The Impact of Blockchain Technology on the Development of the Internal Audit Function in Banks Operating in Yemen - Sana'a

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ABSTRACT

The objective of this study was to ascertain the extent to which blockchain technology impacts the speed and accuracy of transactions, encryption technology (security and protection), transparency and credibility, and decentralisation. The objective of the study was twofold: firstly, to ascertain the extent to which these dimensions enhance the efficiency and effectiveness of internal audit operations; and secondly, to develop the internal audit function. The present study employed a descriptive-analytical approach. The study population comprised employees working in the 22 banks operating in Sana'a. The present study sample comprised 140 specialist employees from Yemeni banking institutions, including financial managers, heads of internal audit departments, financial administration employees, internal audit employees and information technology employees.

The study concluded that blockchain technology exerts a statistically significant impact on the development of the internal audit function in banking institutions in the Republic of Yemen. The technology in question has been demonstrated to improve the speed and accuracy of financial transactions, enhance data security and protection through encryption techniques, increase the transparency and traceability of financial operations and support the decentralisation of information management and exchange.

Keywords: The following topics will be discussed: blockchain technology, the internal audit function and Yemeni banks.

INTRODUCTION

In recent years, the field of financial technology has undergone substantial growth, exerting considerable influence on diverse economic sectors on a global scale. One of the most significant developments is blockchain technology, which has the potential to engender radical change in many fields, particularly the banking sector.

The blockchain technology is a decentralised system that securely and transparently records transactions, providing an unprecedented level of accuracy and protection.

In light of the challenges confronting Yemeni banking institutions, including elevated fraud risk and a paucity of transparency in financial operations, the imperative of leveraging modern technologies to bolster internal auditing processes becomes evident.

The pivotal function of internal auditing within an organisation is threefold: firstly, to ensure compliance with extant laws and regulations; secondly, to enhance internal control; and thirdly, to provide management with accurate reports. Nevertheless, a paucity of available resources and technology has the potential to exert a detrimental effect on the effectiveness of this function.

The present study will explore the potential of blockchain technology to enhance the internal audit function in banking institutions operating within Yemen. The study will analyse how this technology can enhance transparency, reduce risk and increase the accuracy of financial operations.

This study is considered a significant addition to the extant literature on the subject, as it highlights the impact of blockchain in a banking environment facing specific challenges. The objectives of this study are to provide practical recommendations that will assist banks in the effective adoption of this technology, thereby contributing to the development of the internal audit function and enhancing the efficiency of financial operations. The objective of this study is to examine the characteristics of blockchain technology, which are manifold.

The following four factors must be considered when evaluating encryption technology: accuracy, encryption technology, transparency and disclosure, and decentralisation.

Study Problem

It is widely acknowledged that blockchain technology constitutes a novel technological revolution, with the potential to engender fundamental changes in financial and banking systems. In the context of mounting challenges confronting Yemeni banking institutions, including elevated levels of fraud, opacity in operations, and deficiencies in internal audit processes, there is an imperative to investigate the potential of leveraging this technology to enhance the efficacy of internal operations.

The central issue of the present study is to ascertain the extent of the impact of blockchain technology on the development of the internal audit function in Yemeni banks. The fundamental question pertains to: The impact of blockchain technology on the enhancement of internal audit functions in banking institutions operating within the Republic of Yemen is a subject that merits investigation.

The problem under discussion is characterised by a series of sub-questions that address the various aspects of the impact of blockchain technology. These sub-questions include the following:

1. The present study sets out to investigate the impact of transaction processing speed and accuracy on the development of the internal audit function in banking institutions operating within the Republic of Yemen. The present study sets out to investigate the extent to which the speed and accuracy of transaction processing affects the development of the internal audit function in banks operating in the Republic of Yemen.

2. The present study seeks to investigate the impact of encryption technology on the development of the internal audit function in banking institutions operating within the Republic of Yemen. The present study seeks to investigate the impact of encryption technology on the development of the internal audit function in banking institutions operating within the Republic of Yemen.

3. The present study sets out to investigate the extent to which the completion of transactions with transparency and credibility affects the development of the internal audit function in banks operating in the Republic of Yemen. The present study sets out to investigate the extent to which the completion of transactions with transparency and credibility affects the development of the internal audit function in banks operating in the Republic of Yemen.

4. The extent to which decentralisation affects the development of the internal audit function in banks operating in the Republic of Yemen is the central question of this study. The extent to which decentralisation affects the development of the internal audit function in banks operating in the Republic of Yemen is the central question of this study.

The objective of this research is to explore the potential benefits that blockchain technology can offer to banking institutions, with a view to enhancing the efficacy of internal audit processes. The central hypothesis is that this can be achieved by achieving a higher level of transparency and reliability in financial performance.

