

Blockchain in accounting and auditing: unveiling challenges and unleashing opportunities for digital transformation in Egypt

Blockchain in
accounting and
auditing

359

Ahmed Anis
Cairo University, Cairo, Egypt

Received 18 June 2023

Revised 19 July 2023

19 July 2023

Accepted 26 July 2023

Abstract

Purpose – This paper aims to examine the role of Blockchain in the accounting and auditing literature and profession. Specifically, the paper investigates auditors' perceptions about the role of blockchain in accounting and auditing and the perceived potential benefits and challenges of blockchain-based accounting systems in Egypt. Moreover, what are the capabilities required for successfully implementing blockchain-based accounting systems?

Design/methodology/approach – A mixed-method approach was adopted to achieve the research objectives. The qualitative study included 11 in-depth interviews with external auditors, and the results of the interviews and the literature review helped develop a survey collected from 58 auditors.

Findings – The findings revealed low-to-moderate awareness of Blockchain-based accounting systems. Also, there were significant differences between auditors from large audit firms and small-and-medium audit firms regarding the benefits and challenges associated with Blockchain-based accounting systems.

Practical implications – The results provide valuable insights for practitioners, researchers and policymakers.

Originality/value – Understanding blockchain-based accounting systems and the benefits and challenges associated with their application is crucial for developing effective strategies and frameworks to overcome barriers and realize the transformative potential of blockchain in the accounting and audit market.

Keywords Blockchain-based accounting systems, Triple-entry ledger, Real-time auditing, Digital auditing

Paper type Research paper

1. Introduction

Distributive technologies are changing the business world as we know it. Blockchain technology (BT) is one of the most significant disruptive technologies nowadays (Parmoodeh *et al.*, 2023; Perera and Abeygunasekera, 2022). BT gained popularity after its inception in 2008 as the underlying technology supporting cryptocurrencies such as Bitcoin (Alarcon and Ng, 2018). Since then, BT has been a disruptive force in many industries, such as financial markets, information sharing and supply chains (Smith and Castonguay, 2020). Recently, it has gained considerable attention in the accounting and auditing environment. Blockchain is a public ledger distributed across a peer-to-peer computer network (Blockchain.com, 2022). Transactions are stored and spread across the entire network of computer systems on the Blockchain (Mahtani, 2022). Therefore, information stored on the Blockchain is hard to change or cheat.

BT is gaining momentum in the accounting profession because it provides a new recording principle, i.e. “third-entry” accounting (Kiviat, 2015; Kabir *et al.*, 2022) instead of the “Double entry” accounting that was the basis for corporate bookkeeping, recording and



reporting since it was developed in 1494 by Luca Pacioli. BT helps to record business transactions between several participants in real-time and save them on a computer database where each participant can access them (Alarcon and Ng, 2018). Additionally, transactions are time-stamped and immutable (Kabir *et al.*, 2022).

BT arguably positively impacts the auditing profession by reducing the auditor's workload. In addition, BT features such as decentralization and security should enhance information quality and increase reporting and disclosure efficiency (Peprah *et al.*, 2022). BT also validates asset ownership and liabilities, minimizes fraud and does audit traces, thereby saving time and cost (Lombardi *et al.*, 2022; Abreu *et al.*, 2018; Supriadi *et al.*, 2020). Therefore, many BT solutions exist for auditing, such as Libra, Verady and Factom (Abreu *et al.*, 2018).

Nevertheless, adopting BT in auditing is also associated with specific risks, such as risks related to privacy and security, that will exist because of the public transaction in a distributed ledger (Schmitz and Leoni, 2019; Wang and Kogan, 2018). Scholars and practitioners must address these BT consequences because they must still be better understood. Additionally, the full integration of BT into the accounting ecosystem is challenged by many technical and non-technical issues, such as scalability, security and suitable architecture (Shi *et al.*, 2022; Bonsón and Bednárová, 2019).

The research on BT in accounting is in a nascent and thriving stage (Perera and Abeygunasekera, 2022; Lombardi *et al.*, 2022). BT research is essential to practitioners, academics, organizations, regulators and standard-setting bodies (Fosso Wamba and Guthrie, 2020; Lombardi *et al.*, 2022). However, the impact of BT on auditing is relatively unexplored (Elommal and Manita, 2021; Ali *et al.*, 2020; Helliari *et al.*, 2020; Troshani *et al.*, 2019). Furthermore, most research is conceptual, and most studies are conducted in a specific geographic region (Lombardi *et al.*, 2022). As a result, practitioners' perspective on BT as a disruption in auditing needs to be better addressed (Lombardi *et al.*, 2022). In addition, the regulators and accounting standard-setting bodies did not provide specific guidelines regarding the auditing procedures in digital auditing environments, such as with BT (Vincent and Wilkins, 2020). Therefore, there is still a need for research about (1) how the auditing procedures must be adapted to be compatible with the adoption of BT and digitalization of accounting procedures (Bonsón and Bednárová, 2019); (2) the impact of BT on the auditing work (e.g. procedures, privacy, timeliness and risks); (3) the impact of BT on enhancing data and information quality (e.g. relevance, timeliness and completeness); (4) the development of new and standardized auditing procedures for cryptocurrency and smart contracts; and finally (5) investigate the impact of BT in new and unique contexts (i.e. Egypt).

In light of the literature synthesis mentioned above, further research is needed about the use and impact of BT on accounting and auditing practices, especially in emerging MENA (Middle Eastern and North Africa) countries that have yet to receive much attention from the previous literature. Accordingly, this study aims to investigate the perceptions of accountants and auditors on the impact of implementing BT on the accounting ecosystem in Egypt. Specifically, this study will focus on exploring the perceptions of Egyptian auditors on the effect of BT on the auditing processes and procedures. Also, what are the potential benefits of BT to the auditing ecosystem, and what are the challenges associated with adopting BT in the accounting and auditing environment in Egypt?

The contributions of the study are threefold. First, there are few studies about the accountants' awareness and utilization of BT to prepare and attest financial information. Second, there are few studies about BT's impact on Egypt's accounting ecosystem. Third, BT is expected to have significant shifts in the accounting paradigm and practice; many countries have developed strategies and started to adopt BT in accounting practices. Specifically, most North American and European banks are exploring adopting BT in the payment field (Matskiv *et al.*, 2023; Abreu *et al.*, 2018; Chang *et al.*, 2020), and many countries in the MENA (e.g. UAE) region are developing strategies and infrastructure to adopt BT

(Papadaki and Karamitsos, 2021). Also, many logistics organizations (e.g. DHL) in many industries have adopted BT in the last three years (DHL, 2022), and since it is a global world and all organizations are connected to do business, Egyptian organizations and financial institutions will eventually have to adopt BT.

Therefore, Egypt is collaborating with BT service suppliers to provide Ethereum [1] BT services in Egypt (Bartlett, 2022). Furthermore, the Central Bank of Egypt (CBE) developed an initiative to introduce BT in the remittance market, which holds the fifth-highest position in the global remittance market rankings (Papadaki and Karamitsos, 2021). Also, the CBE initiated a project called “Block Banking” in 2019 to adopt the BT in the banking and financial sector and support financial inclusion in Egypt. At least two commercial banks have implemented BT in remittance (Ahram online, 2023). Additionally, some startups are developing a blockchain-based accounting platform for accounting and auditing processes and transactions (Ahram online, 2023). Therefore, the accounting and auditing profession and regulatory bodies must be prepared to deal with the technology when BT is fully adopted in the business world (Cusack, 2018; Hashem *et al.*, 2023).

2. Overview of the role of blockchain in accounting

Blockchain is a decentralized and distributed digital ledger technology that allows multiple participants to maintain and update a shared database without a central authority (Perera and Abeygunasekera, 2022; Lombardi *et al.*, 2022). It operates through a network of computers called nodes, where each node has a copy of the entire Blockchain and validates transactions based on a consensus mechanism (Matskiv *et al.*, 2023; Han *et al.*, 2023). An organization must develop a BT designed explicitly to use blockchain in accounting, creating a private blockchain network. The following example is developed and depicted in Figure 1 to understand how blockchain-based accounting works:

1. Recording Financial Transactions (creating Blocks)

The blockchain-based accounting system is a network of connected computers (called Nodes). The first step in blockchain-based accounting is recording financial transactions. When a financial transaction occurs (e.g. sales, collections, acquisitions and payments), the transaction information, i.e. the date, time, type of transaction details and monetary amount, is added as a new block to the blockchain ledger. When a block is added, the block is broadcasted to every computer (Node) in the network. Accordingly, each node has a copy of the blockchain ledger, so when a new transaction (Block) is added, it needs to be verified by the network.

