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THE IMPACT OF BLOCKCHAIN TECHNOLOGY ON AUDIT PROCESS QUALITY: An Empirical Study on the Banking Sector

Rehab Esam El Din Ragheb Hashem[1]*, Al-Rifai Ibrahim Mubarak[2] and Ahmad Abd EI-Salam Abu-Musa[3]

[1]Lecturer Assistant - Accounting Department, Faculty of Commerce, Tanta University, Egypt. Email: rehab.hashem92@gmail.com
[2]Professor of Auditing, Ex-Vice President of Tanta University for Students Affairs and Education, Faculty of Commerce, Tanta University, Egypt
[3]Professor of Accounting Information Systems, Ex-Vice Dean for Student Affairs and Education, Faculty of Commerce, Tanta University, Egypt
*(*Corresponding author)*

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Abstract: Blockchain is transforming not only the way of recording, processing, and storing financial transactions and information, but also the way audit firms can practise their profession. The purpose of this article is to examine how this technology will affect the audit process quality. An empirical study was conducted on a sample of Egyptian banks that use Blockchain Technology in the period from (2017) to (2021). The Conceptual Framework and Literature Review concluded that this technology could affect audit firms at six key levels. Blockchain will allow an auditor to: (1) Save time and improve the efficiency of their audit, (2) Favour an audit covering the whole population instead of an audit based on sampling techniques, (3) Focus the audit on testing controls rather than testing transactions, (4) Set up a continuous audit process, (5) Play a more strategic audit role, and (6) Develop new advisory services. Furthermore, the empirical study concluded that there is a significant relationship between Blockchain and Audit quality in the banking sector. The results underline the need for the establishment of a clear and coherent legislative system and new audit standards, allowing auditors to embed this technology and enhance audit practices.

Keywords: Blockchain, Audit Quality, Innovation, Digital Transformation, Egypt

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1. INTRODUCTION

The financial scandals that appeared in the early 2000s, (Enron, WorldCom, Parmalat, …) testifies to manipulations done by several managers and showed the limits of this governance mechanism. An improvement in audit quality is, therefore, necessary to enable the audit to play its full role as a governance mechanism. De Angelo (1981) defines the quality of the audit as the probability for an auditor to detect discrepancies in the financial statements and disclose them to the parties concerned. An upper audit quality improves the quality of financial information and promotes better control by managers and better decision-making by investors. Several previous studies have demonstrated the increased demand for quality audits to reduce information asymmetry as well as earning management. For example, Francis *et. al.*, (1999) demonstrated that earning management is negatively related to audit quality. In addition, other studies find that investors, especially international ones, require superior audit quality and enhanced governance to invest in companies (Ashbaugh and Warfield, 2003; Leuz *et al.*, 2009). Other studies have also demonstrated the indirect and positive effects of audit quality, used as a mediating variable, on other governance mechanisms (Manita, *et. al.*, 2020).

Nowadays, audit firms are digitising, developing their internal processes, and studying how to exploit big data and new digital tools to add value to their customer. This digitalisation may improve the audit quality and better satisfy shareholders and other stakeholders by making the audit more relevant. First, with digital tools, such as the analysis of big data, the auditor can evaluate all data of the audited firm and no longer use the sampling method. Indeed, the digitalisation of audit processes enables him to improve risk assessment and the quality of judgments by identifying all the anomalies and by proposing solutions to issues highlighted. Finally, the audit could also focus on current data, not just historical information, to give a prospective vision of the sustainability of the audited firm by evaluating the current level of sales, the planned order booking, etc. This additional analysis could significantly reduce the managers' opportunistic behaviours and thus enhance the audit relevance and improve corporate governance (Manita, *et. al.*, 2020).

Blockchain Technology, which has recently made a great impression in the national and international press, attracted the attention of the private sector and various public institutions, and potentially as a stronger technology than the internet, is one of the biggest innovations of the digitalised age (Celayir& Celayir, 2020).

One of the expected technological advances is Blockchain Technology. Even though today's companies and countries have only recently attracted attention, the mentioned technology has begun to enter our lives step by step, similar to the introduction of the internet into our lives years ago. The Internet's creation of a virtual world by transforming our business and social habits into digital data saves both money and time in the workflow and communication process. Similar to the way the World Wide Web was gifted to the world without obtaining any patents, the Blockchain Technology that has been heard in our ears recently has been gifted to the world in the same way (Erdoğan& Bodur, 2020).

Blockchain, with a general definition, is a technology protocol that allows data sharing with trust-based transactions such as identification and authorisation in a decentralised distributed network environment without the approval or control requirement of the central authority (Celayir& Celayir, 2020). Blockchain Technology offers "a secure, transparent, fast, and affordable digital solution to many government problems" (Rooney, *et. al.*, 2017). The combination of these capabilities is also likely to transform auditing by automating workflows, but more importantly, increasing audit effectiveness and reporting (Rozario& Thomas, 2019).

The audit process is constantly moving towards the use of digital tools. The majority of auditors are turning to digital tools and general audits. The audit concept may need to adjust its current paradigm to adapt to such a rapidly changing environment. In addition, new audit approaches based on advanced technologies can be used to improve assurance quality (Dai, 2017).

Although researchers offer the opinion that Blockchain Technology will affect financial instruments to a large extent at the first stage, they believe that over time, it will affect every sector with digital data following the requirements of the age (Erdoğan& Bodur, 2020). In addition, the results of the literature review show that there is a lack of awareness of the adoption of Blockchain Technology (Özyürek, 2021).

2. LITERATURE REVIEW

Blockchains are one of the technologies produced by the environment of digital transformation of business models, which is likely to change the way companies work. This emerging technology and its multiple capabilities can overcome the problems in the accounting system, and there are conflicting opinions about the relationship of Blockchain on the audit profession, there are those who believe that Blockchains have the potential to eliminate the audit

profession, while others argue that Blockchains can help develop the audit process, and auditors will need to understand this technology because it is applied in the companies being audited, and it may change both the roles and skills of auditors and the way they follow them. In carrying out their tasks, which means the necessity of increasing their skills as a result of the expansion of the adoption of blockchains in the business world, and this can be clarified through the following studies:

(CPA& AICPA, 2017) studied the potential effects of digital Blockchain Technology on the audit of financial reports and additional assurance services that the auditor can perform in light of this modern technology.

The study concluded that digital blockchains have an impact on all stages of the accounting cycle, starting from the inception of transactions, their processing, authorisation, and registration, which affects the current auditing model. Therefore, audit methods and procedures must be changed in line with this technology. Also, this technology will provide more data and greater capabilities in analysing this data, which may create additional assurance services performed by the auditor, which requires him to increase his skills and technological knowledge in response to these additional services.

(Dai & Vasarhelyi, 2017) dealt the impact of Blockchain Technology on the accounting system and the assurance services provided by auditors. The study provided an initial discussion of how Blockchain can enable a transparent, verifiable, and real-time accounting system. The study concluded that Blockchain Technology can make a change in current auditing practices, which leads to a more accurate and timely automatic confirmation system, in light of the system produced by the Blockchain environment, which allows the recording of the data necessary for audits. Examples of this data include:

1. The financial statements of companies from the three-entry accounting information system.
2. Records of physical items (such as inventory, machinery, and buildings) recorded and transmitted by the Internet of Things.
3. Non-financial information from various business operations or from external information sources (such as news and social media).
4. System records that record real business operations as used in the process of financial mining.

(Sahlin & Levenby, 2018) aimed to investigate how Blockchains help auditors implement audit trails. This is by defining what Blockchain is, and checking whether Blockchain Technology can be used in audit trails and

whether the use of Blockchain Technology can contribute to a more cost-effective, secure, and reliable audit trail.

