The Impact of using Blockchain on the Auditing Profession

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Abstract: - Rapid technological changes cause several challenges for established processes and approaches to the auditing. A special role in this context is assigned to the blockchain as a key driving force in changes in auditing. The aim of the article is to identify the key features of blockchain's impact on auditing. The research employs economic and statistical methods, namely trend analysis, in-depth semi-structured interviews, assessment of the economic effect to identify the main changes in auditing under the influence of blockchain technologies. The experience of using blockchain was studied through a sample of 27 auditors from Azerbaijan, Israel, and Jordan. The respondents indicated changes in the operational work of auditors (88,9% of respondents) among the main areas of influence of blockchain technologies. The surveyed auditors also consider it necessary to improve auditors' IT skills under the influence of blockchain (88,9% of respondents). The respondents emphasize the appropriateness to change the audit methodology under the influence of blockchain (77,8% of respondents). The surveyed auditors see the prospect in using real-time auditing (55,6% of respondents) and other higher value-added services (44,4% of respondents). Data from the financial statements of the 4 largest auditing companies were analyzed to determine the economic effect of the impact of blockchain on auditing. It was determined that the average annual growth rate under the basic scenario is 6.9% for 2023-2025, or $72.1 billion on average per company in 2025. The prospects for further research are studying the directions of strategic and operational transformations in auditing because of the influence of blockchain in terms of audit methodology, organizational structure of audit companies.

Key-Words: - blockchain, audit, IT skills, real-time audit technology, audit IT infrastructure.

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1 Introduction

The advent of blockchain technology became publicly known in 2008 when it was initially presented as the underlying framework for the Bitcoin cryptocurrency. One notable benefit of blockchain technology is its capacity to remove middlemen, such as banks and other financial intermediaries, inside the system of transaction record-keeping. The establishment of this attribute is facilitated using architectural concepts in constructing the blockchain system, which incorporates a fusion of peer-to-peer networks and encryption. Furthermore, it is worth noting that blockchain technology possesses the capacity to substantially diminish transaction expenses and settlement duration by eliminating the necessity for several middlemen. Consequently, this reduction in intermediaries leads to a decrease in labor prices for experts, specifically auditors. It is imperative to acknowledge that the pervasive utilization of blockchain technology has yielded transformative prospects across various sectors, notably the financial, healthcare, education, governmental, and non-profit domains. Further, several entities such as the corporate sector, research centers, and governments are actively engaged in extensive endeavors to examine and develop practical solutions based on blockchain technology. The primary focus of these endeavors is to modify and enhance current business processes and models. The discipline of audit is not exempt from this phenomenon. Blockchain technology can revolutionize the transaction record-keeping process inside the audit framework, including the many stages of transaction initiation, processing, verification, recording, and reporting in the management and financial reporting system.

The *objective* of this study is to ascertain the primary characteristics of the influence of blockchain technology in the field of auditing. The objective of this study encompassed the accomplishment of the following research *goals*:

1. Determine the fundamental elements that contribute to the influence of blockchain on the field of auditing
2. Examine the primary alterations in auditing practices resulting from the integration of blockchain technology
3. Assess the economic implications associated with the use of blockchain technology in the context of auditing.