Study objectives

The objective of the present study is to provide a comprehensive understanding of the impact of blockchain technology on the development of the internal audit function in Yemeni banks. In order to achieve the primary objective of this study, which is to ascertain the extent of the impact of blockchain technology on the development of the internal audit function in banking institutions operating within the Republic of Yemen, the following subsidiary objectives are proposed:

1. The present study aims to evaluate the impact of the speed and accuracy of transaction completion using blockchain technology on the development of the internal audit function in banks operating in the Republic of Yemen. The present study aims to evaluate the impact of the speed and accuracy of transaction processing using blockchain technology on the development of the internal audit function in banks operating in the Republic of Yemen.

2. This study sets out to examine the impact of encryption technology on the development of the internal audit function in banking institutions operating within the Republic of Yemen. The primary focus of this analysis is to explore the implications of encryption technology on aspects of security and protection. This study sets out to examine the impact of encryption technology on the development of the internal audit function in banking institutions operating within the Republic of Yemen. The primary focus of this analysis is to explore the implications of encryption technology on aspects of security and protection.

3. This study explores the extent to which the completion of transactions with transparency and credibility affects the development of the internal audit function in banks operating in the Republic of Yemen. This study explores the extent to which the completion of transactions with transparency and credibility affects the development of the internal audit function in banks operating in the Republic of Yemen.

4. The present study will examine the impact of decentralisation on the development of the internal audit function in banking institutions operating within the Republic of Yemen. This study sets out to examine the extent to which decentralisation impacts the development of the internal audit function in banking institutions operating within the Republic of Yemen.

The importance of the study is as follows

1. The scientific importance of the following points is demonstrated by the following evidence: Scientific significance:

This study contributes to the extant corpus of research on blockchain, thereby enabling researchers and students to benefit from the presented results and recommendations.

2. The practical significance of the text is as follows: The practical significance of the aforementioned point is as follows:

The significance of this research is rooted in the pressing necessity for financial institutions to embrace contemporary technologies in order to contend with the mounting challenges pertaining to security and regulatory compliance. By comprehending the repercussions of blockchain technology on the domain of internal auditing, financial institutions can enhance their operational efficiency, fortify the confidence of their clientele and investors, and optimise their adherence to financial standards and regulations.

Study Hypotheses

In the context of extant studies and theoretical literature pertaining to the impact of blockchain technology on the development of the internal audit function in banking institutions, the following hypotheses can be formulated in light of the study's problem and objectives:

The primary hypothesis posits that: The impact of blockchain technology on the development of the internal audit function in banking institutions operating within the Republic of Yemen is not found to be statistically significant.

The following sub-hypotheses can be derived from this

1. The present study investigates the hypothesis that the speed and accuracy of financial transaction processing exerts a statistically significant effect on the development of the internal audit function in banking institutions operating within the Republic of Yemen. The present study investigates the hypothesis that the speed and

accuracy of financial transaction processing exerts a statistically significant effect on the development of the internal audit function in banking institutions operating within the Republic of Yemen.

2. The present study finds no statistically significant effect of encryption technology on the development of the internal audit function in banking institutions operating within the Republic of Yemen. The impact of encryption technology on the development of the internal audit function in banking institutions operating within the Republic of Yemen is not statistically significant.

3. The study found no statistically significant impact of transparency and credibility in transactions on the development of the internal audit function in banking institutions operating within the Republic of Yemen. The present study finds no statistically significant effect of conducting transactions with transparency and credibility on the development of the internal audit function in banks operating in the Republic of Yemen.

4. The present study finds no statistically significant effect of decentralisation on the development of the internal audit function in banking institutions operating within the Republic of Yemen. The present study finds no statistically significant effect of decentralisation on the development of the internal audit function in banking institutions operating within the Republic of Yemen.

Study model

LITERATURE REVIEW

Al-Harbi's (2023) study examined the impact of blockchain technology on the enhancement of internal auditing practices in Gulf banks. The study's findings indicated that the technology has the potential to contribute to the improvement of audit efficiency, the acceleration of procedures, the enhancement of information accuracy, and the reduction of fraud risks. However, the study also identified challenges related to implementation costs and a lack of technical competencies. The study by Shaboun and Al-Tairi (2022) sought to ascertain the extent of accountants' knowledge of blockchain technology and their expectations regarding its importance in financial accounting. The study indicated that the level of knowledge was average, while the expectations were positive, with a positive relationship between knowledge of the technology and expectations of its use. In a similar vein, Hassan's study (2020) demonstrated that the implementation of blockchain technology contributes to the enhancement of external auditing procedures, leading to a reduction in execution time and an improvement in the efficiency of audit evidence. The study by Nakhal (2020) also found that the utilisation of blockchain technology enhances the auditor's accountability and improves the quality of the audit process and the reliability of its results. Conversely, the study by Alarcon et al. (2024) demonstrated that blockchain technology enhances auditors' capacity to detect and prevent fraud, whilst concomitantly increasing the efficiency and accuracy of audit processes, notwithstanding challenges related to training and institutional implementation. The study by Christensen et al. (2023) demonstrated that the technology contributes to enhancing the quality of financial data, promoting transparency, trust, and compliance, in addition to developing auditing tools. Nevertheless, the study identified ongoing challenges related to cost and technical skills. The study by Cao et al. (2019) confirmed that blockchain enhances the reliability of financial information, provides more suitable audit evidence, and improves the quality of financial reports. By way of contrast, the study by Manlu et al. (2019) concluded that the development of technology will have a significant impact on the accounting and auditing profession. This impact will be characterised by the development of transaction recording mechanisms, improvements in audit efficiency, and the emergence of new roles for auditors requiring advanced technical skills.

