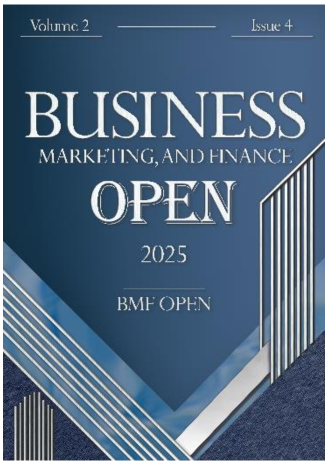
Investigating the Role of Blockchain Technology and Artificial Intelligence in the Enhancement and Improvement of Accounting Information Systems Using an Interpretive Structural Approach



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Abstract: Blockchain technology and artificial intelligence can significantly enhance accounting information systems. Blockchain, by providing an immutable and transparent record of transactions, increases data reliability and security and enables accurate and real-time tracking of financial information. On the other hand, artificial intelligence, by analyzing big data and identifying patterns, can assist in improving financial forecasts, detecting fraud, and automating accounting processes. Together, these two technologies increase the efficiency, accuracy, and transparency of accounting systems, leading to improved decision-making. Therefore, this study was conducted to investigate the role of blockchain technology and artificial intelligence in enhancing and improving accounting information systems using an interpretive structural approach. The data required for the study were collected through interviews with expert accountants who had full familiarity with information technology, blockchain, and artificial intelligence. In this research, using Interpretive Structural Modeling (ISM), a framework for enhancing and improving accounting information systems based on blockchain technology and artificial intelligence was designed. Based on interpretive structural modeling, a total of 15 components were presented within three dimensions in the final ISM model. The components of reducing human error, managing and processing big data, improving process automation, forecasting and analyzing processes, and enhancing computations were placed under the dimension of "artificial intelligence" at the third level of the model. The components of increasing information security, decentralization, cost reduction, enhancing speed and efficiency, transaction transparency, and standardization were placed under the dimension of "blockchain technology" at the second level of the model. Additionally, the components of increasing information security, improving the accuracy and speed of reporting, enhancing transparency and reliability, and the enhancement and improvement of software were categorized under the dimension of "enhancement and improvement of accounting information systems" at the third level of the model.

Keywords: Accounting Information Systems, Blockchain Technology, Artificial Intelligence.

1. Introduction

With the expansion and increase in the volume of information production, as well as the speed of responding to the fluid needs of the market, it is necessary to use powerful tools capable of replacing humans in examining, analyzing, predicting, and then making decisions [1]. Organizations and financial service institutions are increasingly using artificial intelligence to collect and transform data from various sources and extract information to make better decisions in complex environments to achieve economic benefits [2]. Artificial intelligence can be metaphorically viewed as an umbrella in this global megatrend, encompassing big data approaches and complex machine learning algorithms for predicting the future [3, 4].

On the other hand, when it comes to privacy and data protection, blockchains, given their data storage in a secure and distributed ledger, are often considered an innovation in accounting and auditing. Blockchain provides encrypted, tamper-resistant data storage that enables the traceability of individuals who have entered and altered data. Such traceability is crucial for auditing, creating transparency in stored data, and building trust [5, 6].

Reports based on accounting information generated through an organization's accounting information system are vital for effective strategic decision-making. The functional characteristics of the accounting information system impact the quality of accounting information reports [7, 8]. If an organization can continuously analyze and evaluate high-quality accounting information for its strategic decisions, it can create a competitive advantage. However, the benefits gained from investing in information technology are often not easily observable due to increased technical, organizational, and other complexities in today’s business environment. Nevertheless, these complexities themselves can create new growth opportunities [9].

The collection, storage, processing, and analysis of business events and accounting data, as well as the production and distribution of accounting information reports, are managed by accounting information systems. Both system quality and information quality, individually and jointly, affect user satisfaction. A high-quality information system can effectively meet its users' needs, optimizing user and organizational performance. Therefore, organizations must support such technology and information systems to the best extent possible [10].

All organizations possess some form of accounting information system, and these systems perform almost the same tasks for their respective organizations. Accordingly, it might seem that this system is a general-purpose technology and thus unsuitable to be recognized as a potential source of competitive advantage based on the resource-based view of the firm. However, even accounting information systems can be highly customized to meet diverse organizational needs or to provide complex information for decision-making [8]. When an accounting information system functions properly, it serves as a source of high-quality information for an organization's business activities, leading to organizational growth and operational efficiency [11, 12].

The digitization of corporate systems enables them to adopt new technological tools to streamline business processes and transform business models to innovate operations, as they can increasingly access advanced computing power and large databases [13, 14]. Today, the world's most valuable businesses are internet- and platform-based. Academics, social media, industries, and governments devote considerable attention to digital forms of technology, including blockchain, artificial intelligence, big data, the Internet of Things, and cloud computing. These innovations are significantly transforming organizations and individuals. Blockchain, now considered the fifth pillar of the information technology revolution, is expected to evolve into a foundational technology as the next-generation internet. With blockchain’s increasing maturity, innovators are discovering new opportunities to create value and enhance trust and resilience in the face of digital transformation by integrating blockchain with other technologies, especially artificial intelligence, the Internet of Things, or cloud computing [15].