2. Verification

At this step, the blockchain-based accounting systems must authenticate the new transaction (Block), ensuring the transaction is genuine and not fake or altered. Then, using predefined rules and protocols, the nodes in the blockchain network check the transaction to tell if it is accurate or fake and ensure that it meets the rules and guidelines of the blockchain network. This helps to ensure that the transactions recorded on the blockchain are reliable and trustworthy for accounting purposes. Once the transaction (Block) is verified, it becomes a part of the blockchain.

3. Consensus mechanism

One of the unique features of blockchain is the use of consensus mechanisms. It works according to specific rules. When a block is created, nodes compete together to add this block to the blockchain according to a set of mathematical rules. The first node that wins gets to add the block to the blockchain. This feature ensures that no single entity can control the blockchain; therefore, tampering with the ledger will require significant computational power.

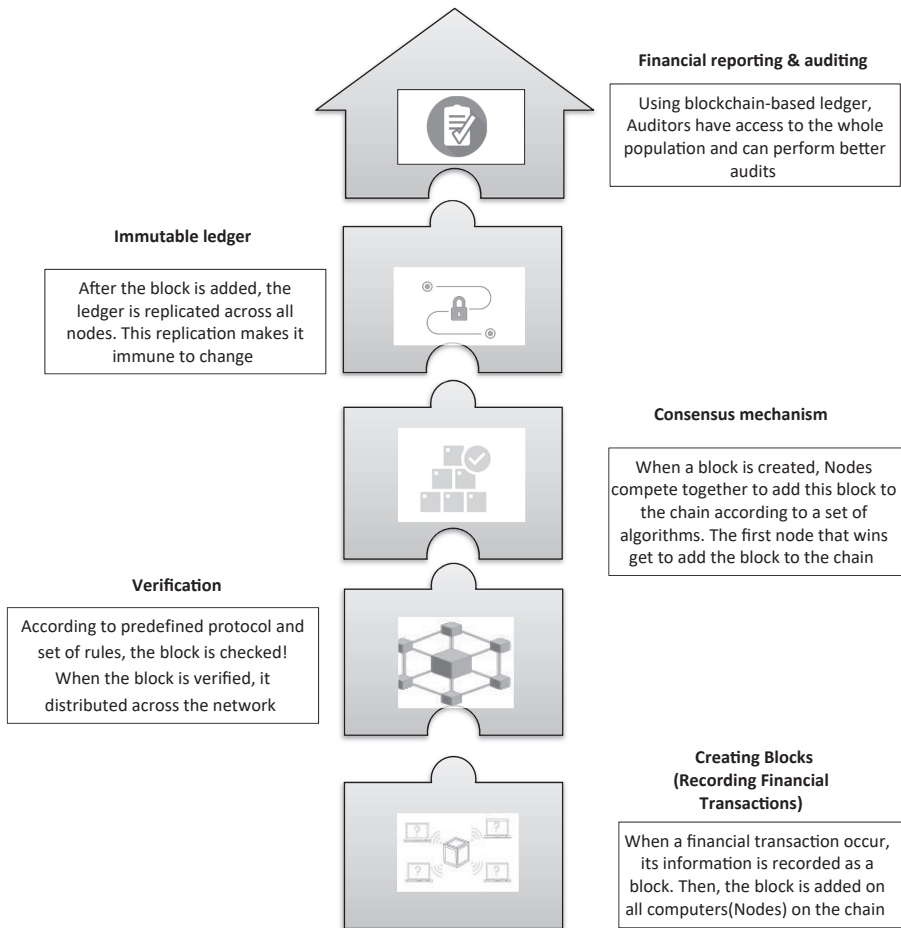


Figure 1.
Blockchain-based
accounting

Source(s): Figure by author

4. Immutable Ledger

Once the transaction block is added to the blockchain and verified, it becomes a permanent part of the ledger. As a result, the ledger is replicated across all participating nodes, ensuring each node has an identical copy of the blockchain. This replication makes the ledger highly secure and resistant to tampering or fraud.

5. Financial reporting and auditing

Using the data in the blockchain-based ledger, all types of financial reports can be generated in real-time and with minimal cost. Moreover, auditors can have access to the whole data population and can perform more efficient audits.

Blockchain offers several advantages in accounting by enhancing the transparency, security and efficiency of financial transactions and record-keeping processes. Some of the beneficial aspects of Blockchain-based accounting (Ayedh *et al.*, 2021; Mahtani 202; Supriadi

et al., 2020; Peprah *et al.*, 2022; Bonyuet, 2020; Kabir *et al.*, 2022) are shown in Figure 2 and explained below.

Improved transparency: Blockchain technology enables the creation of an immutable and transparent ledger where all transactions are recorded chronologically. This transparency helps reduce fraud, as any alterations or unauthorized changes to the records can be easily identified.

Enhanced security: Blockchain provides a high level of security by utilizing cryptographic algorithms. Each transaction is encrypted and linked to the previous transaction, forming a chain of blocks. This makes it extremely difficult for unauthorized parties to tamper with the data stored on the Blockchain.

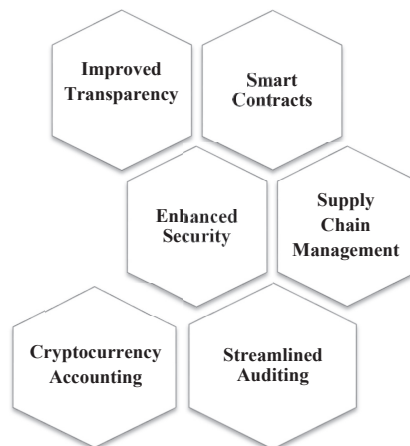
Streamlined auditing: Since all transactions are recorded on the Blockchain, auditors can access the underlying data directly, eliminating the need for complex reconciliation procedures. This can help auditors to perform real-time audits and verify the accuracy and integrity of financial information.

Smart contracts: Smart contracts are self-executing contracts with predefined terms and conditions written into the code. They are stored and executed on a blockchain. Smart contracts can automate accounting processes like invoice processing, payments and revenue recognition. These contracts can significantly reduce the likelihood of errors and provide higher trust and efficiency.

Supply chain management: Blockchain can be utilized to enhance the transparency and traceability of supply chains, which is relevant for auditing purposes. By recording every transaction and movement of goods on the Blockchain, auditors can verify the accuracy of inventory records, trace the origin of products and ensure compliance with regulations, principles and standards.

Cryptocurrency accounting: With the rise of cryptocurrencies like Bitcoin, accounting for digital assets has become crucial. Blockchain technology facilitates the recording and tracking of cryptocurrency transactions, ensuring accuracy and reliability in cryptocurrency accounting. This includes maintaining proper records of digital wallets, tracking transfers and calculating gains or losses.

It is important to note that while blockchain technology offers various benefits for the accounting and auditing profession, its implementation and adoption are still in the early



Source(s): Figure by author

Figure 2.
Advantages of
Blockchain-based
accounting

stages. In addition, there are challenges to overcome, including scalability, regulatory considerations and standardization. The synthesis of the previous studies on blockchain-based accounting shows that some technical and non-technical challenges are associated with blockchain-based accounting and auditing, as indicated in Table 1 (Hsieh and Brennan, 2022; Faccia *et al.*, 2022; Papadaki and Karamitsos, 2021; Peprah *et al.*, 2022; Bonsón and Bednárová, 2019; Shi *et al.*, 2022; Gauthier and Brender, 2021).