Theoretical framework

The nature of blockchain technology

The term "blockchain" was first coined in a paper titled "Bitcoin: A Peer-to-Peer Electronic Cash System", published in 2008 by an individual or group operating under the name Satoshi Nakamoto. The term was then applied to the fundamental part on which the Bitcoin electronic cash system operates, as presented in the paper (Al-Subaie, Fatima, p. 4).

The term "blockchain" is defined as a database that uses encryption mechanisms to build a decentralised electronic ledger, distributed and interconnected in a chronological, immutable, and tamper-proof manner. The platform is distinguished by its commitment to transparency, expediency, and simplicity in transactional processes. Furthermore, it enables the relevant parties to engage in its construction, verify its accuracy, and maintain it in accordance with regulated self-operating systems and instructions.

The utilisation of the concept is as follows (Ahmed and Munir, 2019, p. 13).

The importance of blockchain

The significance of blockchain technology lies in its capacity to address numerous challenges confronting the banking sector, particularly in developing countries, where conventional systems are characterised by a paucity of transparency and elevated fraud risks.

The World Bank (2023, p. 56) asserts that the integration of blockchain technology within financial systems has the potential to contribute to a reduction in transaction costs and an enhancement in transaction execution speed. This, in turn, has the capacity to engender an improvement in the efficiency of banking performance.

A study by Deloitte (2024, p. 18) posits that blockchain contributes to

- The enhancement of data quality is of paramount importance.
- The enhancement of internal control is of paramount importance.
- The reduction of operational errors is a key benefit of blockchain technology in the context of internal auditing. By providing a reliable data environment, blockchain enables auditors to shift their focus from manual data verification to risk analysis (Appelbaum et al., 2018, p. 12).

A study undertaken by ICAEW (2020) provided a concise overview of the salient aspects of blockchain technology. The following points were identified as the most significant

1. Spread: It is important to note that, in contrast to traditional ledgers, which are subject to the limitations of a single, primary copy, blockchain technology facilitates the distribution of numerous replicas, thereby ensuring redundancy and resilience. Distribution: It is important to note that, in contrast to traditional ledgers, which are subject to the limitations of a single, primary copy, blockchain technology facilitates the distribution of numerous replicas, thereby ensuring redundancy and resilience. It is imperative to note that all participants have the capacity to access a complete copy of the ledger. It is equally crucial to emphasise that all these copies are identical and equivalent. It is evident that no individual or group has the capacity to exercise uncontested authority over the ledger. New transactions. New operations are rapidly catalogued, implemented, and circulated to all network participants.

2. Stability: It is imperative that each participant possesses a copy of the ledger. Stability: It is imperative that each participant possesses a copy of the ledger. It is not possible to modify previous transactions; they can only be added to. This means that blockchain records are considered to be immutable. The entire ledger is stored by each participant and can be inspected and verified through consensus.

3. Programming: It is notable that certain blockchains facilitate the storage of code in addition to ledger entries, a feature that leads to the automatic generation of journal entries upon execution. Programming: It is notable that certain blockchains facilitate the storage of code in addition to ledger entries, which automatically generate journal entries upon execution. This is known as a "smart contract".

The following section outlines the components of blockchain technology.

The technology is comprised of the following elements: (Al-Bar, 2021, p. 8)

1. Block: This fundamental component of blockchain represents the building unit, comprising a series of operations, transactions, or tasks that must be executed.

2. Transactions: These elements represent the information, operations, or sub-tasks contained within the block. Transactions: These elements represent information, processes, or sub-tasks within the block.

3. Encryption: The application under discussion is employed for the execution of numerous tasks, the most significant of which are: the derivation of the unique address of the blockchain, the creation of unique definitions within the block, the securing of block data and the securing of the block header. Encryption: The application under discussion is employed for the execution of numerous tasks, the most significant of which are:

- the derivation of the unique address for the blockchain, which facilitates the differentiation between different blockchains;

- the creation of unique definitions within the block;

- the securing of block data; and

- the securing of the block header.

4. The asymmetric encryption key: The underlying technology of blockchain is reliant upon a cryptographic system that utilises a pair of asymmetric keys, referred to as a public key and a private key. These keys are mathematically linked to each other, forming the fundamental basis of the blockchain network. The asymmetric encrypted key: The underlying principle of blockchain technology is predicated on an encryption system that utilises a pair of asymmetric keys, namely a public key and a private key, which are mathematically linked to each other.

5. The following essay will explore the concept of addresses and address derivation. The technology functions by utilising an address, which is comprised of a series of alphabetical or numerical characters derived from the public key of the blockchain user, employing encryption technology.