Since accounting departments centrally authorize what is recorded in the databases of the accounting information system, they are responsible for the credibility of financial reports. Delays in financial reporting can help managers fabricate or manipulate financial information to gain unfair advantages over creditors or investors.

Because accounting lacks full transparency, auditors often spend significant time collecting and validating transactions. Such paper-based procedures for verifying signed supporting documents are tedious and thus prone to human error and fraud [16]. Blockchain technology has the potential to address current challenges in accounting by offering greater transparency, traceability, timeliness, and better evidence of manipulation compared to other existing financial record-keeping systems. The Institute of Chartered Accountants in England and Wales refers to blockchain as an accounting technology. Blockchain is considered a game changer in accounting because it guarantees record integrity by providing fully traceable audit trails that enable fully automated auditing. Since the introduction of double-entry bookkeeping centuries ago, no other factor has contributed more to the advancement of financial record-keeping than blockchain. Its innovative technology enables an accounting ecosystem inherently capable of transaction validation [15].

Financial information, as the output of the accounting system, serves as the input for decision-making theories. According to the American Institute of Certified Public Accountants, "accounting is the art of recording, classifying, and summarizing transactions and events of a financial nature in a significant manner and interpreting the results thereof." In the literature, the common point among various definitions of accounting is that accounting is an information system with specific functions. Today, the fundamental functions of recording, classifying, summarizing, reporting, and analyzing, essential to accounting, have been significantly integrated with artificial intelligence technology. Accordingly, the aim of artificial intelligence is to enhance learning and the use of information collected from big data streams to make technology smarter. The management of big data is potentially considered a revolution in information systems and management in the digital age. Thanks to new technologies such as artificial intelligence and blockchain, the enormous volume of data and the ability to analyze it represent highly significant developments. Therefore, many issues in accounting information systems can be addressed through the roles of artificial intelligence and blockchain technologies [17].

In recent studies, various scholars have emphasized the transformative role of artificial intelligence (AI) and blockchain technologies in accounting information systems. Zayed et al. (2024) examined the role of AI, including data collection, automation, precise reporting, enhanced efficiency, and predictive analysis, in detecting and preventing fraud within accounting systems, confirming that AI could significantly explain 70.1% of changes in fraud detection with a strong predictive influence [6]. Han et al. (2023) explored how blockchain technology, through its immutability, consensus validation, and data sharing capabilities, can enhance transparency, trust, and decision-making in accounting and auditing, interpreting findings through agency and stakeholder theories [15]. Alkan (2022) conceptually analyzed the impact of blockchain and AI integration on cloud-based accounting information systems, highlighting benefits such as decentralized intelligence, enhanced data security, and high operational efficiency [17]. Gharsi et al. (2024) designed a blockchain-based accounting information system model using thematic analysis and identified key constructs such as commitment assurance and digital identity management, proposing a framework to address emerging challenges in audit institutions [18]. Esmaili Kia and Mohtasham (2023) investigated the relationship between the public sector balanced scorecard and the effectiveness of accounting information systems, finding that improved system components positively influence sustainable performance in public organizations [19]. Asnad (2021) discussed blockchain technology's potential to transform digital ecosystems, protect privacy, and reduce fraud, emphasizing its impact on securing digital ledgers for accounting and auditing [20]. Finally, Ghanuni Shishvan et al. (2021) conducted a systematic review on the application of blockchain technology in VAT systems, concluding that blockchain could enhance transparency, security, and trust while highlighting challenges such as privacy concerns, regulatory compliance, and scalability issues [21].

With the expansion of emerging technologies, accounting information systems have also been affected and require improvement and enhancement. One of the main challenges in this field is trust and data security, which can compromise the accuracy and reliability of financial reports. Blockchain technology, as a revolutionary solution, enables the recording and storage of information in an immutable and transparent manner. This technology, by creating a chain of information blocks stored securely and in a distributed manner, can help reduce fraud and increase trust in financial reporting. On the other hand, artificial intelligence, with its data analysis and pattern recognition capabilities, can assist accountants in making faster and more accurate decisions. The combination of these two technologies can lead to improved accounting processes, increased efficiency, and cost reduction. Furthermore, the use of artificial intelligence algorithms in the analysis of financial data can provide more accurate forecasts and identify risks. Ultimately, examining the role of these two technologies in enhancing and improving accounting information systems not only contributes to creating a more efficient environment but may also lead to the development of new accounting standards based on transparency, security, and accuracy.

2. Methodology

The present study is considered an applied and exploratory research in terms of its objective, and its tools can be used to design a model for accounting information systems based on blockchain technology and artificial intelligence. In this study, a mixed-method research approach was employed. Mixed-methods research is a study that combines both quantitative and qualitative outputs within the framework of a single or multi-phase methodology. The fundamental principle of mixed-methods research is the use of both quantitative and qualitative methods at various stages of the study, which can be conducted either simultaneously or sequentially, ensuring complementary strengths and non-overlapping weaknesses. Furthermore, in terms of temporal sequence, the research first collects qualitative data and subsequently quantitative data. Secondary interviews will then be conducted to confirm the findings.

