Комунікаційні аспекти в бухгалтерському

аутсорсингу. Економіка та суспільство. 2024. № 63. URL: https://doi.org/10.32782/2524-0072/2024-63-69.

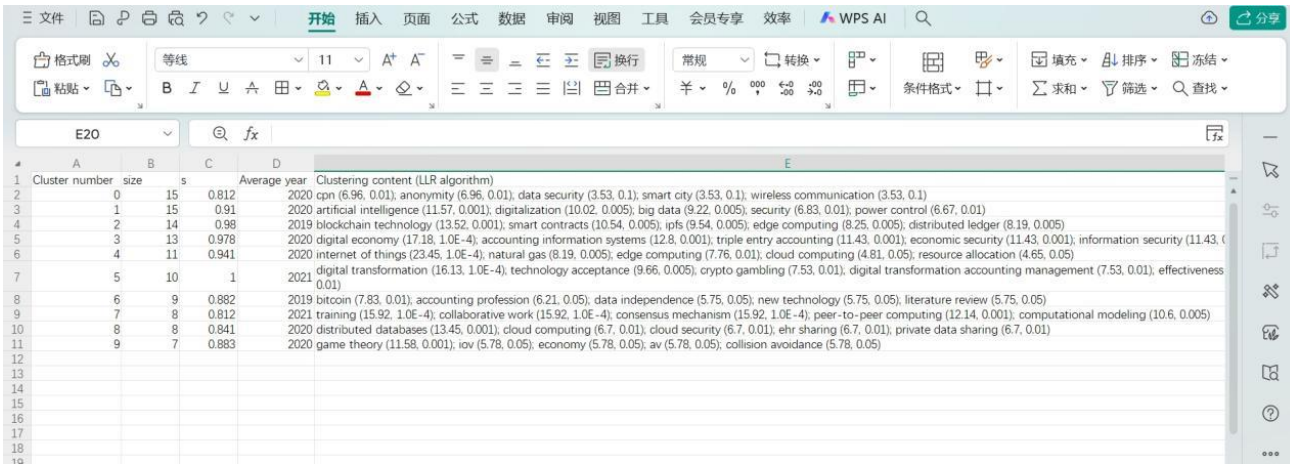
240. Ярощук О., Белова І. Технологія блокчейн в бухгалтерському обліку та аудиті. Інститут бухгалтерського обліку, контроль та аналіз в умовах глобалізації. 2021. № 1(3-4). С. 28-44. URL: https://doi.org/10.35774/ibo2020.03.028.

Appendix A


New Project
Title blockchain accounting
To compute uncertainties, use the same project name in MySQL as well.
Project Home C:\Users\tenglanyaming\Desktop\input
Browse
Data Directory C:\Users\tenglanyaming\Desktop\output
Browse
Data Source WoS Scopus Lens S2AG/MAG CNKI/WanFang CSCD CSSCI PubMed
Preferred Language English Chinese
SO Filter: Enable Disable SC Filter: Enable Disable
LRF: Link Retaining Factor (-1: All) 3.0
LBY: Look Back Years (-1: All) 5
L/N: Maximum Links Per Node (-1: All) 10
Percentage of Nodes to Label (%) 1.0
TopN = {n|f(n)≥e} 1.0
Filter Refs By Intrinsic Citations true
Keyword/Term: Min Words (2) 2
Maximum GML Node Label Length (8) 8
Keyword/Term: Max Words (4) 4
Burst Term Threshold (0.00) 0.0
Use Authors' Fullnames true
Concept Tree Home C:\Users\tenglanyaming\.citespace
Use C3 true
Dimensions Endpoint https://app.dimensions.ai/
Alias List (T/F) false
Export Space (T/F) false
Exclusion List (T/F) true
Export Abstracts (Time Consuming) (T/F) false
Enable JDIC (T/F) true
Export Matrices (csv) (T/F) false
Save Merged Slice (T/F) false
Include GP (Group Author) (T/F) false
Node Degree Weighted (true) true
Include ED (Editors) (T/F) false
Normalize Citations
Global Check
Description How did you create the dataset?
Save
Cancel
Pruning