6. Ledgers: The ledger is notable for its comprehensive and reliable historical records, which are distinguished by their transparency. These records are accessible to all participants in the blockchain via identical copies, utilising a direct network that functions without the necessity for a central intermediary to guarantee or verify these transactions. Ledgers: The ledger is characterised by its comprehensive and reliable historical records, which are transparent and available to all participants in the blockchain. This is achieved through identical copies being distributed using a direct network, thus eliminating the need for a central intermediary to guarantee or verify these transactions.

7. The blocks are interconnected by a hash, thereby forming a chain of blocks. Chained blocks: The blocks are interconnected by a hash, thereby forming a blockchain.

The notion of internal audit, and the interest therein, is the subject of this discourse. (Ibrahim Taha, 2004, p. 275)

Field study

In accordance with the study's problem and objectives, the target population comprises employees engaged in banking operations in Yemen within their primary establishments in the capital, Sana'a. This population is comprised of a total of 22 banks, as reported by the Central Bank of Yemen (Sana'a) in their statistics for the year 2023. The sample comprised all employees in the primary branches of Yemeni banks operating in Sana'a. With regard to the unit of analysis, it was meticulously selected from banking specialists, with a total of 460 employees working in the following roles: financial managers, internal audit managers, financial and internal audit staff, and information technology management. As indicated by the findings of the Krejcie & Morgan table, the study concluded that the optimum sample size is 210 individuals. Therefore, the preparation of 220 questionnaires was undertaken, with subsequent distribution to the respondents. A total of 147 questionnaires were retrieved; however, subsequent examination revealed that seven of these were deemed to be invalid for analysis. Consequently, the number of questionnaires that were approved for statistical analysis was 140, out of the total number of questionnaires that were distributed.

Study reliability

Table (1) Cronbach's alpha reliability coefficient for the study axs and the tool as a whole

No	The variable	The axis	Number of paragraphs	Alpha reliability
1	Independent variable	The velocity and precision of transaction finalisation.	6	.665
2		Security and protection - encryption technology	6	.668
3		Transparency and credibility	6	.676
4		Decentralization	7	.699
5	The dependent variable	Internal audit	8	.636
The axs as a whole			33	.876

As demonstrated in the table, the reliability coefficient (Cronbach's alpha) is deemed acceptable for all axes, with values ranging from 0.636 to 0.699. Concurrently, the aggregate reliability score for all questionnaire items is 0.876. This finding suggests that the study population exhibits homogeneity in their responses to the questionnaire, thereby indicating the presence of a consistent opinion within the sample. It is posited that the community's opinion would remain stable even if the questionnaires were distributed to a larger number of community members. Consequently, the validity and reliability of the study questionnaire in analysing the results, answering the study questions, and testing the hypotheses have been confirmed.

The following section presents the results of the normality test for the study sample.

Table (2) Results of the normality test for the study sample

No	The main axs of the questionnaire	Normal distribution		The judgment
		Value of Z	The indication (Sig)	
1	Speed and accuracy of transaction processing	.194	.000	It follows a normal .distribution
2	Encryption technology (security and protection)	.175	.000	It follows a normal distribution.
3	Transparency and credibility	.202	.000	It follows a normal distribution.
4	Decentralization	.183	.000	It follows a normal distribution.
5	Internal audit	.137	.000	It follows a normal distribution.
The overall indicator		**.160**	**.000**	It follows a normal .distribution

As illustrated in Table 2, the distribution index (Z) exhibited a range of values between 0.202 and 0.137 for the specific study axes. The aggregate distribution index for all axes was determined to be 0.160. The statistical significance of these values was determined at the 0.05 level of confidence, indicating that the data can be considered to follow a normal distribution.

Descriptive statistics:

Firstly: The following analysis is based on the results of the descriptive statistics relating to the axes of speed and accuracy in the completion of financial transactions.

Table (3) The means, standard deviations, and ranks for the axis of speed and accuracy in financial transaction completion.

No	Paragraph	Mean	St.deviation	Rank
1	It helps reduce errors resulting from manual transactions.	4.31	0.564	5
2	It provides accurate data and sharing it with interested parties promptly leads to increased productivity efficiency.	4.31	0.677	6
3	It contributes to speeding up the review processes of accounting data.	4.50	0.569	1
4	Enables the execution of financial transactions at high speed.	4.34	0.706	4
5	It reduces the time required to prepare internal financial reports.	4.41	0.668	2
6	It allows for tracking all transactions and settling them instantly without the need for any intermediaries or regulatory procedures.	4.34	0.585	3
	Total Mean	**4.3690**	**0.38548**	***3**

As demonstrated in Table 3, the arithmetic means for all items on the axis ranged between 4.31 and 4.50, which is higher than the adopted hypothetical mean of 3. This finding suggests that all sample members were in agreement with the items included in the axis. It is also noteworthy that item number (3), which states that the speed and accuracy of transaction completion "contribute to accelerating the review processes of accounting data," was ranked first on the axis with a mean of (4.50) and a standard deviation of (0.569). This indicates that the sample members were in agreement with the content of the item and that their responses were consistent and harmonious. Item number (2), which states that "providing accurate data and exchanging it with interested parties as quickly as possible leads to increased productivity," ranked last in the axis with a mean of (4.31) and a standard deviation of (0.677). This indicates that the sample members agreed with the content of the item, as well as the consistency and harmony of their responses. In the final position at the level of the axis, with a mean of (4.31) and a standard deviation of (0.677), this indicates the level of agreement amongst the sample members with the content of the paragraph, as well as the consistency and harmony of their responses. With regard to the ranking of the axes, the "Speed and Accuracy of Financial Transactions" axis achieved an average of (4.3690), which is the third highest average among all the axes.