In this research, priority and emphasis are given to the collection of qualitative data, while quantitative data are gathered to deepen understanding and to reinforce the investigation. One reason for using this sequence is that qualitative research appropriately explores the issue, identifies the best constructs, variables, and classifications for testing, and significantly aids in identifying and determining factors and scales for the development of quantitative tools. However, these explorations alone are not sufficient, and a quantitative component is also needed for a better and deeper understanding of the research problem. Therefore, the research method in this study is specifically an exploratory sequential mixed-methods design. First, qualitative data were collected through interviews with experts, and then, to pursue and complete the investigation, questions were answered. From the interviews, the components were extracted, and then using Interpretive Structural Modeling (ISM), a conceptual model within the framework of the study was designed.

The statistical population of this study consists of expert accountants fully familiar with information technology, blockchain, and artificial intelligence. Accordingly, expert accountants working in technology companies, familiar with information technology, blockchain, and artificial intelligence, participated as interviewees in the research. The sample size was determined based on theoretical saturation, and interviews continued until saturation was achieved. Ultimately, 18 experts were selected as the sample and participated in the interviews.

To perform Interpretive Structural Modeling, five main steps were taken:

1. Formation of the Structural Self-Interaction Matrix (SSIM)
2. Formation of the Reachability Matrix
3. Formation of the Transitivity Matrix
4. Level Partitioning of Indicators
5. Drawing the Driving Power-Dependence Diagram

3. Findings and Results

In this study, the data were analyzed using Interpretive Structural Modeling (ISM) and Structural Equation Modeling (SEM), which are described step-by-step below.

Step One: Identifying the Components Related to the Problem

Initially, based on the topic of the current research, an open-ended questionnaire was prepared and given to the experts to express the necessary components for model design from their perspective. By analyzing the collected questionnaires, a total of 15 components across three dimensions were identified. To confirm these components, the Content Validity Ratio (CVR) index was used. All 15 components were validated by the experts. Therefore, these 15 components were used for model development. The results of applying the Content Validity Ratio (CVR) are shown in Table 1.

Table 1. CVR Value for Each Component

No.	Component	CVR Value	Result	Dimension
1	Reducing human error	1	Confirmed	Artificial Intelligence
2	Managing and processing big data	1	Confirmed	
3	Improving process automation	1	Confirmed	
4	Forecasting and analyzing processes	1	Confirmed	
5	Improving computations	1	Confirmed	
6	Increasing information security	1	Confirmed	Blockchain Technology
7	Decentralization	1	Confirmed	
8	Reducing costs	1	Confirmed	
9	Increasing speed and efficiency	1	Confirmed	
10	Transparency in transactions	1	Confirmed	
11	Standardization	1	Confirmed	
12	Increasing information security	1	Confirmed	Enhancement and Improvement of Accounting Information Systems
13	Improving the accuracy and speed of reporting	1	Confirmed	
14	Increasing transparency and reliability	1	Confirmed	
15	Enhancement and improvement of software	1	Confirmed	

Step Two: Formation of the Structural Self-Interaction Matrix (SSIM)

After determining the components, another questionnaire in matrix format was designed, and the experts evaluated the relationships between the components in pairs, using a scale from 0 to 3 to define the relationships among components. Bolanos et al. (2005) stated that to integrate expert opinions, the aggregate of their opinions for each matrix entry should be used. The results obtained from the questionnaires regarding the examined components are presented in Table 2.

Table 2. Results Obtained from the Questionnaires

No.	Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

1	Reducing human error	0	50	50	51	52	53	44	45	45	46	39	50	54	52	53
2	Managing and processing big data	49	0	48	45	45	45	43	48	46	40	42	50	51	52	53
3	Improving process automation	48	48	0	47	43	43	45	45	48	49	47	46	50	52	53
4	Forecasting and analyzing processes	48	47	48	0	48	45	46	47	41	50	44	46	51	50	52
5	Improving computations	49	48	48	48	0	48	47	46	45	48	47	48	54	50	52
6	Increasing information security	30	32	32	32	30	0	49	45	44	43	44	50	52	52	53
7	Decentralization	30	30	34	32	32	48	0	48	49	45	46	49	54	50	52
8	Reducing costs	20	20	20	22	16	36	40	0	44	39	38	37	38	36	36
9	Increasing speed and efficiency	33	30	35	35	35	40	44	43	0	45	45	50	53	53	53
10	Transparency in transactions	33	30	30	30	20	45	45	47	46	0	49	51	52	53	52
11	Standardization	35	30	30	32	33	48	41	42	40	40	0	40	53	53	52
12	Increasing information security	34	33	33	29	25	32	32	30	32	31	32	0	52	52	53
13	Improving reporting accuracy and speed	33	28	26	27	26	22	10	12	6	19	28	52	0	53	53
14	Increasing transparency and reliability	28	27	29	28	28	26	21	22	24	28	29	52	51	0	52
15	Enhancement and improvement of software	26	25	22	26	31	30	28	26	30	33	34	52	53	52	0

Step Three: Formation of the Initial Reachability Matrix

The initial reachability matrix is obtained by converting relationships into binary values (zero and one) based on the Structural Self-Interaction Matrix (SSIM) through two stages:

In the first stage, a single numerical scale is defined, and the numbers from the previous table are compared with it. If a number from the previous table is greater than the scale, the new table assigns it a value of one; otherwise, it is assigned zero (Azar et al., 2014).

Bolanos et al. (2005) use the following formula to determine the scaling number:

$M = 2 \times n$

where n is the number of respondents and M is the scaling number. Since the number of experts is 18, it follows:

$M = 2 \times 18 = 36$

Therefore, according to Bolanos' logic, all values in the table smaller than 36 are replaced with zero (0) and values greater than or equal to 36 are replaced with one (1). Table 3 shows the Structural Self-Interaction Matrix (SSIM).