The study found that there is great potential in Blockchain Technology that leads to improving the quality of the audit process. Blockchain Technology can also be used to verify all transactions in the audit trail in real time. In addition, Blockchain enables auditors to focus on understanding the data, rather than verifying transactions and sampling. This would make the auditors more efficient, which leads to cost savings. The study also believes that the biggest challenge that must be considered is that blockchains are a complex system that requires a high level of knowledge, which requires a high level of training, and scientific and practical qualifications of auditors.

(Bonsón & Bednárová, 2019) discussed the impact of Blockchains on the quality characteristics of accounting information, and their expected impact on auditing, considering that Blockchain Technology is the next step in the era of digital transformation, and that, it is a technological revolution that will reshape business sectors. The study found many advantages associated with Blockchains, especially concerning decentralisation, flexibility, and encryption, as well as some challenges facing the effective application of this technology, and I also found an impact of Blockchains on both the characteristics of the quality of accounting information and electronic audit entries.

(Schmitz & Leoni, 2019) dealt the impact of the application of Blockchain Technology on the accounting and auditing profession by reviewing the advantages and disadvantages of applying this technology in the fields of accounting and auditing. The study concluded that Blockchain Technology has an important impact on issues of governance, transparency, and trust in the Blockchain ecosystem and a continuous review that supports Blockchain and smart contract applications, and the paradigm shift in the roles of accountants and auditors. The study results also showed that Blockchain Technology increases the efficiency of transaction registration and compatibility between accounting data and its review. At the same time, it allows accountants and auditors to reduce costs and time in carrying out these tasks and reduce the risk of human error.

(Liu, *et. al.*, 2019) discussed the effects of Blockchains on auditing, and also addressed the opportunities and challenges facing Blockchain Technology for auditors. It also provided specific recommendations to the auditors to adapt, develop, and upgrade the role of the audit in light of the implementation of blockchains.

The results of the study concluded that, at the current stage, auditors must take into account the following initial steps to adapt to the new environment of Blockchain Technology:

- Auditors gain proficiency in dealing with Blockchain Technology and Blockchain Governance: Auditors must be able to assess the costs and benefits of Blockchain adoption.
- Advising on Blockchain implementation for their clients: Audit firms can reach this goal by adjusting their recruitment and training strategy.
- Participate in the development of blockchains with a focus on new risks arising from the use of blockchains: auditors should consider moving forward to influence the implementation of blockchains.
- Audit firms must shift their focus to assessing the effectiveness of risk management and advising on solutions and safeguards for internal control: Rapidly growing technology provides opportunities for auditors to enhance the quality of services provided.

(Rozario & Thomas., 2019) set a vision for the audit of future financial statements through the proposal of Blockchains for an external audit, which supports smart audit procedures. The study found that the use of Blockchain and smart contracts improve business practices by enhancing efficiencies and transparency in the value chain. The study also found that incorporating these innovations is also likely to advance the review by automating the review process, but more importantly, enhancing the effectiveness of review and reporting. The use of blockchains has also increased auditors' ability to improve audit quality and narrow the expectations gap between auditors, users of financial statements, and regulators.

(Cao, *et. al.*, 2019) examined the impact of the use of Blockchain Technology on both financial reports and the audit process. The results of the study showed how auditing, using Blockchain, can improve the verification efficiency of not only recorded transactions or customer databases but also verifications through zero-knowledge protocols that maintain data privacy. Therefore, the use of this technology changes the basis on which to determine audit fees and focus efforts, as the competitive fees for auditors depend on the characteristics of the counterparties of customers and the volume of the corresponding transactions rather than the size of the customer. Blockchain Technology also reduces customers' incentives for distorted reports and sampling costs, allowing auditors to reallocate efforts from transaction-based audits to discretionary audits.

(Wang, *et. al.*, 2020) reviewed the advantages of using Blockchains in the audit process, in addition to studying the possibility of applying the properties of Blockchains, including stability, distributed ledger, and real-time settlement in the field of auditing.

Based on the systematic analysis, this study proposed a conceptual model for auditing a Blockchain-based information system, which provides solutions for the use of Blockchain Technology in the audit profession, which greatly improves the efficiency and effectiveness of auditing and promotes the transformation of the traditional audit model into a real-time model. Continuous and Intelligent Auditing, (Hayrettin& Karaburun, 2020) discussed changes in the professional attributes of auditors in light of Blockchain Technology, as it is considered one of the most important technologies produced by the digital revolution, which in turn, affects the review process and auditors.

The study concluded that the review process has changed, especially when collecting evidence and review procedures as a result of the use of Blockchains, as it can record every transaction by every person on the Blockchain Network and this data cannot be changed, and it also, provides automated evidence, which makes the review process more reliable and transparent. It also enables auditors to access the client's internal and external information. On the other hand, the study found that with the development and change of technology, the professional characteristics of auditors also change, which may require the creation of new areas of specialisation and new opportunities for auditors. The auditors who specialise in Blockchain review can be called Blockchain auditors. As a result, those auditors who will have an interdisciplinary understanding are expected to have proficiency in both auditing and technology.

(Gauthier & Brender, 2021) aimed to determine the impact of Blockchain Technology on financial reporting and auditing processes. That is, by studying the impact of the increasing use of Blockchain on the nature and extent of information available to auditors and how audits are conducted. In addition to verifying how auditors assess the importance of current auditing standards in light of the emerging use of Blockchain Technology.

The findings revealed a growing demand for (IT) audit standards, as well as a timing mismatch between the rapidly changing (IT) environment and the slowness of regulators in issuing new standards or updating standards. The study recommended the need to develop audit standards, related to information technology to better suit the rapidly evolving technology environment, in ways that take into account the views of other stakeholders, including those of standard setters.

(Maffei, *et. al.*, 2021) aimed to provide a critical analysis of the role of Blockchain Technology in accounting and auditing practices, by presenting the benefits, threats, risks, and potential issues associated with its adoption and implementation. Moreover, the study examined the impact of Blockchain Technology on how professionals update accounting and auditing practices.

The results of the study found that accounting practices benefited from a new fully computerized self-managed accounting system that relies on the innovative three-entry bookkeeping system, which is characterized by unchangeable accounting records. Furthermore, audit practices have taken advantage of the benefits of Blockchain Technology, which includes automatic and real-time reconciliation of budget line items and external confirmation of accounting records, along with constantly updated inventory counts and data analysis.

(Elommal & Manita, 2022) examined how this technology will affect the audit profession. Based on a qualitative study carried out on a sample of (17) auditors, this research shows that this technology could affect audit firms at six key levels. Blockchain will allow an auditor to: (1) Save time and improve the efficiency of their audit, (2) Favor an audit covering the whole population instead of an audit based on sampling techniques, (3) Focus the audit on testing controls rather than testing transactions, (4) Set up a continuous audit process, (5) Play a more strategic audit role and (6) Develop new advisory services. The results underline the need for the establishment of a clear and coherent legislative system and new audit standards, allowing auditors to embed this technology and enhance audit practices.

3. THEORETICAL BACKGROUND

3.1. Digital Transformation & Innovation in Auditing

According to (Porter and Heppelmann, 2014), the competition and the increasing pressure to provide their clients with relevant and reliable information are the main factors driving audit firms to digitalise their processes. To stay competitive, audit firms must evolve their business model and service offering by acquiring innovative technologies to propose digital solutions (Van Den Broek & Van Veenstra, 2018). To develop their audit processes, several audit firms have invested in new artificial intelligence (AI) tools such as KPMG, Price Water House Cooper, Ernst & Young, and Deloitte (Kokina and Davenport, 2017). According to (Krahel & Titera, 2015), by moving from the paper age to the digital management of information, digitalization is impacting the

way audits are conducted. Among digital technologies, Big Data, Artificial Intelligence (AI), and Blockchain are currently the most used by audit firms to evolve their processes and service offerings (Montes and Goertzel, 2018).