CiteSpace: Duplicates Removal
Document Types to Retain (Keep first DT only)
All
Article
Review
Proceedings Paper
Editorial
Letter
Meeting Abstract
Book Review
Enrich CR (DSL)
Filter by ZZ
Export WoS
Export DOI
Block Size: 500
Records Found in Total 941
Unique Records 941
Duplicated Records 0
Invalid Records 0
Unique Records by Source
941 WOS
Document Types Retained and (Removed)
517 Article
26 Article; Early Access
10 Article; Proceedings Paper
1 Article; Retracted Publication
1 Correction
5 Editorial Material
1 Editorial Material; Early Access
331 Proceedings Paper
47 Review
2 Review; Early Access
Statistics of Fields
AB 937 99.57492%
DOI 941 100.0%
PMID 46 4.888417%
DE 888 94.36769%
WC 938 99.68119%
SC 938 99.68119%
CR 939 99.78746%
RR 0 0.0%
XX 0 0.0%
YY 0 0.0%
ZZ 0 0.0%
Results saved to: C:\Users\tenglanyaming\Desktop\output
Start
Close

Appendix B



Cluster number	size	s	Average year	Clustering content (LLR algorithm)
0	15	0.812	2020	cpn (6.96, 0.01); anonymity (6.96, 0.01); data security (3.53, 0.1); smart city (3.53, 0.1); wireless communication (3.53, 0.1)
1	15	0.91	2020	artificial intelligence (11.57, 0.001); digitalization (10.02. 0.005); big data (9.22, 0.005); security (6.83, 0.01); power control (6.67, 0.01)
2	14	0.98	2019	blockchain technology (13.52, 0.001); smart contracts (10.54, 0.005); ipfs (9.54, 0.005); edge computing (8.25, 0.005); distributed ledger (8.19, 0.005)
3	13	0.978	2020	digital economy (17.18, 1.0E-4); accounting information systems (12.8, 0.001); triple entry accounting (11.43, 0.001); economic security (11.43, 0.001); information security (11.43,
4	11	0.941	2020	internet of things (23.45, 1.0E-4); natural gas (8.19, 0.005); edge computing (7.76, 0.01); cloud computing (4.81, 0.05); resource allocation (4.65, 0.05)
5	10	1	2021	digital transformation (16.13, 1.0E-4); technology acceptance (9.66, 0.005); crypto gambling (7.53, 0.01); digital transformation accounting management (7.53, 0.01); effectiveness 0.01)
6	9	0.882	2019	bitcoin (7.83, 0.01); accounting profession (6.21, 0.05); data independence (5.75, 0.05); new technology (5.75, 0.05); literature review (5.75, 0.05)
7	8	0.812	2021	training (15.92, 1.0E-4); collaborative work (15.92, 1.0E-4); consensus mechanism (15.92, 1.0E-4); peer-to-peer computing (12.14, 0.001); computational modeling (10.6, 0.005)
8	8	0.841	2020	distributed databases (13.45, 0.001); cloud computing (6.7, 0.01); cloud security (6.7, 0.01); ehr sharing (6.7, 0.01); private data sharing (6.7, 0.01)
9	7	0.883	2020	game theory (11.58, 0.001); iov (5.78, 0.05); economy (5.78, 0.05); av (5.78, 0.05); collision avoidance (5.78, 0.05)