Table 3. Structural Self-Interaction Matrix

No.	Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Reducing human error	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Managing and processing big data	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
3	Improving process automation	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
4	Forecasting and analyzing processes	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
5	Improving computations	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
6	Increasing information security	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
7	Decentralization	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1
8	Reducing costs	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1
9	Increasing speed and efficiency	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1
10	Transparency in transactions	0	0	0	0	0	1	1	1	1	0	1	1	1	1	1
11	Standardization	0	0	0	0	0	1	1	1	1	1	0	1	1	1	1
12	Increasing information security	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
13	Improving reporting accuracy and speed	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
14	Increasing transparency and reliability	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1
15	Enhancement and improvement of software	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0

In the second stage, the matrix obtained in the first stage (Table 3) is added to the identity matrix to obtain the initial reachability matrix. By doing so, all diagonal elements are changed from 0 to 1. Table 4 shows the initial reachability matrix.

Table 4. Initial Reachability Matrix

No.	Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Reducing human error	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Managing and processing big data	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	Improving process automation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	Forecasting and analyzing processes	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	Improving computations	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	Increasing information security	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
7	Decentralization	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
8	Reducing costs	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
9	Increasing speed and efficiency	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
10	Transparency in transactions	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
11	Standardization	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
12	Increasing information security	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
13	Improving reporting accuracy and speed	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
14	Increasing transparency and reliability	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
15	Enhancement and improvement of software	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1

Step Four: Creation of the Final Reachability Matrix

After obtaining the initial reachability matrix, secondary relationships between components are examined. A secondary relationship occurs when component *i* leads to component *j* and component *j* leads to component *k*, thus component *i* also leads to component *k*. If such a relationship does not already exist in the initial matrix, it must be corrected and the missing link should be added. This process is referred to as adapting the initial reachability matrix. In this step, all secondary relationships between components were examined, but no new secondary relationships were discovered. Therefore, the final reachability matrix is the same as the initial reachability matrix. In this matrix, the driving power and dependence level of each component are also shown. The driving power of a component is obtained by summing the number of components it influences, including itself. The dependence level of a component is determined by summing the number of components that influence it, including itself.

Table 5. Final Reachability Matrix

No.	Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Driving Power
1	Reducing human error	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
2	Managing and processing big data	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
3	Improving process automation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
4	Forecasting and analyzing processes	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
5	Improving computations	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
6	Increasing information security	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	10
7	Decentralization	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	10
8	Reducing costs	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	10
9	Increasing speed and efficiency	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	10
10	Transparency in transactions	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	10
11	Standardization	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	10
12	Increasing information security	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	4

13	Improving reporting accuracy and speed	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	4
14	Increasing transparency and reliability	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	4
15	Enhancement and improvement of software	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	4
Dependence Level		5	5	5	5	5	11	11	11	11	11	11	15	15	15	15	-

Step Five: Determining Relationships and Level Partitioning of Components

In this step, using the reachability matrix, after determining the input and output sets, the intersection of these sets is obtained for each component. The output set of a component includes the component itself and the components it affects, which can be identified by the "1"s in the corresponding row. The input set of a component includes the component itself and the components that affect it, which can be identified by the "1"s in the corresponding column. After determining the input and output sets, the intersection of these sets is established for each component. Components whose output and intersection sets are completely identical are placed at the highest level of the Interpretive Structural Modeling (ISM) hierarchy.

In order to find the elements forming the next level of the system, the elements at the highest level are removed from the related mathematical table, and the process of determining the next level elements is carried out similarly to the determination of the first-level elements. This process is repeated until all elements forming the system's levels are identified. Table 6 shows the first iteration of level partitioning.

Table 6. Level Partitioning (First Iteration)

Component	Output Set	Input Set	Intersection Set	Level
1	15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	
2	15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	
3	15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	
4	15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	
5	15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	
6	15, 14, 13, 12, 11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	
7	15, 14, 13, 12, 11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	
8	15, 14, 13, 12, 11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	
9	15, 14, 13, 12, 11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	
10	15, 14, 13, 12, 11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	
11	15, 14, 13, 12, 11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	
12	15, 14, 13, 12	15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	15, 14, 13, 12	1
13	15, 14, 13, 12	15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	15, 14, 13, 12	1
14	15, 14, 13, 12	15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	15, 14, 13, 12	1
15	15, 14, 13, 12	15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	15, 14, 13, 12	1

As shown in Table 6, the output and intersection sets for components 12, 13, 14, and 15 are completely identical; therefore, they are placed in the first level. They are subsequently removed from the table for the continuation of the level partitioning. The next table shows the second iteration of the level partitioning.

Table 7. Level Partitioning (Second Iteration)

Component	Output Set	Input Set	Intersection Set	Level
1	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	
2	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	
3	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	
4	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	

5	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	
6	11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	2
7	11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	2
8	11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	2
9	11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	2
10	11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	2
11	11, 10, 9, 8, 7, 6	11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1	11, 10, 9, 8, 7, 6	2

As shown in Table 7, the output and intersection sets for components 6, 7, 8, 9, 10, and 11 are completely identical; therefore, they are placed at the second level and are subsequently removed from the table for the continuation of the level partitioning.