Furthermore, (Barr-Pulliam, *et. al.*, 2022) conclude that a confluence of positive factors is required to achieve more widespread adoption of digital transformation. The factors require actions by all stakeholders within the audit and assurance ecosystem. Continued collaboration between academia, audit firms, standard setters, and regulators can yield significant insight into the adoption of emerging technologies in the audit.

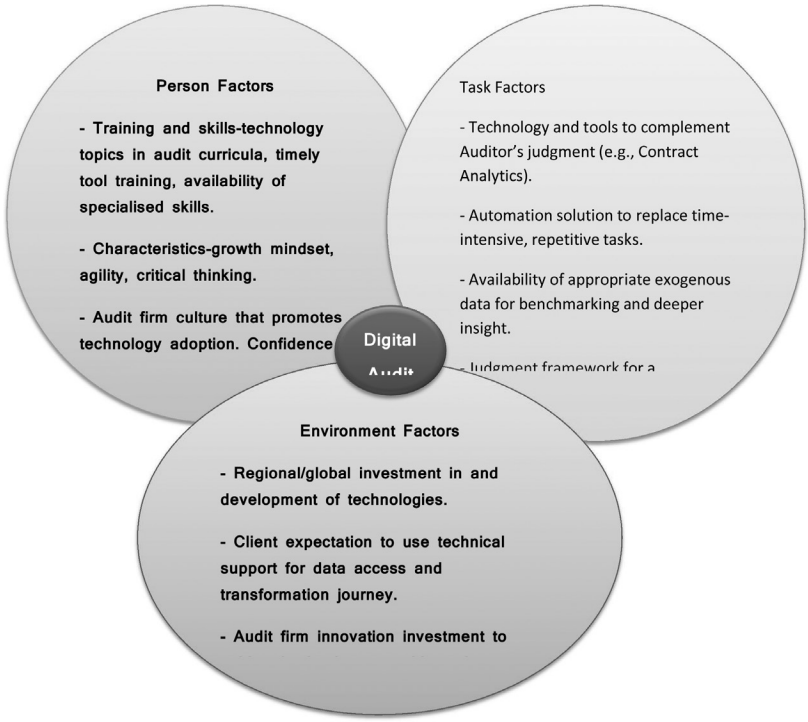


Figure 1: Factors that Positively Influence the Adoption of the Digital Audit

Source: (Devies, D. 2022)

3.1.1. Person Factors Impact Enthusiasm and Willingness to Adopt Technology in the Audit

(a) Training and Skills: (Barr-Pulliam, *et. al.*, 2022) noted that accounting curricula lag behind accounting practice due to the complexities in augmenting university course content and that missing components include an understanding of the information lifecycle and the technologies of the

information system. They also noted a need for greater emphasis on helping students become more agile and use more critical thinking when interacting with disruptive technology, and some studies identified possible approaches to address this, including the use of case studies. Tool-specific training was noted as a critical driver for using technology, with the timeliness of this training (i.e., before the busy season) being a way to encourage greater use.

(b) Auditor Characteristics and Behaviour: (Barr-Pulliam, *et. al.*, 2022) identified certain auditor behaviours that foster greater commitment to technology adoption with a growth mindset, agility, and critical thinking recognised as behaviours that positively influence the reliance on and support for technology in the audit. Research into whether mindset (fixed or growth) moderates the effect of inspection risk on auditors' reliance on data analytics tools found that when inspection risk is high, those with a fixed mindset rely less on data analytic tools than those with a growth mindset. Furthermore, they found conjunction with others related to concerns about regulators' response to and acceptance of emerging technologies provides valuable insight into key barriers to technology adoption.

(c) Stakeholder/External Attitudes: (Barr-Pulliam, *et. al.*, 2022) found that stakeholder views (including peer reviewers and regulators) influence auditors' willingness to adopt the technology. Whilst a primary benefit of data analytics is increased audit quality, also they concluded that external reviewers and key stakeholders viewed quality as largely unaffected by using data analytic techniques as an alternative to traditional audit procedure moreover, confidence in using automated tools and techniques by auditors and various stakeholders in audit outcomes is a key to enabling increased adoption of technology on engagements.

3.1.2. Task-Related Factors, such as Structure and Complexity, Impact Technology Adoption

(Barr-Pulliam, *et. al.*, 2022) identified variations in audit task complexity and noted the importance of understanding how using emerging technology in the audit interacts with task complexity to impact judgment quality.

(a) Task Complexity*:* Descriptive analytics were noted as the most widely used of all the advanced analytics types, particularly data visualisation-which is used to better understand an entity's financial performance and for population testing, as well as for business insights. Research indicates that when data visualisation is appropriately integrated into audit tasks, it can improve decision-making. However, as the data becomes more voluminous and the

analytics more complex, there are challenges for the auditor in understanding and interpreting this data and making appropriate judgments regarding the treatment of anomalies.

Unstructured tasks such as the use of advanced data analytic techniques, like clustering to identify patterns in data that could signal higher risk areas, may increase complexity because the auditor must process a higher number of information cues (i.e., larger data sets), combine the information in an unspecified way (e.g., identify patterns) or adapt to changes in required actions or information cues (i.e., identify higher-risk areas).

As the technology being deployed becomes more complex, there is a risk that auditors experience information processing and cognitive limitations (e.g., information overload) when analysing and interpreting output from data analytic tools. A decision aid, framework, or an accepted systematic approach can help with practical challenges faced when potentially large numbers of outliers result from full population testing. The research identified that higher levels of false positives associated with data analytics can also negatively influence the extent to which auditors exhibit professional skepticism. However, it was noted that this can be mitigated by consistently rewarding auditors for exhibiting appropriate skepticism.

(b) Examples of Technology Driving Audit Quality Improvements and Audit Efficiency*:* Despite challenges around task complexity, the (Barr-Pulliam, *et. al.*, 2022) study identified examples of automated tools and techniques that could positively impact audit quality, as well as potentially improve the audit experience.

- *Exogenous Data* –The use of exogenous data combined with company data to gain deeper insights. the benefits of using this data but stressed the importance of carefully evaluating how the exogenous data linked to financial accounts.
- *Benchmarking*–The use of appropriate benchmarking and incorporation of relevant information can improve auditors' performance of analytical procedures.
- *Machine Learning* –The benefits in using machine learning to develop independent estimates to compare to management's estimates, these are generally more accurate and benefit from the model being retrained each year using the actual figures.
- *Contract Analysis* –Various enabled techniques used in the audit, such as natural language processing to analyse contracts for unusual terms or

clauses enabling a more efficient and effective approach to examining full populations of contracts and related audit tasks.

- *Automation* – The use of Robotic Process Automation (RPA) technologies to automate routine, repetitive tasks to improve audit efficiency.
- *Drones* –The use of drones to support inventory counts can drive significant reductions in inspection time as well as reductions in errors.
- *Process Mining* –The use of this technology is emerging and it can improve the evaluation of the effectiveness of internal controls over financial reporting.

3.1.3. Environmental Factors Influence Technology Adoption in Audit

(Barr-Pulliam, *et. al.*, 2022) study highlighted some environmental factors that influenced the adoption of technology in the audit. These factors include client preferences, competitor activity, the regulatory response to technology in the audit, as well as regional and global shifts toward digitization. The adoption rate, enthusiasm, and expectations of these environmental parties directly impact the audit firm's use of technologies.