3. Literature review

Although the interest in the adoption of BT in the accounting and auditing ecosystems has garnered significant attention from both academics and practitioners over the past decade, there is limited empirical accounting literature on blockchain-based accounting systems (Han *et al.*, 2023; Hsieh and Brennan, 2022). Table 2 summarizes the accounting literature’s themes on the impact of BT on accounting and auditing practices. It is apparent from the synthesis of previous studies that there needs to be more studies on blockchain-accounting systems. Most

Table 1.
Challenges of implementing blockchain in accounting and auditing

Challenges	Description
Scalability	The system can handle a larger volume of economic transactions without sacrificing speed, security or cost-effectiveness
Security and Privacy	Ensuring the confidentiality, integrity and availability of sensitive financial information while maintaining transparency
Governance and Regulation	The legal and regulatory implications of blockchain implementation, such as compliance with financial reporting standards and data protection regulations
Interoperability	Integrate blockchain systems with existing accounting and auditing infrastructure, including legacy systems and databases
Skill Gaps and Education	The knowledge and skill gaps among accounting and auditing professionals to effectively leverage blockchain technology
Cost and Infrastructure	The costs associated with implementing blockchain solutions and the required technological infrastructure
Source(s): By author	

Table 2.
Overview of the literature on BT in accounting and auditing

Theme	Methodology and research context	Author(s) and study
Impact of BT on accounting and assurance services	Conceptual paper (Literature review)	Han <i>et al.</i> (2023), Bonyuet (2020) Lombardi <i>et al.</i> (2022), Schmitz and Leoni (2019), Smith and Castonguay (2020), Supriadi <i>et al.</i> (2020), Elommal and Manita (2021), Al Shanti and Elessa (2023)
Challenges associated with BT	Conceptual paper	Bonson and Bednárová (2019), Lombardi <i>et al.</i> (2022)
Impact of BT on the Role of the Auditor	Qualitative studies	Mahtani (2022), Parmoodeh <i>et al.</i> (2023)
The adoption of BT	Qualitative studies	Perera and Abeygunasekera (2022), Peprah <i>et al.</i> (2022)
How to audit BT	Conceptual paper Survey	Hsieh and Brennan (2022), Tušek <i>et al.</i> (2021)
Types of BT and their Implication on audit quality	Conceptual paper	Faccia <i>et al.</i> (2022), Liu <i>et al.</i> (2019)
The Impact of BT on the audit process	survey	Kabir <i>et al.</i> (2022), Shi <i>et al.</i> (2022)
Source(s): By author		

of these studies are conceptual studies delineating the nature of BT and how it can be used in accounting and auditing. They mainly anticipate the advantages of using BT in the accounting and auditing processes from a technological perspective. Furthermore, based on the information system theories, some of the previous studies report future challenges that will accompany the application of BT in accounting and auditing.

The handful of studies that examined the adoption of blockchain-based accounting systems were qualitative (Han *et al.*, 2023) and focused on developed countries. Furthermore, limited studies reviewed the adoption of BT in the MENA region or identified the reasons for the slow and limited adoption in the MENA region. Therefore, little is known about the awareness of Egyptian auditors about blockchain-based accounting, the audit firms' capabilities required to adopt blockchain-based auditing and auditors' perceptions of the impact of BT on the accounting and auditing environment. To this end, the literature review was synthesized to develop and examine hypotheses to bridge these gaps.

3.1 Awareness of blockchain-based accounting

Limited studies explored the awareness levels of accountants and auditors regarding using blockchain in accounting, and the findings of these studies need to be more cohesive. Some studies argue that although many professionals are familiar with blockchain as a technology used in cryptocurrencies, such as Bitcoin, they need a deeper understanding of its potential applications in accounting (e.g. Tušek *et al.*, 2021; Perera and Abeygunasekera, 2022). In contrast, other studies indicated that auditors and accountants are familiar with the dynamics of blockchain-based accounting systems (e.g. Peprah *et al.*, 2022).

Previous research examined methods to address the lack of knowledge surrounding blockchain-based accounting systems within accounting and auditing. For example, some studies emphasize the need for training and education to bridge the blockchain awareness gap in the accounting and auditing profession (Tušek *et al.*, 2021; Perera and Abeygunasekera, 2022). Professional development programs, workshops and certifications that cover blockchain fundamentals and their specific applications in accounting are recommended to enhance professionals' knowledge and skills (Elommal and Manita, 2021).

Nevertheless, there is a scarcity of research on the implementation of BT in accounting, as well as a lack of understanding regarding the extent to which accountants and auditors in the MENA region perceive the benefits or impact of blockchain-based accounting systems on the accounting and auditing profession (e.g. Parmoodeh *et al.*, 2023; Abdennadher *et al.*, 2022). Additionally, there is limited knowledge of the factors associated with auditors' awareness of technological innovations in accounting, such as BT. Identifying the factors that improve auditors' awareness and understanding of disruptive technologies such as BT or any other technology that disrupts the accounting profession is imperative. Identifying these factors will assist in managing them effectively, ultimately boosting auditors' understanding and awareness of crucial technological innovations that will significantly impact the profession.

A synthesis of the literature on the use of information technology and artificial intelligence (AI) in accounting and auditing suggests that the awareness and application of auditing technologies usually depend on many factors, such as the auditor's experience, technological education and skills (Afsay *et al.*, 2023; Islam and Stafford, 2022). Also, previous studies indicated that firm size affects the adoption of technological innovation; hence some studies found that firm size affect the adoption of accounting-based technological innovations such as cloud-based accounting information systems and machine learning (Lutfi, 2022; Machine, 2021). Accordingly, it can be argued that audit firm size may be associated with the level of auditor's awareness of disruptive technologies such as BT.

Similarly, the in-depth interviews with auditors in Egypt (explained in the results section) support this; they suggest that auditors' awareness of blockchain-based accounting depends

on the auditor's affiliation, professional experience and skills. Therefore, in line with the discussion mentioned above, it can be concluded that the more experienced auditors (e.g. technical skills and professional qualification) are and the larger the audit firm they work for, the higher their awareness about using BT in accounting and auditing practices. Thus, the following hypothesis can be argued:

- H1.* The level of awareness among auditors regarding blockchain-based accounting is associated with their experience and the size of the audit firm they belong to.

3.2 Capabilities required to audit blockchain-based accounting

The information technology systems paradigm argues that the effective use of information technology depends on the availability of specific resources, such as technological infrastructure and technical skills (Balicka, 2023; Afsay *et al.*, 2023). Although blockchain-based accounting systems are currently one of the notable emerging accounting technologies, there is limited literature on the audit firm's resources or capabilities that must be available to enable auditors to effectively audit blockchain-based accounting systems (e.g. Matskiv *et al.*, 2023; Elommal and Manita, 2021).

Based on the technology–organization–environment framework, Perera and Abeygunasekera (2022) argue that adopting BT in accounting depends on specific capabilities such as understanding BT, availability of regulations and accounting standards. In addition, top accounting executives in Egypt also indicated that the lack of technical knowledge and rules about the use of BT could hinder the use of BT in accounting and financial fields (FinTech Egypt, 2021). Furthermore, previous research indicated that the capabilities/resources required for an audit firm to use information technologies effectively differ according to the audit firm's size (Lowe *et al.*, 2018). Large-sized audit firms may possess a competitive advantage over small and medium-sized audit firms in terms of the availability of capabilities required for effective auditing of blockchain-based accounting systems. For example, large-sized audit firms often have more significant financial resources at their disposal, allowing them to invest in advanced technology, hire specialized professionals and establish dedicated departments or teams to handle emerging technologies like blockchain more than small-sized audit firms.

The in-depth interviews showed that specific factors should be available to enable successful auditing of blockchain-based accounting, such as BT education and training, financial support, technological infrastructure, financial reporting regulations and accounting and auditing standards. In addition, the qualitative results show distinct variations between large-sized audit firms and small and medium-sized ones regarding the capabilities required to audit accounting systems based on blockchain. Accordingly, it can be concluded that an effective audit of a blockchain-based accounting system requires the existence of specific capabilities, and these capabilities may differ between audit firms depending on their size. Thus, it is argued that:

- H2.* There are significant differences between large-sized audit firms and small and medium-sized audit firms in terms of the capabilities required for effective auditing of Blockchain-based accounting systems.