Secondly: The following analysis is based on the descriptive statistics results for the encryption technology axis (security and protection).

Table No. (4) The means, standard deviations, and ranks for the security and protection axis – encryption technology (security and protection)

No	Paragraph	Mean	St.deviation	Rank
1	Enhances the protection of banking data against tampering.	4.40	0.644	4

2	Blockchain prevents unauthorized access to sensitive information.	4.41	0.635	3
3	The decentralized database helps reduce data breaches.	4.46	0.693	1
4	It increases the reliability of the data used in auditing due to the stability and sequencing of banking operations.	4.42	0.635	2
5	The bank uses more than one central server to increase security.	4.30	0.596	6
6	The bank has a highly secure and hard-to-hack database.	4.35	0.678	5
	Total Mean	**4.3905**	**0.36415**	***2**

As demonstrated in Table 4, the arithmetic means ranged from 4.30 to 4.46, which is higher than the hypothetical mean adopted in the study (3). The standard deviations for each item in the "Encryption Technology (Security and Protection)" axis also indicate the sample members' agreement with the items included in the axis, as well as the consistency and coherence of the sample members' responses, which were concentrated in agreement. As demonstrated in Table 4, item number 3, which states "Decentralised databases help reduce data breach incidents", occupies the first position on the axis with a mean of 4.46 and a standard deviation of 0.693. Conversely, paragraph 5, "The bank uses more than one central server to increase security", occupies the last position on the axis with a mean of 4.30 and a standard deviation of 0.596. In the final position at the level of the axis, the arithmetic mean is (4.30) and the standard deviation is (0.596). These statistics indicate a consensus among the sample members regarding the paragraph. It is noteworthy that the axis in question attained the second-highest arithmetic mean among all the axes.

Thirdly, an analysis of the descriptive statistics results for the axis of completing transactions with transparency and credibility was conducted.

Table (5) The arithmetic means, standard deviations, and ranks for the axis of completing transactions with transparency and credibility.

No	Paragraph	Mean	St.deviation	Rank
1	Transparency in the bank helps ensure that procedures are implemented correctly.	4.50	0.606	2
2	Transparency enables all parties in the bank to see the changes occurring in the bank.	4.45	0.703	3
3	Transparency in the bank enhances the process of accessing information related to financial activities.	4.54	0.593	1
4	Transparency at the bank increases the degree of flexibility in using financial technology.	4.31	0.613	5
5	The bank is keen on making operations transparent to eliminate financial corruption.	4.17	0.795	6
6	Transparency enhances the reliability of data for all parties dealing with the bank.	4.43	0.711	4
	Total Mean	**4.4000**	**0.41639**	**1**

As demonstrated in Table (5), the arithmetic means for this axis ranged between (4.42–4.63), which are higher than the adopted hypothetical mean (3). This finding suggests that all sample members were in agreement with the items included in the axis. Furthermore, the mean for the axis was found to be 4.4000, indicating a consensus

among the sample members regarding the included items. The standard deviation for the entire axis was (0.41639), indicating the consistency and agreement of the respondents' answers regarding the items included in the axis, meaning that the responses were centered around agreement.

As demonstrated in Table 5, item number 3, which states 'Transparency in the bank enhances access to information related to financial activities', ranked first on the axis with a mean of 4.54 and a standard deviation of 0.593. Conversely, paragraph number 5, which states 'The bank is keen on making operations visible to eliminate financial corruption', ranked last. In the final position at the level of the axis with an arithmetic mean of (4.17) and a standard deviation of (0.795), it is evident that there is a consensus among the sample members regarding the items of the transparency and credibility axis. This is further supported by the consistency of the answers and their tendency to align with the prevailing opinion. The axis as a whole was found to be the most effective, with the highest arithmetic mean.

Fourthly, an analysis of the descriptive statistics results for the decentralisation axis is to be conducted.

Table 6 presents the responses of the sample members to the items of the decentralisation axis.

Table (6) The means, standard deviations, and ranks for the decentralization axis.