The Following Environmental Factors were Noted:

1) *A Regional and Global Shift Towards Digitization, Automation, and Business Intelligence* – Regional factors such as government influence, competition of audit firms, regulation, advancement of technology, and availability of necessary talent play a significant role in the adoption of technology.
2) *Influence of the Audit Client on the Adoption of Emerging Technologies* – Factors such as the client's expectation of auditor use of emerging technology and client support for data access influence how the auditor can deploy emerging technology and the regularity of use. Client expectations regarding additional insights gleaned from using emerging technology coupled with tensions around anticipated audit fee reduction because of using technology impact adoption. Additionally, an expectation gap may exist regarding the level of assurance attained from testing full populations of transactions or related to the evaluation of non-financial information through technology.
3) *Business Drive to Achieve/Maintain a Competitive Advantage* – Emerging technologies provide opportunities to increase audit

efficiency and effectiveness, for example, through the use of Robotic Process Automation (RPA) to automate routine, repetitive audit tasks. A disparity was noted in emerging technologies and the phase of digital transformation across accounting firms with larger firms having innovation leaders or organisations that help identify, develop, and otherwise facilitate the digital transformation journey whilst smaller firms are more likely to use off-the-shelf tools, placing them at a disadvantage in competing for clients and human capital.

4) *Regulator Response to the Adoption of Emerging Technologies* – Uncertainty about regulators' response and acceptance of emerging technologies can hinder their adoption. Insights provided through using data analytics may be perceived by regulators as a breach of independence impacting audit quality, with a lack of clarity on regulator response to using technology, causing "confusion and frustration." So, there is a need for regulators to be more proactive in identifying the appropriate use of emerging technology in the audit, rather than being reactive through identified findings from inspecting completed engagements.

Environmental factors that support the adoption of technology create the right conditions for successful use. Where these factors work against the adoption of technology in the audit, they give the auditor a greater hill to climb to achieve successful technology adoption.

Of these factors, the influence of the audit client on an auditor's adoption of emerging technology seems to be the most significant. This factor is particularly important when it comes to supporting the acquisition of data needed to run the technology and in setting an expectation with the auditor of technology use, whilst the auditor needs to manage appropriately expectations around fees and the level of assurance to be provided (reasonable, not absolute) where technology is deployed.

3.2. Blockchain Innovation& Audit Profession

The Internet has revolutionised and changed the complex global network. The medium to exchange information has been completely transformed by the internet means. However, the ever going digital evolution has accepted and developed the Blockchain a peer-to-peer (P2P) based dispersed network, which supports data registration and transfer safely and securely. Blockchain is assumed to be the future in the digital era, creating an influential impact on businesses and society (Dsouza, 2021).

Blockchain is considered today one of the most powerful technologies after the Internet. Audit firms are concerned by these changes. Indeed, Blockchain could radically change the working methods of audit firms and the way they design and develop their business (Liu et al., 2019).

Blockchain could lead audit firms both to create potential opportunities to develop new services also to destroy existing services, which will be totally or partially replaced by technological systems (Appelbaum, *et al.*, 2017). Aware of the very significant development potential of this technology, audit firms are investing more than $3 billion a year into it (Smith, 2018). As an example, Ernst& Young (EY), the first firm to accept Bitcoin for its consulting services in 2017, has invested in the development of applications and services to facilitate the use of Blockchain technology in its business. (KPMG) has launched new Blockchain-based services with its partner Microsoft to assist companies in implementing business processes. Deloitte created the first Blockchain lab in (2016) (KPMG, 2017). PWC launched digital asset services in (2016) using Blockchain technology. Like other new technologies, Blockchain presents challenges and opportunities that auditors must understand and/or acquire, at the risk of seeing their profession practiced by other companies specialising in that technology. Indeed, several authors have stressed that companies must strengthen their agility and their capacity to integrate innovation in an uncertain context. This will be the only way to remain competitive and face the challenges of tomorrow (Ayerbe *et al.*, 2020).

Blockchain involves (IT) risks (unauthorized access and threats to confidentiality) but could also have an impact on the traditional audit process and business development. According to Alles (2015), the use of advanced technologies and Blockchain by audit clients would be the catalyst for the adoption of these technologies by auditors. Blockchain, associated with other digital technologies, could change the audit process by modifying how the auditor accesses data, collects evidence, and analyses data (Rozario & Thomas, 2019).

Auditors have the choice only to integrate these technologies and to change their organisation and their process at the risk of losing their legitimacy in the audit market. Aware of these risks, the Big Four (Deloitte, EY, KPMG, and PWC) are, for example, working on a joint pilot project with (20) Taiwanese banks, aiming to offer new accounting services. The objective of this cooperation is to test a new Blockchain platform allowing auditors to directly verify and confirm evidence of transactions and facilitate the external confirmation of balances, which represents an onerous audit task (Zhou, 2018). More concretely, audit

firms no longer manually assess audit evidence, as transaction information is easily accessible and can be tracked and validated through Blockchain, saving audit firms a lot of time. (Elommal& Manita, 2022).

3.3. The Blockchain: Evolution, Advantages, and Types

The Blockchain appeared in (2008) with the Bitcoin or crypt currency, presented by Satoshi Nakamoto. Crypt currency, which correctly uses Blockchain Technology, has made it possible to carry out private-to-private transactions directly and without the intervention of an intermediary. Several researchers define Blockchain as "a network of nodes (i.e. users' computers) working together as peers to produce an immutable transaction history that can be made viewable to the public" (Sheldon, 2019). Blockchain is therefore a technology for storing and transmitting digital data. Knowing the origin of the data in circulation is possible thanks to this technology since each movement is traced using a register. Each new transaction carried out is automatically stored in a block linked to the other blocks relating to previous transactions. A chain of blocks is thus formed from the different blocks linked to each other, which form a Blockchain. Therefore, the Blockchain allows users to transact directly with each other without the need for a trusted third body (Gruber, 2013; Singh, 2015). According to Delahaye (2014), this technology can be compared to a large notebook or open book which can be consulted by everyone for free and freely, but for which no information can be erased or destroyed.

3.3.1. The Characteristics and Benefits of Blockchain Technology

The analysis of Blockchain definitions brings out three major characteristics of this technology: (Elommal& Manita, 2022)

(a) ***Transparency and Traceability****:* The Blockchain contains information that cannot be modified or deleted, and which is shared by users. Also, each operation carried out is definitively recorded in the Blockchain, thus making it possible to trace the path travelled by each piece of stored information. Indeed, the longevity and the coherence of the system are ensured by the reproduction of the record that it creates in the memory of independent computers in one of the others (the nodes of the network). Transparency and traceability would increase user confidence.

(b) ***Security or Data Protection****:* The data recorded in the Blockchain are secured by crypto-encryption, authenticated, certified, and immutable because blocking eliminates frictional errors and reduces their risks. Indeed, the need for validation by a set of nodes makes it possible to greatly reduce the risk of

malicious acts, hijacking, or hacking. The nodes control each other, which makes it possible to do this without a central authority. Also, it is possible to anonymize users.

(c) ***Decentralisation:*** The Blockchain makes it easy to transact without the central network, which provides control and governance of the system. The validation of the operations recorded there is not carried out by a specific actor, but by a constraint whose modalities are defined by the chain. If we combine this technology with smart contracts, the programming of value exchange between two parties without intermediaries becomes possible.

Eliminating intermediaries would thus make it possible to gain productivity and efficiency and to reduce transaction costs such as inspection and verification fees, etc. These characteristics make Blockchain technology a revolutionary technology that can lead companies to design new methods and work organisations and to change their business models.