3.3 Perceived benefits, challenges and impact of blockchain-based accounting on auditing

Previous studies argued that there are many potential benefits associated with blockchain-based accounting systems, such as real-time audit, fraud detection and collecting more evidence (e.g. Matskiv *et al.*, 2023; Ayedh *et al.*, 2021; Mahtani, 2022; Supriadi *et al.*, 2020; Praph *et al.*, 2022; Bonyuet, 2020; Smith and Castonguay, 2020; Kabir *et al.*, 2022; Tušek *et al.*, 2021). Furthermore, prior research has shown that using BT significantly influences auditors'

responsibilities (e.g. Al-saedi and Almaliki, 2023). By implementing a blockchain-based accounting system, the audit process can be streamlined, allowing auditors to concentrate on minimizing audit risk and gathering more reliable and accumulate more objective audit evidence.

Nevertheless, when considering the potential benefits of BT in the auditing context, it is essential to analyze how the size of the audit firm may affect the perceived advantages of BT for the external auditor's role. Institutional differences exist between big four and non-big four audit firms, including firm size, global reach, market share, client base and financial capital (Afsay *et al.*, 2023; Jackson *et al.*, 2022). These institutional differences may lead to differences in the perceptions of the benefits of BT between large-sized and small and medium-sized audit firms (Afsay *et al.*, 2023).

For example, the results of the in-depth interviews show that the streamlined audit and the overwhelming volume of information associated with blockchain-based accounting systems will pose a burden on auditors from small-sized audit firms, which have a limited number of auditors. Therefore, it can be argued that the perceived impact and benefits of blockchain-based accounting will differ between large-sized and small and medium-sized audit firms.

Additionally, several barriers to adopting blockchain technology in accounting were identified in the previous studies. The most prominent barriers include the complexity of understanding blockchain, limited knowledge about its practical implementation, regulatory uncertainties and data privacy and confidentiality concerns (e.g. Hsieh and Brennan, 2022; Faccia *et al.*, 2022; Papadaki and Karamitsos, 2021; Peprah *et al.*, 2022; Bonsón and Bednárová, 2019; Shi *et al.*, 2022; Gauthier and Brender, 2021). However, these barriers encountered when auditing can also vary according to the size of the audit firm due to the institutional differences between audit firms. With their global reach and high market share, large-sized audit firms will be able to manage challenges associated with BT more than small and medium-sized audit firms. To this end, the following hypotheses can be developed.

- H3/1.* There are significant differences between large-sized audit firms and small and medium-sized audit firms in terms of the impact of BT on the accounting and auditing profession in Egypt.
- H3/2.* There are significant differences between large-sized audit firms and small and medium-sized audit firms in terms of the benefits of BT to the audit process.
- H3/3.* There are significant differences between large-sized audit firms and small and medium-sized audit firms in terms of barriers to adopting BT in the Egyptian business environment.

4. Methodology

This paper investigates the awareness levels of external auditors in Egypt regarding adopting BT in accounting and auditing practices. Additionally, it seeks to explore their perceptions regarding the potential benefits and challenges associated with implementing BT in the accounting ecosystem. A mixed-method approach of two studies was adopted to achieve these objectives. The first study employed qualitative methods, conducting in-depth interviews with external auditors from large, small and medium-sized firms in Egypt. The second is a quantitative study utilizing a survey sample of external auditors in Egypt.

4.1 Study one

4.1.1 Research approach. The research approach employed in this study is qualitative, using in-depth interviews as the primary data collection method. This approach allows for a

comprehensive exploration of auditors' awareness and perceptions. Furthermore, it enables a deeper understanding of their experiences, opinions and insights regarding Blockchain technology adoption in the accounting and auditing domain.

4.1.2 Data collection. A snowball sample was used, and in-depth interviews were chosen as the primary data collection method due to their ability to capture rich and nuanced information (Rubin and Rubin, 2011). A snowball sample was used to identify experienced auditors and audit industry experts in disruptive audit technologies and their impact on the accounting and auditing profession. The interviews were conducted face-to-face or online, depending on the participants' preferences. Each interview session lasted approximately 45–60 min, and notes were taken during the interview with the consent of the participants. The data collection stage was terminated after theoretical saturation was reached when no new data or insights were found when discussing the topics under investigation with auditors. Thereby, the sample size of the qualitative study was eleven external auditors from large-sized firms and small and medium-sized audit firms in Egypt.

4.1.3 Interview guide development. A semi-structured interview guide was developed to ensure consistency and comparability across interviews. The interview guide included open-ended questions designed to elicit detailed responses about auditors' awareness of Blockchain technology adoption and their perceptions of the benefits and challenges associated with its implementation in the accounting ecosystem. Appendix presents the questions of the interview guide.

4.1.4 Data analysis. Thematic analysis was employed to analyze the interview data. The analysis process involved several steps: familiarization with the data, coding, theme development and interpretation. Initially, the transcripts were checked for accuracy. Next, coding was conducted, where meaningful data units were identified and labeled with descriptive codes. These codes were then organized into themes and sub-themes, representing the key patterns and insights emerging from the data. Finally, to ensure validity and reliability, the themes developed by the researcher were reviewed and validated through iterative discussions with two colleagues.

4.2 Study two

Based on the insights gained from study one, study two was developed.

4.2.1 Population and sample. The research population comprises all auditors registered with the Financial Regulatory Authority in Egypt (FRA, 2023). A judgmental sample was used to collect data to ensure that the criteria affecting the research phenomenon are represented in the sample: audit firm size (large-sized, small and medium-sized firms) and auditor experience. The sample size was determined in light of the population size, statistical techniques used (*t*-test), and the statistical power and effect size (Kang, 2021). Therefore, based on these factors, the minimum sample size from Cohen Tables for statistical power (0.99) and high effect size (0.80) is 46 auditors.

4.2.2 Survey development and data collection. The questionnaire included three main questions that responded answered using a five-point Likert-type scale, anchored by "strongly disagree" to "strongly agree." The questions' statements were adapted from previous studies (e.g. Tušek et al., 2021; Peprah et al., 2022; Perera and Abeygunasekera, 2022; Ayedh et al., 2021; Kabir et al., 2022) and the results of the qualitative study. Finally, there were some demographic questions at the end of the questionnaire. The data collection involved multiple steps to ensure data quality and minimize potential biases. First, the survey instrument was pre-tested on a small sample of external auditors to assess its clarity and validity. Next, based on the pre-test results, minor revisions were made to improve the questionnaire's clarity. Finally, the final survey instrument was administered to the targeted sample of external auditors in Egypt. A combination of online and in-person methods was

used to distribute the questionnaire. In addition, a follow-up reminder was sent to enhance response rates; hence 58 questionnaires were collected. Table 3 provides the sample description.

5. Results

5.1 Qualitative study results

The in-depth interviews with auditors covered specific topics: (1) the awareness of BT and blockchain-based accounting and auditing; (2) the potential benefits and challenges of blockchain-based accounting on the auditing processes; (3) the impact of blockchain-based accounting on the auditing profession; and the required capabilities for effective auditing of the blockchain-based accounting systems. The in-depth interview data was analyzed through the following steps (Jenkins *et al.*, 2023): Initially, the interviews were deconstructed into individual quotes. Then, the quotes underwent coding, merging comparable quotes under a common code. Lastly, a comprehensive summary encompassing the essential aspects within a specific category was formulated based on the relevant points.

The results of the in-depth interviews with auditors indicate that there is awareness of the application of BT in accounting and auditing and of the initiative toward the application of BT in the Egyptian banking industry. Some of them mentioned the attempts of international organizations in Egypt and other big Egyptian organizations to develop blockchain-based accounting systems. Nevertheless, they noted that although the BT terminology has been discussed in the accounting and financial market in the recent few years, not many auditors fully understand the BT or how it will be implied in the accounting and auditing processes: Specifically, one of the interviewees stated that:

While the terminology has gained prominence, the understanding among auditors remains inadequate, leaving a gap in comprehending its implications for accounting and auditing. –auditor-big Four audit firm.