The next table shows the third (final) iteration of level partitioning.

Table 8. Level Partitioning (Third Iteration)

Component	Output Set	Input Set	Intersection Set	Level
1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	3
2	5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	3
3	5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	3
4	5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	3
5	5, 4, 3, 2, 1	5, 4, 3, 2, 1	5, 4, 3, 2, 1	3

As shown in Table 8, the output and intersection sets for components 1, 2, 3, 4, and 5 are completely identical; therefore, they are placed at the third level (final level), and the level partitioning is completed.

Step Six: Drawing the Final Model

At this stage, based on the component levels and the final reachability matrix, an initial model is drawn, and by eliminating transitive relationships from the initial model, the final model is obtained. Thus, the final ISM model, derived from the components related to accounting information systems based on blockchain technology and artificial intelligence, is illustrated as Figure 1.

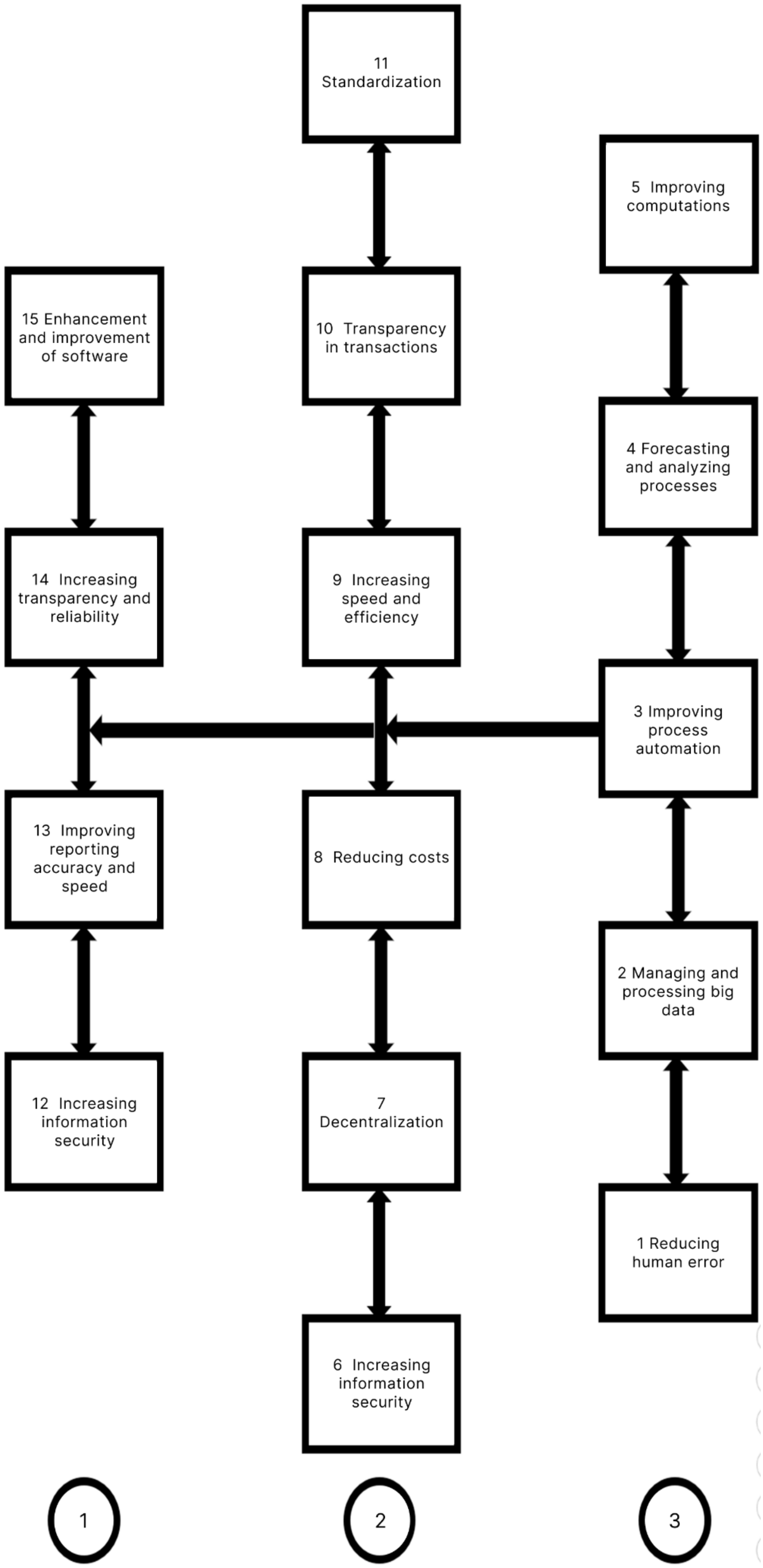

Figure 1. Initial ISM Model

By categorizing the components into the main dimensions, the model of accounting information systems based on blockchain technology and artificial intelligence is obtained, as illustrated in Figure 2.