The Blockchain allows the recording of the transaction as a single event, which is validated by the community of minors. This process is very efficient for businesses as it saves them the need to enter and store the transaction in multiple databases, saving them time and significantly reducing human errors and fraud. This technology can certainly generate competitive advantages for companies, but it is not without risk because it requires fundamental organisational changes, new skills, new tools, and working methods that can overturn old practices (Adams *et al.*, 2006). The invention of the Blockchain is often compared to that of the Internet, given its enormous potential to create radical transformations in several industries (Lepak *et al.*, 2007). As a result, Blockchain technology will challenge companies and lead them to be more innovative and rethink their business model at the risk of seeing their survival threatened.

3.3.2. Blockchain Types (Shrivas & Yeboah, 2018)

Blockchain types based on the nature of data accessibility, Blockchain can be categorized as below:

- Public Blockchain: In this type of Blockchain, anyone can read and submit transactions.
- Private Blockchain: In this type of Blockchain, only one organisation or all subsidiary organisations within the same group are allowed to read and submit transactions.
- Community/Consortium Blockchain: In this type of Blockchain, multiple groups of organisations form a consortium and are allowed to submit transactions and read transactional data.

– Hybrid Blockchain: This is a new category where any of three Public, Private, or Community/Consortium, Blockchain can be combined to facilitate transactions. A Blockchain platform can be configured in multimode using a Hybrid Blockchain.

Based on the need for authorization to participate in Blockchain, it can be categorized as below:

– Permissionless Blockchain: No prior permission is needed to participate in this type of Blockchain. Everyone is allowed to participate in the verification process and can join the Blockchain network with their computational power.
– Permissioned Blockchain: To join this type of Blockchain, prior permission is needed. Only authorized parties are allowed to run nodes to verify transactions in the Blockchain network.
– Hybrid Blockchain: There could be a possibility that a node is participating in Permissionless and Permissioned Blockchain together to facilitate inter Blockchain communication, such Blockchain can be called a Hybrid Blockchain. A Blockchain platform can also be configured to support Permissioned and/or Permissionless model.

as far as core functionality and smart contract support in concern, Blockchain can be categorized into the following:

– Stateless Blockchain: Stateless Blockchain systems only focus on transaction optimisation and chain functionality, which is verifying the transaction by computing hashes. It is independent of the smart contract logic layer and thus unaffected by smart contract code bugs and vulnerabilities.
– Stateful Blockchain: This type of Blockchain provides smart contract and transaction computing capabilities. It also supports multifaceted business logic and its optimisation, and preserves logic states.

3.3.3. Blockchain Implication for the Auditing Profession (Elommal& Manita, 2022)

- Time Saving and More Relevant Audit

Blockchain facilitates the dematerialisation of accounting practices and documents. It allows both the dematerialisation of transactions and contracts, identity certificates, and control and verification procedures. The original single document is no longer a paper document, but an electronic document with a unique and inviolable identification.

- Toward an Audit Covering the Whole Information

The validation and recording via the Blockchain of information integrated by several users allow a real-time collective certification of this information by all users. This process of building information, combined with the characteristics of tamper-proof and transparent technology, has a significant positive impact on the reliability and sincerity of information. These processes will affect audit work. Currently, an audit is based on historical data relating to the financial statements for the previous year. It provides only a reasonable level of audit. The auditor's opinion is mainly based on a risk-based approach using sampling techniques in inspection work. As Blockchain technology offers access to all information that becomes instantly available, the auditor can, in this case, conduct his audit by using all information. This is very possible when we combine Blockchain with other technologies available today, such as big data, robotics, and analytics. Therefore, Blockchain will allow the audit process to evolve from a process based on control of a reasonable part of the available information toward control of all information.

- Toward an Audit Centered on Testing Controls rather than Testing Transactions

Blockchain technology offers several advantages related to the security and reliability of transactions. These advantages are also valid for the accounting record of transactions stored on the Blockchain. To ensure the reliability of companies' financial statements, these accounting records also need to be audited. Indeed, certain "chain" transactions could be concluded between two parties, which are linked to an "off-chain" agreement. In addition, fraudulent transactions could be slipped into "the chain". As a result, the effectiveness of the internal controls surrounding the Blockchain becomes an essential element on which the auditor must focus in his audit process. In other words, faced with a specific Blockchain, the auditor must focus on the quality of the control tests put in place (quality of the Blockchain code, protocol changes, distribution of power between peers, etc.) rather than on direct transaction tests to ensure the reliability of the information hosted on this Blockchain.

- For A More Strategic Audit Role

Once Blockchain technology is integrated and applied more broadly, the role of audit firms would evolve toward a strategic role. Given the availability of data via the Blockchain, the auditor will be able to analyse this data, interpret it to give it meaning, and make it useful for management decision-making. In this case,

the auditor can move from a simple controller of the reliability of information to a strategic advisor for his client and an essential partner in the evolution of his management and control systems. Also, the saving of time generated by the use of this technology at the level of certain classic audit tasks (confirmations and verifications of the amounts, verifications of paper proofs, physical inventory of stocks, etc.) allows the auditor to devote this time to conducting higher-level analyses, design more preventive tests, and improve the quality of his audit.

- Toward the Development of New Advisory Services

Blockchain allows auditors to develop their advisory business by offering new services. They can assist their clients in implementing the technology and choosing the best procedure to follow. For clients already using Blockchain, audit firms can, based on their assessment of the risk management systems in place, give them advice to improve their internal control and risk management systems.

In addition, audit firms can use their sectoral experience to develop new consulting assignments on best practices regarding Blockchain usage protocols. They can also offer new services in acting as a planner and coordinator of potential participants of a Blockchain. Audit firms could therefore leverage their networks to propose a permissioned Blockchain. Finally, audit firms can leverage their expertise in IT auditing to develop new services on an audit internal control of Blockchain, including data integrity and security, change management, and Blockchain governance.

Figure 2: Blockchain Implication for the Auditing Profession

Source: (Elommal & Manita, 2022)

4. EMPIRICAL STUDY

Research Method

This section aims to address the applied framework to provide practical evidence of the impact of the use of Blockchain technology on the quality of the audit process.

Sample Selection

The study's sample includes banks that applied Blockchain technology. Secondary data from the banks' databases and websites, acquired between (2017) and (2021), was used in this study. Other information was collected from the annual reports. According to Table 1, there are two different banks included in this study.

Table 1: Describe the Study Sample

Bank	*Code*	*since*	*Capital*
National Bank of Egypt	NBE	1898	205929000000
Commercial International Bank	COMI	1975	592,368,377000

Model Specifications

This section deals with a presentation of the study variables and how to measure them, as well as a derivation of the study hypotheses that are tested through the applied study, as follows:

$EM= (WC/ CFO)_{t-0} - (WC/ CFO)_{t-1}$

EM: The degree of use of flexible standards and profit management

WC: Change in working capital

CFO: net cash flow from operating activities

t-1: last year

t-0: current year

Blockchain Technology

Indicator of Digital Transformation Processes Represented by the Use of Blockchain Technology

The use of Blockchain technology represents the independent variable for the study Measuring By the contribution of Blockchain technology to the symmetry

of accounting information (the predictive value of accounting information): The Tobin's Q Ratio was used, which is used to measure growth opportunities and information asymmetry, and this ratio was calculated as follows:

(Market Value of Shares + Book Value of Debts) / Book Value of Assets.