In addition, many interviewees said there are expected benefits from blockchain-based accounting in the auditing process, such as immutable ledger, eliminating fraud, time-saving and real-time auditing. An auditor noted that:

The decentralized nature of blockchain-based ledger offers immutability and trust, which will save time for some parts of the auditing processes. –Partner-non-big-four-audit firms

However, they also voiced many challenges that need to be managed before you can reap the benefits of blockchain-based accounting. One of the interviewees said:

As an auditor, it is evident that the current standards for IT auditing lack the necessary specificity, leaving room for ambiguity and potential oversight. We must adapt and reinforce auditing

Items	Large-sized audit firms	Small and medium-sized audit firms
<i>Auditors' experience</i>		
- Professional qualifications	12 (20.6%)	5 (8.6%)
- Technical skills	16 (27.5%)	9 (15.5%)
- Industry experience	17 (29.3%)	7 (12%)
- Non-assurance services	17 (29.3%)	11 (18.9%)
Audit firm size	30 (52%)	28 (48%)

Note(s): Each auditor may possess multiple attributes from the auditor experience attributes. Therefore, the percentages do not collectively sum up to 100%

Source(s): By author

Table 3.
Sample distribution

standards with comprehensive directives, empowering auditors to confidently address the particulars of auditing blockchain and utilize technology as proficient audit tools. –Auditor, big-sized audit firm.

Furthermore, qualitative data analysis shows that although auditors perceive the potential benefits of a large amount of data and evidence provided by blockchain-based accounting systems, they also fear the heavy information load associated with blockchain-based data. Also, auditors referred to the fear of inflexibility in correcting mistakes because mistakes are inevitable, and blockchains do not delete incorrect data. Instead, they add a new block with the correct data.

Moreover, auditors have concerns about blockchain-based accounting systems' scalability. For example, a senior auditor stated that:

Blockchain-based accounting systems pose limitations regarding processing speed and transaction volume. As an auditor, it is crucial to consider the scalability limitations of such systems and carefully assess their capacity to handle increasing data volumes without compromising efficiency. Striking a balance between innovation and practicality is essential to ensure blockchain-based accounting systems can effectively support the demands of a growing and dynamic business environment. –senior auditor- big-four audit firm.

Auditors also mentioned that blockchain-based accounting systems would significantly impact the auditing profession, such as minimizing the role of external auditors and affecting the competition in the audit market to benefit big-sized audit firms. One of the interviewees said:

The use of blockchain technology can potentially change the way auditors perform their procedures, i.e. less reliance on manual procedures. – Partner-small and medium-sized audit firm

Finally, auditors indicated that the successful implementation of auditing blockchain-based accounting systems requires new skills for auditors, either in big or non-big audit firms. Therefore, auditors must have specific training courses to understand BT and its application in the accounting cycle. Also, training should be regular to be aware of the changes in the BT and how they will affect the accounting and auditing processes. They also indicated the need for investment in technological infrastructure to deal with such advanced technologies. Lastly, auditors said that regulators need to set new regulations and standards to govern the application and auditing of blockchain-based accounting systems. As a CPA auditor mentioned:

There is a mismatch between a highly evolving technological audit environment and accounting standard setters' hesitance to develop specific standards to deal with this emerging audit environment.

5.2 Survey study results

The results presented in [Table 4](#) show that there is low to moderate auditors' awareness of blockchain-based accounting systems. Moreover, the level of auditors' awareness of blockchain-based accounting is associated with auditors' experience and audit firm size, as the one-way ANOVA results indicate in [Table 5](#). Therefore, [H1](#) is accepted.

The *t*-test results shown in [Table 6](#) indicate few significant differences between large-sized and small and medium-sized audit firms regarding their perceptions of the audit firm's capabilities required for effective audit of blockchain-based accounting. For example, small-sized audit firms are more concerned about securing adequate resources to train auditors on understanding and implementing blockchain-based accounting and auditing. In addition, the *t*-test results for the differences between audit firm groups show that small-sized audit firms place higher importance on data protection, security

Statements	Overall sample Mean (SD)	Difference from Neutral ¹	t-test
1 Familiarity with blockchain technology and its potential applications in accounting	3.18 (0.91)	0.18	2.12*
2 Knowledge of the advantages and disadvantages of utilizing blockchain for accounting purposes	2.81 (0.74)	0.81	2.08*
3 Willingness to invest time and effort in learning about blockchain technology and its implications for accounting	3.11 (0.88)	0.11	2.10*
4 Openness to exploring and implementing blockchain-based solutions in your current auditing practices	3.45 (0.69)	0.45	2.60**
5 The belief that blockchain technology can revolutionize the accounting profession	3.96 (0.83)	0.96	2.81***

Note(s): 1- refers to deviations in the auditors' responses from the midpoint of the scale (3)
*, **, *** indicate significance levels at 0.05, 0.01 and 0.001, respectively
SD refers to Standard Deviation

Source(s): By author

Table 4.
Auditors' awareness of
blockchain-based
accounting

Items	Level of awareness	F	Significance
<i>Auditors' experience</i>			
- Professional qualifications	4.18	3.10	0.05*
- Technical skills	4.11	6.90	0.02*
- Industry experience	3.65	4.15	0.04*
- Non-assurance services	3.92	7.11	0.01*

<i>Audit firm size</i>			
- Large-sized firms vs Small and medium-sized firms	3.88	6.50	0.02*

Note(s): F test values are significant at a 0.05 significance level

Source(s): By author

Table 5.
Auditors' awareness of
blockchain-based
accounting

Statement	Big-sized firms (Mean)	Non-big sized firms (Mean)	t-test
Technical expertise in implementing Blockchain-based accounting systems	4.15	4.35	1.45
Necessary resources to train auditors on BT and its application in accounting	3.19	4.18	2.25*
Robust security measures to protect Blockchain-based accounting data	3.32	4.40	2.20*
Continues leverage of Blockchain technology for enhancing audit processes	4.22	4.10	1.33
Maintains up-to-date knowledge of regulatory requirements related to Blockchain-based accounting	3.90	4.45	2.12*
Integration of Blockchain-based accounting systems into their audit procedures	3.65	4.60	3.97**

Note(s): T-test values are significant at 0.05* and 0.01** levels

Source(s): By author

Table 6.
Audit firm's
capabilities for
effective audit process
of Blockchain-based
accounting

measures, compliance with audit regulation about BT and integrating blockchain-based accounting in the audit process as the antecedents for effective audit. Therefore, H2 is accepted.

Auditors' perceived potential benefits of blockchain-based accounting differ partially between big and non-big audit firms, as shown in Table 7. Accordingly, H3/1 is accepted. Likewise, auditors perceived challenges associated with auditing blockchain differ between both groups of audit firms, as presented in Table 8. Thus, H3/2 is accepted.

Finally, the results about the impact of BT on the audit profession shown in Table 9 indicate some significant differences between large and small/medium-sized audit firms in terms of the impact of BT on the audit industry. Both groups of audit firms believe that BT is a significant technology disruption in the accounting and auditing profession nowadays. However, small/medium-sized audit firms indicated that reconciliation automation would put the accounting and auditing profession at risk. Therefore, H3/3 is accepted.

Statements	Large-sized firms	Small and medium-sized firms	t-test
- Facilitates the audit process	3.65	2.16	4.15**
- The immutability of data in blockchain-based accounting facilitates the collection of more evidence	3.60	2.46	3.24**
- Audit the whole population of transactions	4.15	4.10	1.12
- Allows for real-time audits to be performed	4.11	4.13	1.09
- Enables auditors to provide live recommendations during the audit process	3.46	3.51	1.21
- Reduces the number of tasks performed by the auditor	4.22	3.80	2.12**
- Leads to time and cost savings	3.55	3.45	1.11
- Provides evidence on new types of non-financial data	3.16	3.20	1.34
- Verifying data recorded without the need for third-party verification	3.98	3.87	1.23
- Verify asset ownership	3.60	3.54	1.12
- Streamlining financial reporting and auditing	3.92	2.71	2.85**
- Reduce the risk of fraud and errors in financial reporting	3.85	2.24	4.15**

Table 7.
Auditors' perceptions about the potential benefits of blockchain-based accounting

Note(s): T-test values are significant at 0.05 and 0.01 levels, respectively
Source(s): By author