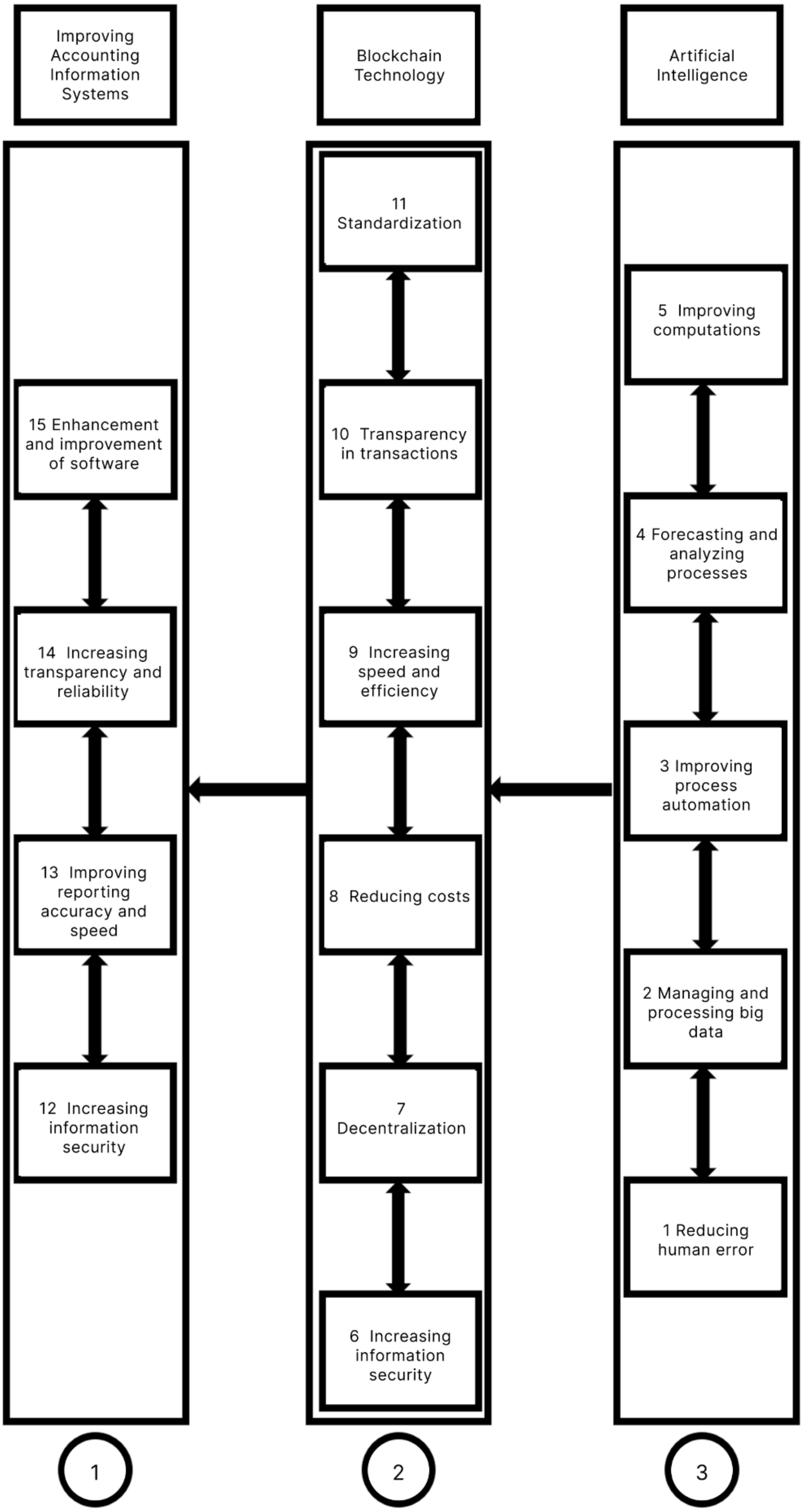

Figure 2. Model of Accounting Information Systems Based on Blockchain Technology and Artificial Intelligence

As shown in Figure 2, components 1 to 5 are categorized under the dimension of "Artificial Intelligence," components 6 to 11 under the dimension of "Blockchain Technology," and components 12 to 15 under the dimension of "Enhancement and Improvement of Accounting Information Systems."

Step Seven: Analysis of Driving Power and Dependence (MICMAC Diagram)

In this step, the components are classified into four groups. The first group includes autonomous components (Area 1) which have weak driving power and weak dependence. These components are somewhat isolated from other components and have limited relationships. The second group includes dependent components (Area 2), which have weak driving power but high dependence. The third group comprises linkage components (Area 3). These components have both high driving power and high dependence. In fact, any action on these components results in changes in other components. The fourth group includes independent components (Area 4). These components have high driving power and low dependence. Components with high driving power are referred to as key components. Clearly, these components fall into either the independent or linkage categories.

By summing the "1" entries in each row and column, the driving power and dependence of the components are determined. Based on this, the driving power-dependence diagram is drawn.

Using the data obtained from Step Four, the studied components can be categorized into the following four levels based on the driving power of each component over others and their dependence on others:

- Autonomous: Components with minimal dependence and minimal driving power over other components.
- Dependent: Components that have a high dependence on other components.
- Linkage (Connected): Components that have a two-way relationship with other components.
- Independent (Driving): Components that have significant influence over other components.

To determine the coordinates of each component in the MICMAC matrix, the driving power and dependence values of the component are used. These values are obtained from the final reachability matrix. Table 9 shows the driving power and dependence of each component.