Audit Process Quality

- **Audit Firm Size Indicator:** It is a dummy variable that takes the value (1) if the bank is being audited by Big Four Firms, and takes the value (0) if not.
- **Indicator of the Auditor's Report and a Reservation on the Lack of Profits**: Two steps were used to measure and characterize this variable**:**

The First Step: measuring the level and quality of profit through the application of the model (Miller, 2009), which reveals the relationship between the change in working capital as an element vulnerable to manipulation and the cash flow from operating activities as an element that is not exposed to manipulation. According to this model, it is assumed that the arithmetic means to measure the value of EM, which refers to the practices of using standards and profit management, is zero, and the farther this ratio is from zero, negative or positive, this indicates the lack of quality of profits. This value is calculated through the following equation (Miller, 2009):

The Second Step: measuring the amount of the audit in the auditor's report: where a dummy variable was included that expresses the quality of the audit, and if there is a conservative opinion in the auditor's report, the level of quality of profits referred to through Miller's coefficient is given number (1), and in case of non-conformity, the value (0) is given. In other words, if the auditor skips over the financial statements in the presence of a Miller ratio (greater or less than zero), this means the quality of the audit process.

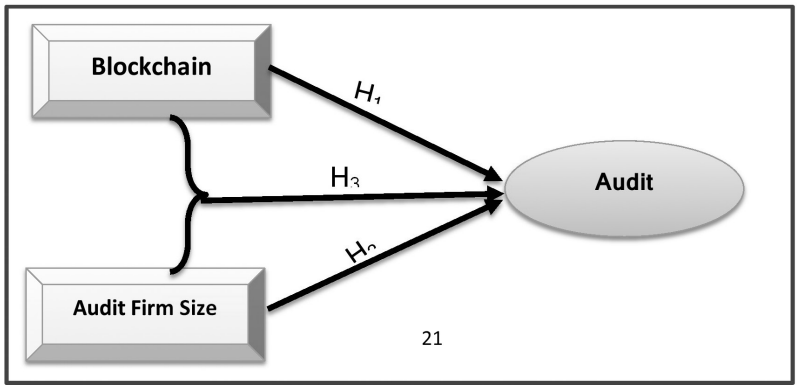
- The Study Hypotheses Can be Formulated as Follows:

  H_1: There is a significant impact of Blockchain implementation on audit quality.

  H_2: There is a significant impact of Audit Firm Size on audit quality.

  H_3: There is a significant impact of Blockchain implementation and Audit Firm Size on audit quality**.**

- The Relationships Between these Variables Can be Expressed through the Following Figure



$$AQ = B0 + B1\ X1 + B2\ X2 + B3\ X3 + e$$
$$AQ = B_0 + B_1\ BC + B_2\ FS + B_3\ BC^{*}FS + e$$

Where

AQ: Audit Quality

$B_{0, 1, 2, 3}$: Model Coefficient

X_1: Blockchain Technology

X_2: Firm Size

X_3: Blockchain Technology by Audit Firm size.

Empirical Results

This section deals with the analysis of the data of the applied study that was collected to determine the results of the study and its importance in the Egyptian business environment, and it will be organized as follows:

Descriptive Analysis

This section discusses the descriptive statistics for the data of the study variables, such as mean, largest, and smallest value, variance, and standard deviation. These statistics can be used to quantitatively describe the main characteristics of a data set to organize, categorize, summarize and clearly display them in the form of tables or graphs, and to calculate various statistical measures to describe a variable (or more) in a population.

Descriptive Analysis for Every Item

This study was conducted by applying to the banking sector, to collect comprehensive data that shows the impact of Blockchain on the audit quality of these banks, and their analysis can be presented in Table (2).

Table 2: Describe Financial Items

	Mean	*Std. Deviation*	*Variance*	*Minimum*	*Maximum*
Firm Value	281311469727.1	293664893673.07	862390697760178300000000.0	7736778902.0	690116000000.00
Debit	25297690.9000	48312830.96261	2334129635622111.0	38623.0	137479983.00
Total liabilities	458326810.6000	540461306.25937	292098423563583620.0	1649658.00	1501303715.00
Total Assets	501988624.6000	574588690.22668	330152162936412800,000	1769093.00	1601613745.00
Current Assets $_{t-1}$	588798372.3000	582229269.50303	330152162936412800,000	1763202.00	1596594481.00
Current Assets $_{t-0}$	500055145.3000	572940972.40576	328261357861253310.000	1763202.00	1596594481.00
Current liabilities $_{t-1}$	511974213.4000	502898202.73059	252906602309657312.000	1529546.00	1363823732.00
Current liabilities $_{t-0}$	433029119.7000	494570862.28741	244600337823715808.000	1529546.00	1363823732.00
Operating Cash Flow $_{t-1}$	32068473.8000	41863758.87607	1752574307233627.000	160480.00	138259130.00
Operating Cash Flow $_{t-0}$	17149638.7000	18717671.42789	350351223682359.200	160480.00	55642627.00
Audit Opinion	1.0000	.00000	.000	1.00	1.00

From the previous table, it is clear that:

- The mean of the firm value was (281311469727.1) and the maximum was (690116000000.00), furthermore, the minimum was (7736778902.0).
- The mean of the debit was (25297690.9000) and the maximum was (137479983.00.00), furthermore, the minimum was (38623.0).
- The mean of the Total liabilities was (458326810.6000) and the maximum was (1501303715.00), furthermore, the minimum was (1649658.00).
- The mean of the Total Assets was (501988624.6000) and the maximum was (1601613745.00), furthermore, the minimum was (1769093.00).
- The mean of the Current Assets $_{t-1}$ was (588798372.3000) and the maximum was (1596594481.00), furthermore, the minimum was (1763202.00).
- The mean of the Current Assets $_{t-0}$ was (500055145.3000) and the maximum was (1596594481.00), furthermore, the minimum was (1763202.00).
- The mean of the Current liabilities $_{t-1}$ was (511974213.4000) and the maximum was (1363823732.00), furthermore, the minimum was (1529546.00).
- The mean of the Current liabilities $_{t-0}$ was (433029119.7000) and the maximum was (1363823732.00), furthermore, the minimum was (1529546.00).
- The mean of the Operating Cash Flow $_{t-1}$ was (433029119.7000) and the maximum was (1601613745.00), furthermore, the minimum was (160480.00).
- The mean of the Operating Cash Flow $_{t-0}$ was (17149638.7000) and the maximum was (55642627.00), furthermore, the minimum was (160480.00).

Testing of Hypotheses

The hypothesis will test in this section by using the correlation test, and the regression test, the results of this test were as follows:

The hypothesis will test in this section by using the Bivariate Correlations procedure, which computes Pearson's correlation coefficient. Pearson's correlation coefficient is a measure of linear association. Two variables can

be perfectly related, but if the relationship is not linear, Pearson's correlation coefficient is not an appropriate statistic for measuring their association, and using the Regression test, Linear Regression estimates the coefficients of the linear equation, involving one or more independent variables, that best predict the value of the dependent variable. Table (3) summarizes the trends across categories as below:

Table 3: Correlation Matrix

		Audit Quality	Blockchain	Firm size	Blockchain * Firm size
Audit Quality	Pearson Correlation	1	.709*	.720*	.801**
	Sig. (2-tailed)		.022	.019	.005
	N		10	10	10
Blockchain	Pearson Correlation		1	.998**	.946**
	Sig. (2-tailed)			.000	.000
	N			10	10
Firm size	Pearson Correlation			1	.957**
	Sig. (2-tailed)				.000
	N				10
Blockchain * Firm size	Pearson Correlation				1
	Sig. (2-tailed)				
	N				
*. Correlation is significant at the 0.05 level (2-tailed).					
**. Correlation is significant at the 0.01 level (2-tailed).					

From the previous analysis, it is clear that (i) there is a significant relationship between Blockchain and Audit quality in the banking sector, where R = 70.9% at a significant level of less than 5%, (ii) there is a significant relationship between Audit firm size and audit quality in the banking sector, where R = 72% at a significant level of less than 5%, and (iii) there is a significant relationship between Blockchain by audit firm size and audit quality in the banking sector, where R = 80.1% at a significant level of less than 5%.