Statements	Big-sized firms	Non-big sized firms	t-test
Non-flexibility in correcting business mistakes	4.10	3.90	1.05
Information overload	4.15	4.30	1.11
Slow performance linked to the decentralized database	3.14	3.20	1.14
Duplicate information	3.23	3.11	0.34
The need for sizeable computational power	3.54	4.12	2.35**
Scalability-related problems	4.33	3.94	1.41
1. Reviewing blockchain ledgers stored in multiple locations	4.00	4.95	3.33**
2. Verify the validity of transactions from different users	3.90	4.44	2.98**

Table 8.
Challenges associated with auditing blockchain-based accounting systems

Note(s): T-test values are significant at 0.05 and 0.01 levels, respectively
Source(s): By author

Statements	Large-sized firms	Small and medium-sized firms	t-test
- BT is a significant technology disruption in the accounting and auditing profession nowadays	4.75	4.80	0.85
- Accountants will still be responsible for preparing the financial statements	4.60	4.55	0.92
- Auditors will have more time to focus on tasks requiring professional judgment	4.50	4.45	1.10
- The automation of reconciliation will put the accounting and auditing profession at risk	3.90	4.20	2.10*
- Auditors will still be needed to express their opinion about the fair representation of the financial statements	4.25	4.30	1.15
- BT implementation will highly require tech-skilled auditors	4.80	4.85	1.28
- Accounting and auditing standards must be adapted to BT	4.78	4.89	0.95
- The auditing process must be adapted to follow how the technology of BT works	3.95	4.10	1.49

Note(s): T-test values are significant at 0.05 and 0.01 levels, respectively

Source(s): By author

Table 9.
Auditors' perceptions
about the impact of
blockchain-based
accounting on the audit
profession

6. Discussion

The study focused on investigating the awareness of external auditors of accounting systems based on blockchain technology. Further, the study examined auditors' perceptions about the capabilities of the audit firm to audit accounting systems based on blockchain technology effectively and the perceived benefits and challenges associated with blockchain implementation in the accounting systems. The study results reveal a significant awareness gap among auditors regarding using blockchain in accounting. The results related to the auditors' awareness of blockchain-based accounting are consistent with [Tušek et al. \(2021\)](#) and inconsistent with that of [Peprah et al. \(2022\)](#). However, the results also show that the awareness of accounting systems based on BT is related to auditors' experience and audit firm size. Regarding their professional qualification, specialization and technical skills, high-experienced auditors are more aware of blockchain implementation in accounting than low-experienced auditors. Also, auditors working in large-sized audit firms are more aware of blockchain-based accounting systems than those working in small and medium-sized audit firms.

The findings also show that there are specific capabilities that the audit firm must have to audit blockchain-based accounting systems effectively. These results are consistent with [Perera and Abeygunasekera \(2022\)](#). In addition, non-big-sized audit firms place higher importance on data protection, security measures, compliance with audit regulations about BT and integrating blockchain-based accounting in the audit process as the antecedents for effective auditing. Most likely, non-big-sized audit firms need more organizational capabilities to adopt robust security measures to protect blockchain-based accounting data effectively. They also have limited time and personnel to monitor and interpret regulations and standards regarding blockchain usage in accounting and auditing.

Moreover, while both large-sized audit firms and small and medium-sized ones agree on the advantages and difficulties of blockchain-based accounting systems, notable differences exist between them. For example, the results show that the benefits of adopting blockchain technology in accounting varied between large-sized and small and medium-sized audit firms. Large-sized audit firms emphasize the following potential benefits more than small and medium-sized auditing firms: simplifying the audit process, collecting additional evidence, reducing the workload of auditors, enhancing efficiency in financial reporting and auditing

and reducing the likelihood of fraud and errors in financial reporting. The explanation of the differences in the perceived benefits of BT between both groups of audit firms can be attributed to the variations in their scale of operations, the complexity of financial systems, resource availability and risk exposure. Large audit firms, with their global reach and broad client base, are more likely to explore and appreciate the potential advantages that blockchain accounting can bring to their audit processes than small and medium-sized firms.

Also, there is a consensus between large-sized audit firms and small and medium-sized firms about the challenges confronted when attesting accounting systems based on blockchain. However, small and medium-sized companies emphasize the following challenges more than large audit firms: the need to review blockchain ledgers stored in multiple locations and verify the validity of transactions from different users and the need for enormous computational power. The reason behind these variations is that small and medium-sized audit firms suffer from resource constraints and lack adequate technical expertise. Further, large-sized firms may have more resources and skills to deal with complex regulatory environments than small and medium-sized audit firms.

Finally, auditors agree that BT is a significant technology disruption in the accounting and auditing profession nowadays. However, small and medium-sized audit firms fear that reconciliation automation will put the accounting and auditing profession at risk than large-sized audit firms. Probably because the available technological and professional resources to enable them to compete in the blockchain-based accounting environment are less than large-sized audit firms, which might lead to erosion of their prospective client base.

7. Conclusion, implications and future research

In conclusion, this study aimed to investigate the awareness of external auditors regarding accounting systems based on blockchain technology, as well as their perceptions of the audit firm's capabilities, benefits and challenges associated with blockchain implementation in accounting. The findings contribute to the literature by highlighting the awareness gap among auditors regarding blockchain-based accounting systems, the importance of specific capabilities for effective auditing, the divergent perceptions of benefits and challenges between large and small/medium-sized audit firms and the apprehensions of small and medium-sized firms regarding technological disruptions.

The study's findings revealed a significant awareness gap among auditors concerning using blockchain in accounting. Moreover, the study demonstrated that auditors' awareness of blockchain-based accounting systems is influenced by their experience and the size of the audit firm. Highly experienced auditors and those working in large-sized audit firms exhibited greater awareness of blockchain implementation in accounting than their less experienced counterparts and those in small and medium-sized firms.

Also, the results highlighted specific capabilities that audit firms must possess to audit blockchain-based accounting systems effectively. Small and medium-sized audits require additional organizational capabilities than large-sized audit firms to adopt robust security measures and interpret regulations and standards, given their limited resources and personnel.

Regarding the benefits and challenges of blockchain-based accounting systems, significant differences were observed between large-sized audit firms and small and medium-sized firms. Large-sized firms emphasized benefits such as simplifying the audit process, collecting additional evidence, reducing the workload of auditors, enhancing efficiency in financial reporting and auditing and reducing the likelihood of fraud and errors. On the other hand, small and medium-sized firms faced challenges related to reviewing blockchain ledgers stored in multiple locations, verifying transaction validity from different users and requiring significant computational power. These differences can be attributed to differences in resources and capabilities between the two groups.

Auditors agree that blockchain technology significantly disrupts the accounting and auditing profession. However, small and medium-sized audit firms express concerns about reconciliation automation posing a risk to the profession, potentially eroding their client base. This apprehension may stem from their limited technological and professional resources to compete effectively in the blockchain-based accounting environment.

7.1 Theoretical implications

The study's results conform with the institutional theory, i.e. how organizational decisions are influenced by the institutional environment's norms and values. The results provide insights into how institutional pressures shape audit firms' perceptions of blockchain in accounting. Notably, the study's results suggest that auditors' awareness of blockchain-based accounting systems is not high because the pressures of the institutional environment are still not present enough to force auditors, especially from non-big-sized audit firms, to learn how blockchain-based accounting systems work. Further, as more large-sized clients, e.g. commercial banks, adopt blockchain-based accounting systems, audit firms will be more involved in adopting the capabilities required to effectively audit blockchain-based accounting systems to conform with institutional norms and respond to coercive pressures.

7.2 Practical implications

The results provide insights to auditors about effectively auditing blockchain-based accounting systems. The study findings show that blockchain-based accounting systems have unique features; therefore, it is recommended that audit firms should adopt the following strategy, shown in [Figure 3](#), when auditing blockchain-based accounting systems. In addition, the results also recommend investing in regular BT education and training to effectively use the BT and be aware of the advances of a continuously evolving BT. Audit firms are encouraged to benefit from these insights because audit firms that will conduct effective audits for blockchain-based accounting systems will have a competitive advantage in this newly blockchain-based accounting market. They will be able to acquire new clients and will be able to maintain their current clients, especially because some large-sized banks have already announced their intention to adopt the BT within the near future.