Table 9. Driving Power and Dependence of Each Component

No.	Component	Dependence	Driving Power
1	Reducing human error	5	15
2	Managing and processing big data	5	15
3	Improving process automation	5	15
4	Forecasting and analyzing processes	5	15
5	Improving computations	5	15
6	Increasing information security	11	10
7	Decentralization	11	10
8	Reducing costs	11	10
9	Increasing speed and efficiency	11	10
10	Transparency in transactions	11	10
11	Standardization	11	10
12	Increasing information security	15	4
13	Improving reporting accuracy and speed	15	4
14	Increasing transparency and reliability	15	4
15	Enhancement and improvement of software	15	4

Using the coordinates of the components listed in Table 9, the MICMAC matrix is formed (Figure 3).

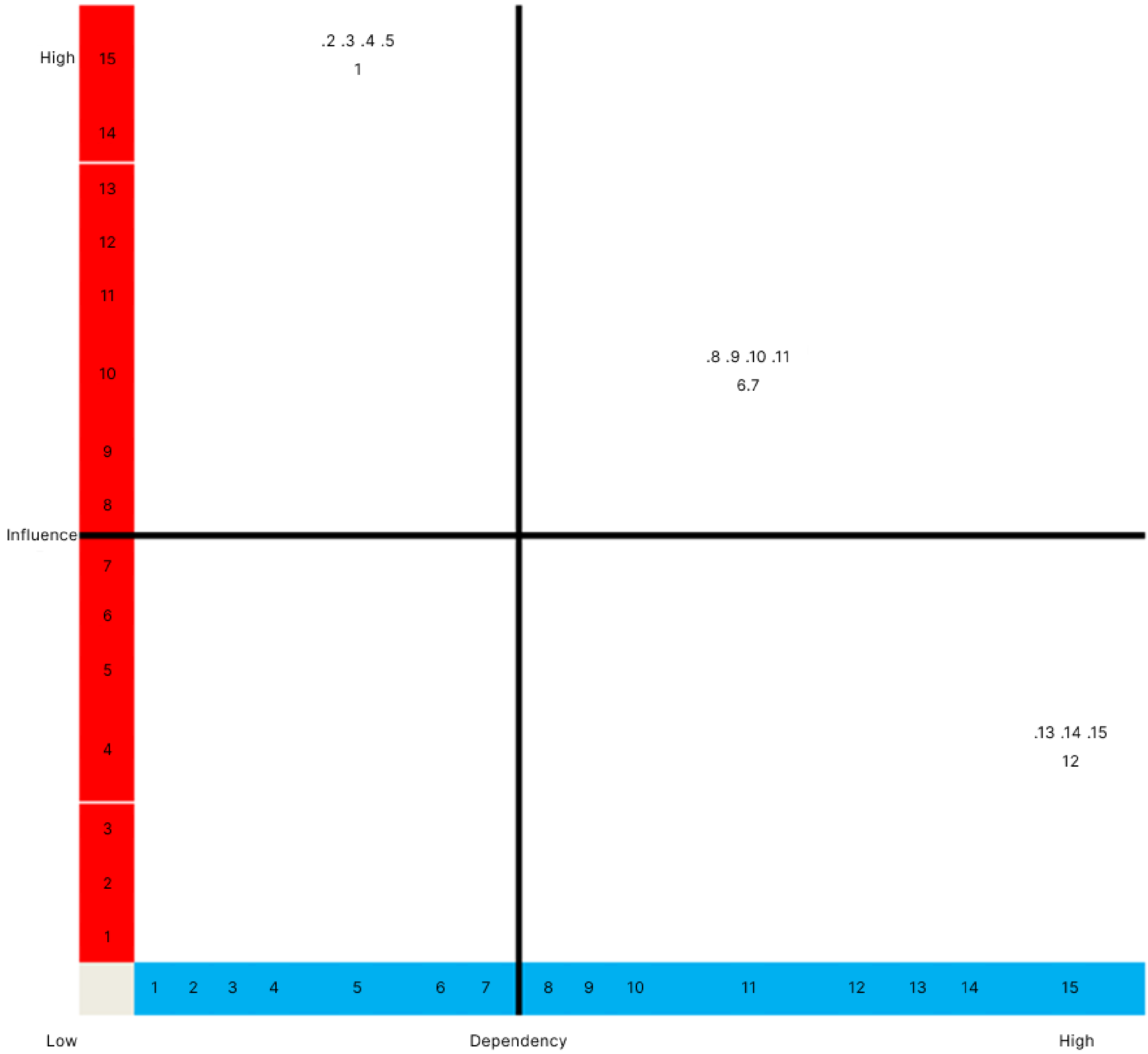

Figure 3. MICMAC Matrix

As shown in the MICMAC matrix, components 12, 13, 14, and 15 fall into the dependent area, meaning they have low driving power but high dependence relative to other components. Components 1, 2, 3, 4, and 5 fall into the driving area. These components have high driving power with minimal dependence. Components 6, 7, 8, 9, 10, and 11 fall into the autonomous area, meaning they have both low driving power and low dependence.

4. Discussion and Conclusion

Blockchain technology and artificial intelligence, as two modern tools, play a significant role in the enhancement and improvement of accounting information systems. Blockchain, by creating an immutable and transparent structure, increases security and trust in recording and storing financial data, thereby minimizing the risk of fraud. On the other hand, artificial intelligence, with its capability to analyze data and identify patterns, assists accountants in making faster and more accurate decisions. The combination of these two technologies can optimize accounting processes and enhance efficiency. Moreover, the use of artificial intelligence algorithms in forecasting financial trends and identifying risks contributes to improved financial reporting and analysis. Ultimately, these innovations can establish new accounting standards based on transparency, security, and accuracy.