Results of the Regression Test

The regression test was conducted to determine the regression coefficients for the study variables to show the effect of the disclosure type on the other various variables. Table (4) shows the results of the regression test for blockchain.

Table (4) confirms that the regression coefficients were all at a significant level of less than 5%, which means that: (i) there is a statistically significant effect of Blockchain on audit quality in the banking sector, (ii) there is a statistically significant effect of firm size on audit quality in the banking sector and (iii) there is a statistically significant effect of Blockchain by firm size on audit quality in the banking sector.

Table 4: The Results of the Regression Test for Blockchain

Model		*Unstandardized Coefficients*		*Standardized Coefficients*	*t*	*Sig.*
		B	*Std. Error*	*Beta*		
	(Constant)	-7.978	.000		-1.125	.293
	Blockchain	8.427	.000	.709	2.841	.022
	Firm size	1.174	.000	.720	2.939	.019
	Blockchain * Firm size	2.708	.000	.801	3.780	.005

The Essential Differences Before and After the Implementation of Blockchain

The Independent-Samples T Test procedure compares means for two groups of cases. Ideally, for this test, the subjects should be randomly assigned to two groups, so that any difference in response is due to the treatment (or lack of treatment) and not to other factors.

Table 5: Independent Samples Test

			Audit Quality	
			Equal variances assumed	*Equal variances not assumed*
Levine's Test for Equality of Variances	F		7.903	
	Sig.		.023	
t-test for Equality of Means	T		1.112	1.390
	Df		8	5.009
	Sig. (2-tailed)		.298	.223
	Mean Difference		.00000	.00000
	Std. Error Difference		.00000	.00000
	95% Confidence Interval of the Difference	Lower	.00000	.00000
		Upper	.00000	.00000

From the previous table, it is clear that the significance value is less than 5%, which means that there are fundamental differences in the quality of the review before and after the implementation of Blockchains.

The Results of the Empirical Study Indicate that

- There is a significant relationship between Blockchain and Audit quality in the banking sector, where R= 70.9% at a significant level of less than 5%. And there is a significant impact of Blockchain on audit quality, where R^2 = 50.2% at a significant level of less than 5%.
- There is a significant relationship between audit firm size and audit quality in the banking sector, where R= 72% at a significant level of less than 5%. And there is a significant impact of audit firm size on audit quality where R^2 = 50.9% at a significant level of less than 5%.
- There is a significant relationship between Blockchain by audit firm size in audit quality in the banking sector, where R= 80.1% at a significant level of less than 5%. And there is a significant impact of Blockchain by audit firm size on audit quality, where R^2 = 64.1% at a significant level less of than 5%.

5. DISCUSSION OF RESULTS

This paper aimed to study the impact of Blockchain technology on the quality of the audit process. results of the study suggested the following:

- Blockchains are considered a centralised sequential database that allows sharing of data and information and keeping records of accounting transactions. It can ensure data integrity and preserve it from manipulation. Not only that but it is also secured by high-accuracy encryption methods. It is also considered an alternative to conventional accounting books and records, as it is considered a distributed ledger.
- Blockchain technology has many characteristics that distinguish it from any traditional database in terms of its distributed and shared nature of the record of transactions between members, which leads to increased transparency and its reliance on the peer-to-peer feature that gives confidence between the two parties to the transaction and the lack of the need for an intermediary party to complete transactions and its use of encryption and stamping techniques The timeframe for transactions and smart contracts that enable it to automatically record and execute transactions, which works to increase confidence in transaction data and its inability to change.
- The use of Blockchain technology leads to achieving many advantages for accounting and auditing, the most important of which are

represented in reducing the cost of maintaining transaction records, non-adjustability, limiting fraud, eliminating the need for accounting settlements due to the application of accounting in real-time and the consequent updating of the ledger Up-to-date, transparency as Blockchains provide full visibility of transactions, reliability in data and minimizing human errors, reducing audit process time by automating many audit processes and giving more time to verify how operations flow between systems and enabling continuous audit, allowing Proactively address problems.

- Blockchains will change the work method of external auditors, as it improves the data collection process during the audit process and allows them to implement electronic audit procedures. This is accompanied by many opportunities and challenges facing the external auditor when auditing accounting systems based on blockchains.
- There is a positive response by the (Big 4) accounting and auditing firms towards the adoption of blockchains in accounting systems to take advantage of the opportunities provided by the use of Blockchain technology for the accounting and auditing professions.
- The results of the statistical analysis showed that there is a significant relationship between the application of Blockchain technology and the quality of the audit process, therefore the first hypothesis was accepted, also the statistical study found that there is a significant relationship between the size of the audit firm size and the quality of the audit process, moreover, the second hypothesis was accepted, additionally, the statistical study found There is a significant relationship between the application of Blockchain technology and the size of the audit firm size on the quality of the audit process, as a result, the third hypothesis was accepted.

6. CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

This study focused on the impact of blockchain technology on the quality of the audit process as one of the important techniques produced by the digital transformation environment, building on the literature review. The study shed light on electronic audit in the digital transformation environment and reviewed the factors that positively affect the adoption of the digital audit source. The study also dealt with blockchain technology in terms of concept,

types, and the most important characteristics. In addition, the study discussed the changes that the use of blockchain technology can bring about in the auditing profession. Finally, many research opportunities can be done, such as first, studying the effects of blockchain on internal control and on the process of preparing financial statements. Also, study how this technology will affect the recruitment policies of firms. Moreover, study the implications of Blockchain on small audit firms that do not have the same human and financial resources as the Big Four.

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References

Adams, R., Bessant, J., Phelps, R. (2006). Innovation Management Measurement: A Review, *International Journal of Management Reviews*, *8*(1),pp. 21-47.

Alles, M. G. (2015). Drivers of the Use and Facilitators and Obstacles of the Evolution of Big Data by the Audit Profession. *Accounting Horizons*, *29* (2), pp. 439-449.þ

Appelbaum, D. A., Kogan, A., & Vasarhelyi, M. A. (2018). Analytical Procedures in External Auditing: A Comprehensive Literature Survey and Framework for External Audit Analytics. *Journal of Accounting Literature*, 40, pp.83-101.

Ashbaugh, H., & Warfield, T. D. (2003). Audits as a Corporate Governance Mechanism: Evidence from the German Market. *Journal of International Accounting Research*, *2*(1),p. 1-21.þ

Ayerbe, C., Dubouloz, S., Mignon, S., & Robert, M. (2020). Management Innovation and Open Innovation: For and Towards Dialogue. *Journal of Innovation Economics Management*, *32* (2), pp.13-41.þ

Barr-Pulliam, D., Brown-Liburd, H. L., & Munoko, I. (2022). The Effects of Person-Specific, Task, and Environmental Factors on Digital Transformation and Innovation in Auditing: A Review of the Literature. *Journal of International Financial Management & Accounting*, *33*, pp. 337-374.

Bonsón, E., & Bednárová, M. (2019). Blockchain and Its Implications for Accounting and Auditing. *Meditari Accountancy Research*, 27(5),pp. 725-740.þ

Cao, S., Cong, L. W., & Yang, B. (2019). Financial Reporting and Blockchains: Audit Pricing, Misstatements, and Regulation. *Misstatements, and Regulation, pp.* 1-56.

Celayir, D., & Celayir, Ç. (2020). Dijitalleşmenin Denetim Mesleğine Yansımalari. *Avrasya Sosyal ve Ekonomi Araştırmaları Dergisi (ASEAD*), 7(6), pp.128-148.