7.3 Public policy implications

The results indicated a lack of specific financial reporting regulations to govern the effective audit process of blockchain-based accounting. Therefore, it is recommended that the Egyptian Society for Accountants and Auditors (ESAA) and the Financial Regulatory Authority in Egypt (FRA) participate in developing the required standards and regulations to audit accounting systems based on blockchain technology and in promoting and supporting the integration of BT into the accounting ecosystem by providing BT education and training courses. Also, professional bodies can assist small and medium-sized audit firms in forming collaborations with blockchain technology developers and startups to address the challenges posed by blockchain audits. These collaborations could help small and medium-sized audit firms to leverage their resources and expertise to compete in this evolving technology market effectively. These initiatives are essential to realign and confront the challenges associated with auditing accounting systems based on blockchain technology.

8. Future research

Many venues for future research can be derived from the study's findings. For example, future studies can investigate how internal and external auditors can adapt their audit

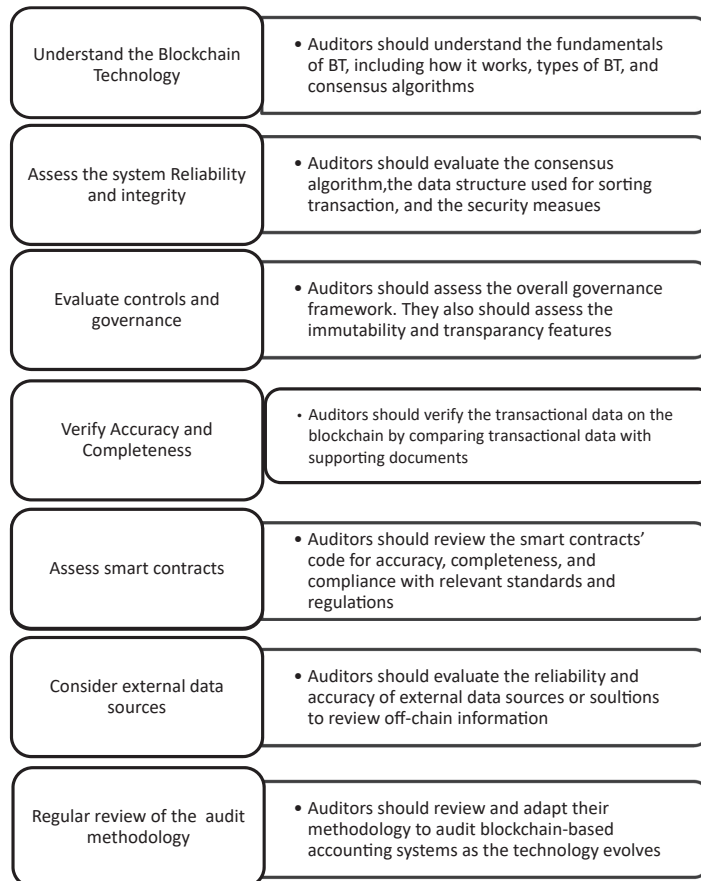


Figure 3.
Preliminary Audit
strategy for
Blockchain-based
Accounting System

Source(s): Figure by author

methodologies and procedures to effectively assess the integrity, security and accuracy of transactions recorded on a blockchain. Moreover, future research can assist regulatory bodies in establishing standards and guidelines to ensure the compliance and reliability of financial reporting within blockchain ecosystems. Finally, studies can further examine the impact of disruptive technologies in accounting and auditing on the competition in the auditing and assurance services market.

Note

1. Ethereum is an open source BT that enable digital global payment through smart contract functionality.

References

Abreu, P.W., Aparicio, M. and Costa, C.J. (2018), "Blockchain technology in the auditing environment", *2018 13th Iberian Conference on Information Systems and Technologies (CISTI)*, IEEE, pp. 1-6.

- Abdennadher, S., Grassa, R., Abdulla, H. and Alfalasi, A. (2022), "The effects of blockchain technology on the accounting and assurance profession in the UAE: An exploratory study", *Journal of Financial Reporting and Accounting*, Vol. 20 No. 1, pp. 53-71.
- Afsay, A., Tahriiri, A. and Rezaee, Z. (2023), "A meta-analysis of factors affecting acceptance of information technology in auditing", *International Journal of Accounting Information Systems*, Vol. 49, 100608.
- Ahram online (2023), "Central Bank of Egypt renews warning against dealing in cryptocurrencies", available at: <https://english.ahram.org.eg/NewsContent/3/12/476005/Business/Economy/Central-Bank-of-Egypt-renews-warning-against-deali.aspx> (accessed 04 June 2023).
- Al Shanti, A.M. and Elessa, M.S. (2023), "The impact of digital transformation towards blockchain technology application in banks to improve accounting information quality and corporate governance effectiveness", *Cogent Economics and Finance*, Vol. 11 No. 1, 2161773.
- Alarcon, J.L. and Ng, C. (2018), "Blockchain and the future of accounting", *Pennsylvania CPA Journal*, Vol. 88 No. 4, pp. 26-29.
- Ali, O., Ally, M. and Dwivedi, Y. (2020), "The state of play of blockchain technology in the financial services sector: a systematic literature review", *International Journal of Information Management*, Vol. 54, doi: [10.1016/j.ijinfomgt.2020.102199](https://doi.org/10.1016/j.ijinfomgt.2020.102199) (forthcoming).
- Al-saedi, M.O. and Almaliki, O.J. (2023), "The impact of applying blockchain technology in accounting and auditing", *World Bulletin of Management and Law*, Vol. 22, pp. 136-142.
- Ayedh, A.M., Echchabi, A., Hamid, F.A. and Salleh, S. (2021), "Implications of cryptocurrency and blockchain on auditing and accounting practices: the Malaysian experience", *International Journal of Blockchains and Cryptocurrencies*, Vol. 2 No. 2, pp. 172-186.
- Balicka, H. (2023), "Digital technologies in the accounting information system supporting decision-making processes", *Scientific Papers of Silesian University of Technology. Organization and Management/ Zeszyty Naukowe Politechniki Slaskiej. Seria Organizacji i Zarzadzanie*, (169), pp. 57-89.
- Bartlett, C. (2022), "Egypt expands customs handling via blockchain and goes multimodal", available at: <https://theloadstar.com/egypt-expands-customs-handling-via-blockchain-and-goes-multimodal/> (accessed 26 November 2022).
- Blockchain.com (2022), "About Blockchain.com", available at: [https://www.blockchain.com/about at 21/9/2022](https://www.blockchain.com/about-at-21/9/2022)
- Bonsón, E. and Bednárová, M. (2019), "Blockchain and its implications for accounting and auditing", *Meditari Accountancy Research*, Vol. 27 No. 5, pp. 725-740.
- Bonyuet, D. (2020), "Overview and impact of blockchain on auditing", *International Journal of Digital Accounting Research*, Vol. 20, pp. 31-43.
- Chang, V., Baudier, P., Zhang, H., Xu, Q., Zhang, J. and Arami, M. (2020), "How Blockchain can impact financial services—The overview, challenges, and recommendations from expert interviewees", *Technological Forecasting and Social Change*, Vol. 158, 120166.
- Cusack, B. (2018), "Is block chain the next big thing? Am Cham Egypt", available at: <https://www.amcham.org.eg/publications/business-monthly/issues/266/February-2018/3691/is-blockchain-the-next-big-thing> (accessed 26 November 2022).
- DHL (2022), "Blockchain", available at: <https://www.dhl.com/eg-en/home/insights-and-innovation/thought-leadership/trend-reports/blockchain-logistics.html> (accessed 12 October 2022).
- Elommal, N. and Manita, R. (2021), "How blockchain innovation could affect the audit profession: a qualitative study", *Journal of Innovation Economics and Management*, Vol. 1 No. 37, pp. II03-II27.
- Faccia, A., Pandey, V. and Banga, C. (2022), "Is permissioned blockchain the key to supporting the external audit shift to entirely open innovation paradigm?", *Journal of Open Innovation: Technology, Market, and Complexity*, Vol. 8 No. 2, p. 85.