Appendix C

	id	year	TAT	Blockchain	ROA	Size	ALR	CAR
1	8	2010	.133921	0	.011407	18.17135	.04531932	1
2	8	2011	.181013	0	-.006984	18.162384	.04370549	1
3	8	2012	.540021	0	.063746	20.235228	.11893076	1
4	8	2013	.485853	0	.036318	20.25586	.10060482	1
5	8	2014	.45574	0	.011522	20.328782	.11227616	.99079884
6	8	2015	.36081	0	.052909	22.001238	.18980924	.92698797
7	8	2016	.228986	0	.064758	22.826504	.24658309	.97345873
8	8	2017	.218287	0	.08331	23.091481	.32694879	.98218847
9	8	2018	.245061	1	.032666	23.071433	.29250966	.90522171
10	8	2019	.267353	1	.037977	23.211878	.37096158	.91817463
11	8	2020	.149476	0	-.069531	23.27492	.48016709	.74443146
12	8	2021	.178909	0	-.111377	23.239306	.56895391	.78632305
13	8	2022	.157623	0	-.075325	23.143464	.60169612	.87018853
14	63	2010	.83496	1	.041312	25.155895	.70337137	.81015641
15	63	2011	.818601	1	.021288	25.380726	.7505054	.79769847
16	63	2012	.783827	1	-.024241	25.400257	.78930192	.85685116
17	63	2013	.75174	1	.014325	25.329231	.76393078	.79087624
18	63	2014	.767047	1	.025681	25.388724	.75245772	.8155901
19	63	2015	.828713	1	.030938	25.518179	.64143264	.81064075
20	63	2016	.714717	1	-.00994	25.676561	.71134688	.90178148
21	63	2017	.75586	1	.037415	25.692817	.68477738	.91304462
22	63	2018	.661095	1	-.053725	25.585794	.74518373	.90475274
23	63	2019	.642601	1	.040911	25.673458	.73120592	.81748978
24	63	2020	.673487	1	.031345	25.738125	.69381263	.69187715
25	63	2021	.678593	0	.041691	25.851764	.68424639	.65765938
26	63	2022	.67948	0	.043059	25.921506	.67094752	.64593751
27	66	2010	2.534397	0	.02535	24.217491	.67444718	.97652372
28	66	2011	2.331319	0	.014464	24.213703	.68834006	.95673911
29	66	2012	2.035331	0	.002436	24.391525	.73852322	.87983961
30	66	2013	1.984897	0	-.019448	24.392594	.7785103	.88322475
31	66	2014	1.903874	0	-.008379	24.425844	.79115363	.9041765
32	66	2015	1.848533	0	-.004937	24.398454	.77942175	.86415221
33	66	2016	1.691793	0	.005253	24.433439	.76737775	.96061165
34	66	2017	.625385	0	.04579	23.444665	.50277661	.70241675
35	66	2018	.625506	0	.066014	23.495994	.58440613	.76677488

```
**剔除缺失值
drop if TAT==.| Blockchain==.| ROA ==.|Size==.| ALR==.| CAR==.

**描述性统计
asdoc sum TAT Blockchain ROA Size ALR CAR

**相关性分析
asdoc pwcorr TAT Blockchain ROA Size ALR CAR ,star(all) nonum replace


**主回归
xtset  id year
xtreg TAT Blockchain  i.year,fe
est sto m1
xtreg TAT Blockchain ROA Size ALR CAR i.year,fe
est sto m2
outreg2 [m1 m2 ] using xxx.doc, replace  tstat bdec(3) tdec(3) ctitle(TAT) e(F)
keep(Blockchain ROA Size ALR CAR) addtext(ID,YES,YEAR,YES)

**稳健性检验
xtset  id year
xtreg f.TAT Blockchain  i.year,fe
est sto m1
xtreg f.TAT Blockchain ROA Size ALR CAR i.year,fe
est sto m2
outreg2 [m1 m2 ] using xxx.doc, replace  tstat bdec(3) tdec(3) ctitle(TAT) e(F)
keep(Blockchain ROA Size ALR CAR) addtext(ID,YES,YEAR,YES)

**稳健性检验 剔除疫情影响
xtset  id year
xtreg TAT Blockchain  i.year if  year<2020,fe
est sto m1
xtreg TAT Blockchain ROA Size ALR CAR i.year if  year<2020,fe
est sto m2
outreg2 [m1 m2 ] using xxx.doc, replace  tstat bdec(3) tdec(3) ctitle(TAT) e(F)
keep(Blockchain ROA Size ALR CAR) addtext(ID,YES,YEAR,YES)
```

Appendix D

LIST OF PUBLICATIONS ON THE THEME OF THE DISSERTATION

Scientific works in which the main scientific results of the dissertation are reflected

1. Muravskyi V, Khoma N, Khokhlova L., Liu Chengyu. Open document flow based on blockchain technology for cyber security of the accounting system. *Herald of Economics*. 2021. № 4. P. 156-170. URL: https://doi.org/10.35774/visnyk2021.04.156. (1.1 printed sheet, including the author's personal contribution - 0.3 printed sheet; a methodology for using blockchain technology for electronic documentation in accounting has been developed).