No	Paragraph	Mean	St.deviation	Rank
1	The bank uses decentralization to increase the speed of information access.	4.27	0.687	4
2	Decentralization reduces the need for direct human intervention in data verification.	4.25	0.760	5
3	Decentralization supports the ease of data flow between different departments.	4.32	0.649	2
4	Decentralization contributes to improving the efficiency of the internal control system.	4.20	0.712	6
5	Decentralization reduces the risk of relying on a single source for data verification.	4.31	0.821	3
6	Decentralization in the bank enhances the process of accurately measuring performance.	4.20	0.779	7
7	Decentralization contributes to cooperation and coordination with external entities.	4.41	0.739	1
	Total Mean	**4.2806**	**0.44037**	***5**

As demonstrated in Table 6, the arithmetic means for this axis ranged between 4.20 and 4.41, which are higher than the adopted hypothetical mean of 3. This finding suggests that all sample members were in agreement with the items included in the axis. It is also observed that item number (7), which states "Decentralisation contributes to cooperation and coordination with external entities," occupies the first position on the axis with a mean of (4.41) and a standard deviation of (0.739).

Conversely, item number (6), which states "Decentralisation in the bank enhances the performance measurement process accurately," occupies the last position on the axis with a mean of (4.20) and a standard deviation of (0.779). In the final position at the level of the axis with an arithmetic mean of 4.20 and a standard deviation of 0.779, it is evident that there is a consensus among the sample members regarding the content of the paragraph. The axis as a whole received the lowest rank in terms of arithmetic mean or the least agreement.

The fifth issue to be addressed is the analysis of the descriptive statistics results for the internal audit axis.

Table (7) shows the response of the sample members to the items of the monitoring and follow-up axis.

Table (7) The means, standard deviations, and ranks for the internal audit axis.

No	Paragraph	Mean	St.deviation	Rank
1	The use of blockchain technology by the bank helps the internal auditor quickly access information.	4.51	0.629	1
2	The internal auditor can use blockchain technology to track all financial transactions without the need for intermediaries or regulatory procedures.	4.46	0.605	2
3	The transparency provided by blockchain increases the internal auditor's ability to know the changes occurring in the bank.	4.24	0.757	7
4	The use of blockchain technology by the bank helps the internal auditor reduce fraud and identify potential risks.	4.31	0.667	6
5	The use of blockchain technology by the internal auditor contributes to obtaining accurate and clear information in the bank.	4.46	0.693	3
6	The bank's use of blockchain technology contributes to saving a lot of time and effort and freeing itself from routine tasks in the internal audit process.	4.35	0.739	4
7	The transparency provided by blockchain enhances the internal auditor's trust in the information obtained, thereby increasing the efficiency and effectiveness of internal auditing.	4.09	0.694	8
8	Blockchain technology significantly contributes to providing trust in transaction recording due to the encryption system present in the chain.	4.34	0.783	5
	Total Mean	**4.3437**	**0.33865**	***4**

As demonstrated in Table 7, the arithmetic means for this axis ranged between 4.09 and 4.51, which are higher than the adopted hypothetical mean of 3. This finding suggests that all sample members were in agreement with the items included in the axis. It is also noted that item number (1), which states "the use of blockchain technology by the bank helps the internal auditor quickly access information," ranked first in the axis with a mean of (4.51) and a standard deviation of (0.629).

Conversely, paragraph number (7), which states "the transparency enjoyed by blockchain enhances the internal auditor's trust in the information obtained, thereby increasing the efficiency and effectiveness of internal auditing," ranked last in the axis with a mean of (4.09) and a standard deviation of (0.694). In the final position at the level of the axis, with a mean of (4.09) and a standard deviation of (0.694), which indicates a consensus among the sample members regarding the content of the paragraph. The mean overall for the entire axis was (4.3437), with a standard deviation of (0.33865). This indicates that the sample members were in agreement with the content of the axis paragraphs, as well as the consistency and concentration of responses in agreement. The entire axis received the fourth highest mean among the axes.

Hypothesis analysis and testing

• Result of testing the first sub-hypothesis of the first main hypothesis:

Null Hypothesis Ho.a: The present study investigates the hypothesis that the speed and accuracy of financial transaction completion exerts a statistically significant effect on the development of the internal audit function in banking institutions operating within the Republic of Yemen.

Alternative hypothesis Ha.a: The present study investigates the statistically significant effect of the speed and accuracy of financial transaction processing on the development of the internal audit function in banks operating in the Republic of Yemen.

The present hypothesis aims to measure the impact of the speed and accuracy of financial transaction processing on the development of the internal audit function in banking institutions operating within Yemen. Simple linear regression analysis was employed, as demonstrated in Table 3-18.

Table (8) Result of the simple linear regression analysis for the first sub-hypothesis

R	R^2	ANOVA variance		Significance of the T-test effect		
		Value F	F sig.	B	T	T sig.
0.642[a]	0.413	96.949	0.000	0.564	9.846	0.000

As demonstrated in Table (8), there is a statistically significant effect of the speed and accuracy of financial transaction processing on the development of the internal audit function in banks operating in Yemen. The correlation coefficient (R) was (0.642), and the coefficient of determination (R2) was (0.413), indicating that 41.3% of the fluctuations in the development of the internal audit function are attributable to alterations in the velocity and precision of financial transaction processing. Conversely, 58.7% of the fluctuations in the developmental trajectory of the internal audit function are ascribed to disparate factors. The linear regression value (B) was found to be 0.564, indicating that a one-unit increase in the speed and accuracy of financial transaction processing leads to a 56.4% increase in the level of development of the internal audit function. Furthermore, the obtained p-value of 0.000 fell below the commonly accepted threshold of 0.05, thereby indicating a lack of statistical significance. Consequently, the null hypothesis is refuted, and the alternative hypothesis is substantiated, signifying that "there is a statistically significant effect of the speed and accuracy of financial transaction processing on the development of the internal audit function in banks operating in the Republic of Yemen."