- FinTech Egypt (2021), "Episode 4: understanding blockchain's potential in disrupting FinTech", available at: https://fintech-egypt.com/news/news_details.php?id=138 (accessed 12 October 2022).
- Fosso Wamba, S. and Guthrie, C. (2020), "The impact of blockchain adoption on competitive performance: the mediating role of process and relational innovation", *Logistique and Management*, Vol. 28 No. 1, pp. 88-96.
- FRA (2023), "Legal accountants portal", available at: <https://fra.gov.eg/auditors-portal/> (accessed 27 June 2023).
- Gauthier, M.P. and Brender, N. (2021), "How do the current auditing standards fit the emergent use of blockchain?", *Managerial Auditing Journal*, Vol. 36 No. 3, pp. 365-385.
- Han, H., Shiwakoti, R.K., Jarvis, R., Mordi, C. and Botchie, D. (2023), "Accounting and auditing with blockchain technology and artificial Intelligence: a literature review", *International Journal of Accounting Information Systems*, Vol. 48, 100598.
- Hashem, R.E.E.D.R., Mubarak, A.R.I. and Abu-Musa, A.A.E.S. (2023), "The impact of blockchain technology on audit process quality: an empirical study on the banking sector", *International Journal of Auditing and Accounting Studies*, Vol. 5 No. 1, pp. 87-118, doi: [10.47509/IJAAS.2023.v05i01.04](https://doi.org/10.47509/IJAAS.2023.v05i01.04).
- Helliar, C.V., Crawford, L., Rocca, L., Teodori, C. and Veneziani, M. (2020), "Permissionless and permissioned blockchain diffusion", *International Journal of Information Management*, Vol. 54 (forthcoming).
- Hsieh, S.F. and Brennan, G. (2022), "Issues, risks, and challenges for auditing crypto asset transactions", *International Journal of Accounting Information Systems*, Vol. 46, 100569.
- Islam, S. and Stafford, T. (2022), "Factors associated with the adoption of data analytics by internal audit function", *Managerial Auditing Journal*, Vol. 37 No. 2, pp. 193-223.
- Jackson, D., Richardson, J., Michelson, G. and Munir, R. (2022), "Attracting accounting and finance graduate talent—beyond the Big Four", *Accounting and Finance*, Vol. 62 No. 3, pp. 3761-3790.
- Jenkins, N., Monaghan, K. and Smith, M. (2023), "Did they really say that? An agential realist approach to using computer assisted transcription software in qualitative data analysis", *International Journal of Social Research Methodology*, Vol. 26 No. 1, pp. 97-109.
- Kabir, M.R., Sobhani, F.A., Mohamed, N. and Ashrafi, M. (2022), "Impact of integrity and internal audit transparency on audit quality: the moderating role of blockchain", *Management and Accounting Review (MAR)*, Vol. 21 No. 1, pp. 203-233.
- Kang, H. (2021), "Sample size determination and power analysis using the G* Power software", *Journal of Educational Evaluation for Health Professions*, Vol. 18, 1149215.
- Kiviat, T.I. (2015), "Beyond bitcoin: issues in regulating blockchain transactions", *Duke Law Journal*, Vol. 65, pp. 569-608.
- Lombardi, R., de Villiers, C., Moscariello, N. and Pizzo, M. (2022), "The disruption of blockchain in auditing—a systematic literature review and an agenda for future research", *Accounting, Auditing and Accountability Journal*, Vol. 35 No. 7, pp. 1534-1565.
- Lowe, D.J., Bierstaker, J.L., Janvrin, D.J. and Jenkins, J.G. (2018), "Information technology in an audit context: have the Big 4 lost their advantage?", *Journal of information Systems*, Vol. 32 No. 1, pp. 87-107.
- Lutfi, A. (2022), "Understanding the intention to adopt cloud-based accounting information system in Jordanian SMEs", *International Journal of Digital Accounting Research*, Vol. 22, pp. 47-70.
- Machine, C.T.A.A.O. (2021), "How audit firm size moderate effect of toe context toward auditor adoption of machine learning", *Journal of Theoretical and Applied Information Technology*, Vol. 99 No. 24, pp. 5972-5980.

- Mahtani, U. (2022), "Fraudulent practices and blockchain accounting systems", *Journal of Accounting, Ethics and Public Policy*, Vol. 23 No. 1, pp. 97-148.
- Matskiv, H., Smirnova, I., Malikova, A., Puhachenko, O. and Dubinina, M. (2023), "The application of blockchain technology in accounting and auditing: experience of Ukraine and Kazakhstan", *Financial and Credit Activity: Problems of Theory and Practice*, Vol. 1 No. 48, pp. 180-191.
- Papadaki, M. and Karamitsos, I. (2021), "Blockchain technology in the Middle East and North Africa region", *Information Technology for Development*, Vol. 27 No. 3, pp. 617-634.
- Parmooddeh, A.M., Ndiweni, E. and Barghathi, Y. (2023), "An exploratory study of the perceptions of auditors on the impact on Blockchain technology in the United Arab Emirates", *International Journal of Auditing*, Vol. 27 No. 1, pp. 24-44.
- Peprah, W.K., Abas, R.P., Jr. and Ampofo, A. (2022), "Applicability of blockchain technology to the normal accounting cycle", *Applied Finance and Accounting*, Vol. 8 No. 1, pp. 1-5.
- Perera, P.A.S.N. and Abeygunasekera, A.W.J.C. (2022), "Blockchain adoption in accounting and auditing: a qualitative inquiry in Sri Lanka", *Colombo Business Journal*, Vol. 13 No. 1, pp. 57-87.
- Rubin, H.J. and Rubin, I.S. (2011), *Qualitative Interviewing: The Art of Hearing Data*, Sage, Los Angeles.
- Schmitz, J. and Leoni, G. (2019), "Accounting and auditing at the time of blockchain technology: a research agenda", *Australian Accounting Review*, Vol. 29 No. 2, pp. 331-342.
- Shi, Z., Bergers, J., Korsmit, K. and Zhao, Z. (2022), "AUDITEM: toward an automated and efficient data integrity verification model using blockchain", *arXiv Preprint arXiv:2207.00370*, pp. 1-17.
- Smith, S.S. and Castonguay, J.J. (2020), "Blockchain and accounting governance: emerging issues and considerations for accounting and assurance professionals", *Journal of Emerging Technologies in Accounting*, Vol. 17 No. 1, pp. 119-131.
- Supriadi, I., Prasetyo, H.D. and Suprihandari, M.D. (2020), "The effect of applying blockchain to the accounting and auditing", *Ilomata International Journal of Tax and Accounting*, Vol. 1 No. 3, pp. 161-169.
- Troshani, I., Locke, J. and Rowbottom, N. (2019), "Transformation of accounting through digital standardization", *Accounting, Auditing and Accountability Journal*, Vol. 32 No. 1, pp. 133-162.
- Tušek, B., Ježovita, A. and Halar, P. (2021), "The importance and differences of analytical procedures' application for auditing blockchain technology between external and internal auditors in Croatia", *Economic Research-Ekonomska Istraživanja*, Vol. 34 No. 1, pp. 1385-1408.
- Vincent, N.E. and Wilkins, A.M. (2020), "Challenges when auditing cryptocurrencies", *Current Issues in Auditing*, Vol. 14 No. 1, pp. A46-A58.
- Wang, Y. and Kogan, A. (2018), "Designing confidentiality-preserving blockchain-based transaction processing systems", *International Journal of Accounting Information Systems*, Vol. 30, pp. 1-18.

Appendix

In-depth interviews guide

- (1) Do you use any software in the audit practices?
- (2) What are blockchain-based accounting systems? What do you know about it?
- (3) Do you have any experience with blockchain-based accounting?
- (4) What are the potential benefits of blockchain-based accounting systems to the audit process?
- (5) What are the associated challenges with auditing blockchain-based accounting systems?
- (6) How should the auditing process be adapted to be able to audit blockchain-based accounting systems effectively?

JHASS
5,4

- (7) What are the capabilities required for the audit firm to be able to audit blockchain-based accounting systems effectively
- (8) Will blockchain-based accounting systems affect the competition in the audit market?

380

Corresponding author

Ahmed Anis can be contacted at: ahmed.anis@foc.cu.edu.eg