Based on interpretive structural modeling (ISM) and the opinions of experts, a total of 15 components were presented within three dimensions in the final ISM model. The components of reducing human error, managing and processing big data, improving process automation, forecasting and analyzing processes, and enhancing computations were categorized under the dimension of "Artificial Intelligence" at the third level of the model. The components of increasing information security, decentralization, reducing costs, enhancing speed and efficiency, transaction transparency, and standardization were categorized under the dimension of "Blockchain Technology" at the second level of the model. The components of increasing information security, improving reporting accuracy and speed, enhancing transparency and reliability, and improving and upgrading software were categorized under the dimension of "Enhancement and Improvement of Accounting Information Systems" at the third level of the model.

The components related to enhancing information security, improving reporting accuracy and speed, increasing transparency and reliability, and improving and upgrading software under the dimension of enhancing and improving accounting information systems are upgraded through the use of blockchain technology and artificial intelligence. The use of blockchain technology and artificial intelligence can help enhance accounting information systems. Specifically, these technologies can facilitate the improvement of reporting accuracy and speed. Through blockchain, financial and accounting information is recorded permanently and immutably, which increases the reliability and transparency of financial reports.

Additionally, artificial intelligence can expedite software improvement and contribute to increasing information security by automatically identifying and preventing weaknesses and security threats. Artificial intelligence can also implement predictive algorithms for detecting financial fraud and misconduct. Similarly, blockchain ensures the secure and reliable recording and storage of financial transactions, leading to increased trust and transparency in accounting information systems. Overall, the use of blockchain technology and artificial intelligence can bring significant improvements in the performance and security of accounting information systems, as well as assist in enhancing accounting software and processes.

Han et al. (2023) in their study stated that blockchain and artificial intelligence systems improve the reliability and efficiency of accounting and auditing systems [15]. Alkan (2022) noted that blockchain and artificial intelligence impact cloud-based accounting information systems [17]. Fullana and Ruiz (2021) highlighted that the focus of accounting information systems in the blockchain era leads to enhanced governance, transparency, trust, continuous auditing, and smart contracts [22].

In response to the research questions, the factors of increasing information security, decentralization, reducing costs, enhancing speed and efficiency, transaction transparency, and standardization within the dimension of blockchain technology contribute to the improvement of accounting information systems. Likewise, the factors of reducing human error, managing and processing big data, improving process automation, forecasting and analyzing processes, and enhancing computations within the dimension of artificial intelligence contribute to the improvement of accounting information systems.

The use of blockchain technology and artificial intelligence can particularly facilitate the improvement of reporting accuracy and speed. Through blockchain, financial and accounting information is recorded permanently and immutably, increasing the reliability and transparency of financial reports. Artificial intelligence can expedite software improvement and help enhance information security by automatically identifying and preventing weaknesses and threats. Predictive algorithms can be implemented using artificial intelligence to detect financial fraud and misconduct. Blockchain ensures that financial transactions are recorded and stored securely and reliably, boosting trust and transparency in accounting information systems.

Overall, blockchain technology and artificial intelligence can create significant improvements in the performance and security of accounting information systems and assist in enhancing accounting software and processes.

A practical recommendation to company managers is to use blockchain technology and artificial intelligence to improve the reporting of accounting information systems. These technologies can help companies increase the accuracy, transparency, and security of their accounting reporting. The use of blockchain can help companies permanently and immutably record their accounting information, making it possible to detect any improper or fraudulent changes in reports. Furthermore, this technology can enhance the processes of transferring and storing accounting information with higher security.

On the other hand, artificial intelligence can help companies automatically and accurately analyze their accounting information and provide more precise and timely reports. This technology can also help companies identify different patterns in accounting data and assist in better decision-making. In summary, using blockchain technology and artificial intelligence can help companies achieve improved reporting of accounting information systems and enjoy higher accuracy, transparency, and security.

A practical recommendation for companies to enhance the technological infrastructure of blockchain and artificial intelligence in accounting information systems is to develop a blockchain-based accounting system utilizing artificial intelligence. Such a system could offer functionalities like automation of accounting processes, fraud and misuse detection, financial data forecasting and analysis, and automated reporting.

Using blockchain technology, all financial transactions would be recorded and stored in a blockchain network, and using artificial intelligence, these data could be automatically analyzed to predict financial patterns and detect any violations or misuse of the system. These actions would not only improve the accuracy and efficiency of the accounting system but also reduce costs and the time required to carry out accounting activities.

Furthermore, by increasing trust and transparency in financial processes, this system could improve relationships with customers, suppliers, and other stakeholders.

It is recommended that future researchers examine the effects of blockchain technology on improving the security, transparency, and efficiency of financial operations in accounting information systems. It is also recommended that future research evaluate the impact of artificial intelligence on the improvement of data processing and financial information analysis in blockchain-based accounting information systems. Moreover, it is suggested that future studies employ other qualitative methods such as thematic analysis and grounded theory for developing models of accounting information systems based on blockchain technology and artificial intelligence.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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