• Result of the second sub-hypothesis test of the first main hypothesis:

The null hypothesis is thus: there is no statistically significant effect of encryption technology (security and protection) on the development of the internal audit function in banks operating in the Republic of Yemen.

The alternative hypothesis H.a.b. is as follows: A statistically significant effect of encryption technology on the development of the internal audit function in banking institutions operating within the Republic of Yemen has been identified.

The objective of this hypothesis is to assess the impact of encryption technology on the development of the internal audit function, with specific reference to its implications for security and protection. The simple linear regression test (see Table 9) was employed to analyse the data.

Table (9) Results of the simple linear regression analysis for the second sub-hypothesis

R	R^2	ANOVA variance		Significance of the T-test effect		
		F	F sig.	B	T	T sig.
0.630[a]	0.396	90.611	0.000	0.585	9.519	0.000

As demonstrated in Table (9), there is a statistically significant effect of encryption technology on the development of internal auditing in banks operating in Yemen. The technology in question is associated with security and protection. The correlation coefficient (R) was (0.630), and the coefficient of determination (R2) was (0.396), indicating that 39.6% of the variations in the level of internal auditing development are attributable to changes in the level of encryption technology (security and protection). The residual 60.4% of changes in the level of internal auditing development are attributed to other factors. The linear regression value (B) was found to be 0.585, indicating that a one-unit increase in the level of encryption technology (security and protection) leads to a 58.5% increase in the level of internal auditing development. Furthermore, the obtained p-value of 0.000 fell below the commonly accepted threshold of 0.05, thereby indicating a lack of statistical significance. Consequently, the null hypothesis is refuted, and the alternative hypothesis is substantiated, signifying that "there is a statistically significant effect of encryption technology (security and protection) on the development of internal auditing in banks operating in the Republic of Yemen."

Result of the third sub-hypothesis test of the first main hypothesis:

The null hypothesis is defined as follows: The study found no statistically significant impact of transparency and credibility in transactions on the development of the internal audit function in banking institutions operating within the Republic of Yemen.

The alternative hypothesis, H.a.c., is as follows: The present study finds evidence to support the hypothesis that conducting transactions with transparency and credibility has a statistically significant effect on the development of the internal audit function in banks operating in the Republic of Yemen.

The present hypothesis aims to measure the impact of transparency and credibility on the development of the internal audit function in banking institutions operating within the Republic of Yemen. The simple linear regression test (see Table 10) was employed to analyse the data.

Table (10) Results of the simple linear regression analysis for the third sub-hypothesis

R	R^2	ANOVA variance		Significance of the T-test effect		
		F	F sig.	B	T	T sig.
0.510[a]	0.260	48.559	0.000	0.415	6.968	0.000

As demonstrated in Table (10), there is a statistically significant effect of completing transactions with transparency and credibility on the development of the internal audit function. This is indicated by the correlation coefficient R being (0.510) and the coefficient of determination R2 being (0.260). This suggests that 26.0% of the changes in the level of development of the internal audit function are attributable to changes in the level of completing transactions with transparency and credibility. Conversely, 74.0% of the fluctuations in the level of internal audit development are ascribed to disparate factors. The linear regression value (B) was found to be 0.415, indicating that an increase of one degree in the level of completing transactions with transparency and credibility leads to an increase in the level of development of the internal audit function by 41.5%. Furthermore, the obtained p-value of 0.000 fell below the commonly accepted threshold of 0.05, thereby indicating a lack of statistical significance. Consequently, the null hypothesis is refuted, and the alternative hypothesis is substantiated, signifying that "there is a statistically significant effect of completing transactions with transparency and credibility on the development of the internal audit function in banks operating in the Republic of Yemen."

Result of testing the fourth sub-hypothesis of the first main hypothesis:

The null hypothesis is defined as follows: The present study finds no statistically significant effect of decentralisation on the development of the internal audit function in banking institutions operating within the Republic of Yemen.

The alternative hypothesis posits that H.a.d. "There is a statistically significant effect of decentralisation on the development of the internal audit function in banks operating in the Republic of Yemen."

The objective of this hypothesis is to assess the impact of decentralisation on the development of the internal audit function in banking institutions operating within the Republic of Yemen.

The simple linear regression test was utilised, as illustrated in Table (11).