CPA and AICPA. (2017). Blockchain Technology and Its Potential Impact on the Audit and Assurance Profession. Available at: https://www.aicpa.org/content/dam/aicpa/interestareas/frc/assuranceadvisoryservices/downloadabledocuments/blockchaintechnology-and-its-potential-impact-on-the-audit-and-assurance-profession.pdf.

Dai, J. (2017). Three Essays on Audit Technology: Audit 4.0, Blockchain, and Audit App. Rutgers, The State University of New Jersey.

Dai, J., & Vasarhelyi, M. A. (2017). Toward Blockchain-Based Accounting and Assurance. *Journal of Information Systems*, 31(3), pp.5-21.þ

DeAngelo, L. E. (1981). Auditor Independence,'Low Balling', and Disclosure Regulation. *Journal of Accounting and Economics*, *3*(2),pp. 113-127.þ

Delahaye, J. P. (2014). La Cryptographie Réinvente La Monnaie: Le Bitcoin. *Science et Société, LNA*, *66*.þ

Devies, D. (2022). Digital Transformation& Innovation in Auditing: Insights from a Review of Academic Research, Available at: https://www.ifac.org/knowledge-gateway/supporting-international-standards/discussion/digital-transformation-innovation-auditing-insights-review-academicresearch?fbclid=IwAR1letuKivjoAEd6QZSk2_hmGLyDTUXzxiywwq57AHnvesT0tiPsDzZCNmk.

Dsouza, S.(2021).Blockchain, and Internal Auditing.þ Available at: https://www.researchgate.net/publication/364254033, pp.138-149.

Elommal, N., & Manita, R. (2022). How Blockchain Innovation Could Affect the Audit Profession: A Qualitative Study. *Journal of Innovation Economics Management*, *37*(1), pp.37-63.þ

Erdoğan, S., & Bodur, D. (2020). Blockchain Teknolojisi Ve Günümüz Finansal Sistemine Olasi Etkileri. *Mali Çözüm, 30*(160), pp. 281-295.

Francis, J. R., Maydew, E. L., & Sparks, H. C. (1999). The Role of Big 6 Auditors in the Credible Reporting of Accruals. *Auditing: a Journal of Practice & theory*, *18*(2),p. 17-34.þ

Gauthier, M. P., & Brender, N. (2021). How Do the Current Auditing Standards Fit the Emergent Use of Blockchain? *Managerial Auditing Journal*, *36* (3), pp. 365-385.

Gruber, S. (2013). Trust, identity, and disclosure. Are Bitcoin Exchanges the Next Virtual Havens for Money Laundering and Tax Evasion? *Quinnipiac L. Rev. 32*(1), pp. 135–208. þ

Hayrettin, U. S. U. L., & Karaburun, G. (2020). Changes in the Professional Profile of Auditors in the Light of Blockchain Technology. *European Journal of Digital Economy Research*, *1*(1), pp. 5-12.þ

Kokina, J., & Davenport, T. H. (2017). The Emergence of Artificial Intelligence: How Automation is Changing Auditing. *Journal of Emerging Technologies in Accounting*, *14*(1), pp. 115-122.þ

KPMG (2017), KPMG and Microsoft Announce New "Blockchain Nodes", Available at: https://home.kpmg/us/en/home/media/press-releases/2017/02/kpmg-and-microsoft-announce-new-Blockchain-nodes.html.

Krahel, J. P., & Titera, W. R. (2015). Consequences of Big Data and Formalization on Accounting and Auditing Standards. *Accounting Horizons*, *29* (2), pp. 409-422.þ

Leuz, C., Lins, K. V., & Warnock, F. E. (2009). Do Foreigners Invest Less in Poorly Governed Firms?. *The Review of Financial Studies*, *22*(8),pp. 3245-3285.þ

Lepak, D. P., Smith, K. G., & Taylor, M. S. (2007). Value Creation and Value Capture: A Multilevel Perspective. *Academy of Management Review*, *32*(1), pp.180-194.þ

Liu, M., Wu, K., & Xu, J. J. (2019). How Will Blockchain Technology Impact Auditing and Accounting: Permissionless Versus Permissioned Blockchain. *Current Issues in Auditing*, *13* (2), pp. A19- A29.þ

Maffei, M., Casciello, R., & Meucci, F. (2021). Blockchain Technology: Uninvestigated Issues Emerging from An Integrated View within Accounting and Auditing practices. *Journal of Organizational Change Management*, pp .462- 476.

Manita, R., Elommal, N., Baudier, P., & Hikkerova, L. (2020). The Digital Transformation of External Audit and Its Impact on Corporate Governance. *Technological Forecasting and Social Change*, *150*, 119751.þ

Miller, J. E. (2009). The Development of the Miller Ratio (MR): A Tool to Detect the Possibility of Earnings Management (EM). *Journal of Business & Economics Research (JBER)*, *7* (1),pp.79- 90.

Montes, G. A., & Goertzel, B. (2019). Distributed, Decentralized, and Democratized Artificial Intelligence. *Technological Forecasting and Social Change*, *141*,pp. 354-358.þ

Özyürek, H. (2021). Blockchain Teknolojisinin Mevcut ve Muhtemel Kullainm Alaniar. *Anadolu Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *22*(4), pp. 31-50.þ

Porter, M. E., & Heppelmann, J. E. (2014). How Smart, Connected Products Are Transforming Competition?. *Harvard Business Review*, *92*(11), pp. 64-88.

Rooney, H., Aiken, B., & Rooney, M. (2017). Q. Is the Internal Audit Ready for Blockchain? *Technology Innovation Management Review*, *7*(10), pp. 41-44.þ

Rozario, A. M., & Thomas, C. (2019). Reengineering the Audit with Blockchain and Smart Contracts. *Journal of Emerging Technologies in Accounting*, *16(*1), pp.21-35.

Sahlin, E., & Levenby, R. (2018). Blockchain in Audit Trails: An Investigation of How Blockchain Can Help Auditors to Implement Audit Trails, Master Degree,

Jönköping University, Degree Project in Business Administration.pp.1-48.þ *http://hj.diva-portal.org/smash/get/diva2:1212665/FULLTEXT01.pdf*

Schmitz, J., & Leoni, G. (2019). Accounting and Auditing at the Time of Blockchain Technology: a Research Agenda. *Australian Accounting Review*, *29*(2), pp.331-342.

Sheldon, M. D. (2019). A Primer for Information Technology General Control Considerations on a Private and Permissioned Blockchain Audit. *Current Issues in Auditing*, *13*(1), pp. A15-A29.þ

Shrivas, M. K., & Yeboah, D. T. (2018, December). The Disruptive Blockchain: Types, Platforms, and Applications. In *Fifth Texila World Conference for Scholars (TWCS) on Transformation: The Creative Potential of Interdisciplinary*,pp.1-21.

Singh, K. (2015), The New Wild West: Preventing Money Laundering in the Bitcoin Network, *Northwestern Journal of Technology and Intellectual Property*, *13*(1), pp.39-64.

Smith, S. (2018). Blockchain Augmented Audit – Benefits and Challenges for Accounting Professionals. *Journal of Theoretical Accounting Research*,*14* (1), pp.117-137.

Van den Broek, T., & Van Veenstra, A. F. (2018). Governance of Big Data Collaborations: How to Balance Regulatory Compliance and Disruptive Innovation. *Technological Forecasting and Social Change*, *129*,pp. 330-338.þ

Wang, K., Zhang, Y., & Chang, E. (2020). A Conceptual Model for Blockchain-Based Auditing Information System. In *Proceedings of the 2020 2nd, International Electronics Communication Conference*, pp. 101- 107.

Zhou, E. (2018), Big Four to Pilot Blockchain-based Auditing in Taiwan, Available at: https://www.regulationasia.com/big-four-to-pilot-blockchain-based-auditing-in-taiwan.