2 Literature Review

The researchers investigate the theoretical and practical aspects, together with the characteristics pertaining to the utilization of blockchain technology in the field of auditing. Scholars engage in a discourse over the potential efficacy of blockchain technology in the realms of audit and back-office services, [1]. Scholars are now investigating the prospective advantages associated with the utilization of blockchain technology, including enhanced authenticity and transparency, which have the potential to greatly enhance audit efficiency. The present study, [2], examines a data auditing system for ensuring the integrity of large data through the utilization of blockchain technology. A proposal has been made for an audit scheme focused on ensuring data integrity in the Internet of Things (IoT). This scheme utilizes collaborative blockchain technology, incorporating consortium characteristics to enhance security and transparency during the audit process, [3]. The idea of blockchain-based transparent auditing, as established by the authors in, [4], places significant emphasis on the security and transparency of audited data within the framework of blockchain technology. The utilization of blockchain technology to audit data logs has been investigated with regards to enhancing audit security and transparency, [5]. The notion of employing blockchain technology to provide safe, decentralized, and automated auditing procedures has been examined by researchers within the framework of reorganizing the existing audit process, [6]. The study investigated the influence of blockchain technology on the professional competencies of auditors, [7]. The authors in reference, [8], have devised a methodology for implementing auditing and compliance measures in this domain by leveraging blockchain technology. The present study posits that the utilization of blockchain technology has the potential to enhance the quality of audits. Several research have examined the challenges associated with the implementation of blockchain technology in the auditing domain, with a specific focus on application scenarios. These studies underscore the significance of blockchain technology within the context of auditing. The implementation of blockchain technology from an audit viewpoint in risk management was investigated, [9]. The influence of blockchain on auditing in terms of security is examined by the author in reference, [10]. The study elucidates potential benefits and drawbacks, encompassing security concerns, that might emerge from the adoption of blockchain

technology in the field of auditing. The article, [11], introduces a public audit system that utilizes blockchain technology, using its inherent technical characteristics. In this study, researchers, [12], investigate the potential of employing blockchain-based smart contracts to facilitate auditing procedures, hence enabling a substantial level of automation in the auditing process. A distributed blockchain-based audit system was presented to enhance transparency and dependability in network management systems, [13]. A data integrity audit system based on blockchain extension technology was examined in a study to assess its potential for enhancing the reliability of data audits, particularly in relation to the accuracy of the audit outcomes, [14]. Much research has been conducted in the domain of employing blockchain technology for the purposes of auditing and data storage, with the aim of enhancing confidence among external users and the public. In, [15], an approach is presented that aims to guarantee both privacy and auditability in a decentralized storage log through the utilization of blockchain technology. The study conducted by, [16], examines the utilization of a blockchain architecture as a means of automating auditing processes and fostering confidence among both public and external users. The creation and implementation of a blockchain-based auditing method is described by authors in, [17]. The utilization of blockchain technology for conducting public audits of large-scale data stored in cloud environments was explored in a study conducted by, [18]. Researchers suggest a blockchain-based strategy to auditing data sharing that can increase openness in the exchange of data between diverse parties during audit, [19]. Numerous investigations have been conducted to examine the progression and execution of diverse audit frameworks and methodologies relying on blockchain technology. The paper, [20], presents a novel way to data auditing utilizing blockchain technology, which enhances the dependability of audits. The study, [21], introduces a system that utilizes blockchain technology to enhance the software audit procedure. The authors investigate the utilization of blockchain technology to establish an impervious audit system that relies on database management, [22]. Nevertheless, the current body of research lacks comprehensive coverage of the application of blockchain technology in auditing, particularly in terms of addressing the requirements and bolstering the incentives of stakeholders.

3 Methods

3.1 Research Design

The initial phase involves gathering data pertaining to the current utilization of blockchain technology in the field of auditing, which will subsequently be subjected to additional analysis and examination during the study. The last phase of the research entails an examination of the primary domains in which blockchain technology is applied within the field of auditing. The utilization of trend analysis was employed to unveil the primary patterns in the adoption of blockchain technology. Subsequently, a research endeavor ensued, employing comprehensive semi-structured interviews with auditors. The primary objective of this investigation was to discern the principal alterations in their professional practices, therefore facilitating an examination of the influence of blockchain technology on the field of auditing. The examination of the possible economic impact of blockchain use involved estimating the prospective growth rates of income using financial reporting data from the world's leading auditing firms. The concluding phase of the study entails the identification of constraints pertaining to the methodology and execution of the conducted research on the applications of blockchain technology in the job of auditors. The findings derived from the performed investigation were inferred.

3.2 Sample

The selected auditors were surveyed to identify the features of blockchain applications in their work. The sample consisted of 27 auditors from different countries — Azerbaijan, Israel, and Jordan, with different levels of professional experience — 1-2 years, 3-5 years, and more than 5 years. The sample structure is presented in Table 1.