Table (11) Results of the simple linear regression analysis for the fourth sub-hypothesis

R	R^2	ANOVA variance		Significance of the T-test effect		
		F	F sig.	B	T	T sig.
0.484[a]	0.234	42.147	0.000	0.372	6.496	0.000

As demonstrated in Table (11), there is a statistically significant effect of decentralisation on the development of the internal audit function. This is indicated by the correlation coefficient R, which was (0.484), and the coefficient of determination R2, which was (0.234). This suggests that 23.4% of the changes in the level of development of the internal audit function are attributable to changes in the level of decentralisation practice, while 76.6% of the changes in the level of development of the internal audit function are attributed to other factors. The linear regression value (B) was found to be 0.372, indicating that a one-degree increase in the level of decentralisation practice leads to a 37.2% increase in the level of development of the internal audit function. Furthermore, the obtained p-value of 0.000 fell below the commonly accepted threshold of 0.05, thereby indicating a lack of statistical significance. Consequently, the null hypothesis is refuted, and the alternative hypothesis is substantiated, signifying that "there is a statistically significant effect of decentralization on the development of the internal audit function in banks operating in the Republic of Yemen."

RESULTS

A- The impact of blockchain technology on the development of the internal audit function in banking institutions operating within the Republic of Yemen is found to be statistically significant, with a rate of 74.4%.

The present study finds a statistically significant effect of completing financial transactions accurately and quickly on the development of the internal audit function in banks operating in the Republic of Yemen, at a rate of 64.2%.

The most widely held views among the study participants centred on the importance of accurately and expeditiously executing financial transactions.

It has been demonstrated that this contributes to the acceleration of accounting data review processes, with an agreement rate of 90.0%.

The present study has demonstrated that the time required to prepare internal financial reports can be reduced by 88.2%.

The system has been demonstrated to facilitate the real-time monitoring and expeditious finalisation of financial transactions, thereby obviating the necessity for intermediaries or regulatory processes. The efficacy of this approach is evidenced by an impressive agreement rate of 86.8%. Secondly, the findings of this study indicate a statistically significant impact of encryption technology on the development of the internal audit function in banks operating in the Republic of Yemen. The impact is measured at a rate of 63.0%.

The study sample reached a consensus on several points regarding encryption technology

The utilisation of a decentralised database has been demonstrated to assist in the mitigation of data breach incidents, exhibiting an agreement rate of 89.2%.

The present study has demonstrated that the reliability of the data used in auditing is increased due to the stability and sequence of banking operations. The agreement rate was found to be 88.4%.

It has been demonstrated that the blockchain technology has the capacity to impede unauthorised access to sensitive information, with an agreement rate of 88.2%.

Thirdly, the findings of this study indicate a statistically significant impact of conducting transactions with transparency and credibility on the development of the internal audit function in banks operating in the Republic of Yemen, at a rate of 51.0%.

The following aspects were identified as having the most widespread consensus among the study participants

Transparency within the banking sector has been demonstrated to facilitate enhanced access to financial information, with an observed agreement rate of 90.8%.

Transparency within the banking sector is conducive to the accurate execution of procedures, with an agreement rate of 90%.

Transparency is instrumental in facilitating the real-time visibility of data changes among all relevant parties within the banking sector. This approach has been found to yield an 89% consensus rate, underscoring its effectiveness in fostering collaboration and ensuring data integrity.

Fourthly, a statistically significant impact of decentralisation on the development of the internal audit function in banks operating in the Republic of Yemen has been identified, with a rate of 48.4% being observed.

The following aspects were identified as having the most widespread consensus among the study participants:

Decentralisation has been demonstrated to facilitate cooperation and coordination with external entities, resulting in an agreement rate of 88.2%.

Decentralisation has been demonstrated to facilitate the seamless exchange of data between disparate departments, with an agreement rate of 86.4%.

Decentralisation has been shown to reduce the risk of reliance on a single data verification source, with an agreement rate of 86.2%.

RECOMMENDATIONS

1- Enhancing the effectiveness of the speed and accuracy of financial transactions:

The study posits that enhancing the speed and accuracy of financial transactions can be achieved through the augmentation of productivity efficiency by ensuring the provision of accurate data and its rapid exchange with relevant parties. The adoption of electronic mechanisms that reduce errors resulting from manual processing is also recommended, thereby contributing to the acceleration of transaction completion and the improvement of performance quality.

2- Enhancing the effectiveness of encryption technology (security and protection):

The study recommends enhancing the security and protection of banking data by using a more secure technological infrastructure, which includes multiple servers and the development of highly secure databases that are difficult to breach, along with strengthening encryption techniques to reduce the risks of tampering and hacking.

3) Enhancing the effectiveness of transactions by means of transparency and credibility.

The study recommends establishing the principles of transparency and credibility in executing financial transactions by making the processes clearer, which contributes to reducing financial corruption, increasing the flexibility of using financial technology, and enhancing the reliability of data for all parties dealing with the bank.

4- Enhancing the effectiveness of decentralization:

The study recommends enhancing the application of decentralisation due to its role in improving the accuracy of performance measurement, increasing the efficiency of the internal control system, reducing human intervention in data verification, and speeding up access to information, thereby supporting the efficiency of banking operations and the quality of decision-making.

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