2. Muravskyi V, Pochynok N, Reveha O., Liu Chengyu. Accounting and control of foreign economic electronic transactions using cryptocurrencies. *Herald of Economics*. 2022. № 4. P. 44–60. URL: https://doi.org/10.35774/visnyk2022.04.044. (1.2 printed sheet, including the author's personal contribution - 0.3 printed sheet; the place of blockchain technology in accounting for electronic transactions using cryptocurrencies has been clarified).

3. Liu Chengyu, Volodymyr Muravskyi, Wenjun Wei. Evolution of blockchain accounting literature from the perspective of CiteSpace (2013–2023). Heliyon, 2024. Volume 10, Issue 11. e32097. URL: https://doi.org/10.1016/j.heliyon.2024.e32097. URL: https://www.scopus.com/record/display.uri?eid=2-s2.0-85194910440&origin=recordpage (indexed in Scopus and Web of Science, first quartile (Q1); 1.2 printed sheet, including the author's personal contribution - 0.5 printed sheet; statistical data was collected and analyzed, with conclusions drawn regarding the prospects for research into the use of blockchain technology for accounting purposes).

4. Liu Chengyu. Accounting for cryptocurrencies in international practice. Herald of Economics. 2024. №3. P. 218-231. URL: https://doi.org/10.35774/visnyk2024.03.218. (0.9 printed sheet).

Scientific dissertations that additionally reflect the scientific results of the dissertation

5. Liu Chengyu. Cryptocurrencies in international accounting. Стан і перспективи розвитку обліково-інформаційної системи в Україні: матеріали VII Міжнародної науково-практичної конференції, присвяченій 55-річчю кафедри обліку і оподаткування та 85-річчю від дня народження д. е. н., проф. Б. М. Литвина (26-27 вересня 2024 р., м. Тернопіль). Том 1. Тернопіль: ЗУНУ, 2024. С. 288-289. (0.2 printed sheet).

6. Liu Chengyu. The integration of artificial intelligence and blockchain in tax audit. Стратегія розвитку України: фінансово-економічний та гуманітарний аспекти: матеріали XI Міжнародної науково-практичної конференції у 2-х частинах. (15 жовтня 2024 р., м. Київ). Частина 1. Київ: Інтерсервіс, 2024. С. 369-371. (0.2 printed sheet).

7. Liu Chengyu. Improvement of accounting for electronic money and cryptocurrencies. Актуальні аспекти розвитку науки і освіти: збірник матеріалів IV Міжнародної науково-практичної конференції науково-педагогічних працівників та молодих науковців (24 - 25 жовтня 2024 р., м. Одеса). Одеса: ОДАУ, 2024. С. 634-636. (0.2 printed sheet).

8. Liu Chengyu. The role of blockchain in enhancing tax audit accuracy. Інформаційні технології і автоматизація – 2024: матеріали XVII Міжнародної науково-практичної конференції (31 жовтня - 1 листопада 2024 р., м. Одеса). Одеса: Видавництво ОНТУ, 2024. С. 150-151. (0.2 printed sheet).

Appendix E

Information about the approval of the dissertation results

№	Names of conferences, congresses, symposiums, seminars, schools	Place of participation	Date of participation	Form of participation
1	2	3	4	5
1.	VII Міжнародна науково-практична конференція «Стан і перспективи розвитку обліково-інформаційної системи в Україні», присвячена 55-річчю кафедри обліку і оподаткування та 85-річчю від дня народження д. е. н., проф. Б. М. Литвина	Ternopil	September 26-27, 2024	full-time
2.	IV Міжнародна науково-практична конференція науково-педагогічних працівників та молодих науковців «Актуальні аспекти розвитку науки і освіти»	Odesa	October 24 - 25, 2024	part-time
3.	XVII Міжнародна науково-практична конференція «Інформаційні технології і автоматизація – 2024»	Odesa	October 31 - November 1, 2024	part-time
4.	XI Міжнародна науково-практична конференція «Стратегія розвитку України: фінансово-економічний та гуманітарний аспекти»	Kyiv	October 15, 2024	full-time