Table 1. Sample structure of auditors

Country	Number of respondents	Professional experience
Azerbaijan	9	1-2 years - 3 respondents 3-5 years - 3 respondents More than 5 years - 3 respondents
Israel	9	1-2 years – 3 respondents 3-5 years - 3 respondents More than 5 years - 3 respondents
Jordan	9	1-2 years - 3 respondents 3-5 years - 3 respondents More than 5 years - 3 respondents

Source: compiled based on author analysis.

The researched sample was formed by the purposeful sampling method (Purposive Sampling Method). This method contributes to the fact that the studied sample of auditors has a diverse representation of blockchain experience. The respondents were selected based on their level of professional experience, which varies from newly employed to experienced professionals, as well as different countries where they carry out their professional activities.

Criteria of the studied sample:
1. Geographical distribution (Azerbaijan, Israel, Jordan);
2. Level of professional experience (Junior specialists: 1-2 years of experience, Mid-level specialists: 3-5 years of experience; Senior specialists: more than 5 years of experience).

The sampling procedure:
1. Identification of potential candidates: a list of auditors who meet the research criteria was obtained in cooperation with audit companies and professional associations in each of the selected countries. Personal recommendations from researchers' contacts were an additional tool used to identify potential candidates.
2. Segmentation: Potential candidates are segmented based on their professional experience. Representation of each relevant level of professional experience within each of the selected countries was ensured within the studied sample.
3. Random selection of candidates: auditors are randomly selected from each segment, ensuring appropriate geographic representation and representativeness in terms of professional experience.
4. Contacting the candidates: the researchers contacted the selected candidates through official communication channels to explain the purpose, scope, and structure of the survey.
5. Consent to participate in the survey was obtained.
6. The data were collected through semi-structured interviews for a controlled and flexible survey process. The survey questions covered the daily experience of auditors, decision-making processes, and trends in the development of auditing under the influence of blockchain. The interview lasted approximately 20 minutes and was conducted using a secure Internet video conferencing service. To facilitate maximum participation, interviews were conducted at a time convenient for the respondents. The research complied with ethical standards, ensuring the anonymity of respondents.

3.3 Methods

The features of the use of blockchain technology in auditing were determined through economic and statistical methods (trend analysis, in-depth semi-structured interview, assessment of the economic effect) applied to analyze key indicators related to the use of blockchain technology in auditing and to calculate the potential economic effect. A survey of auditors was carried out in order to identify the peculiarities of the use of blockchain in their work. The survey was carried out using the method of qualitative research, namely in-depth semi-structured interviews with 27 auditors from Azerbaijan, Israel, and Jordan, and different levels of professional experience (1-2 years, 3-5 years, more than 5 years). The structure and features of the formation of the studied sample of auditors are presented in more detail in the previous paragraph — Sample.

The results of the interview are presented by the following indicators: 1. Key changes in the operational work of the auditor under the influence of blockchain; 2. Key changes in the auditor's IT skills because of the blockchain use; 3. Key changes in the auditor's strategy under the influence of blockchain; 4. New directions of auditor development because of blockchain use. The indicators are described in Table 2.

Table 2. Indicators used in the economic static analysis of the key directions of changes in the auditor's work as a result of the blockchain use

Indicator	Comment
Key changes in the operational work of the auditor under the influence of blockchain	The main consequences of blockchain technology, which will be reflected in the current auditor's work, % of respondents
Key changes in the auditor's IT skills as a result of the blockchain use	Changes in required and desired IT knowledge and skills of audit company employees involved in blockchain-based audits, % of respondents
Key changes in the auditor's strategy under the influence of blockchain	The main changes in the strategic auditor's work in terms of the business model and the portfolio of offered services due to the blockchain use, % of respondents
New directions of auditor development because of blockchain use	Key innovative directions of changes in the auditor's work in the operational, technological, and organizational components, % of respondents

Source: compiled based on, [23] [24], [25], [26], [27].

Approach for sample indicators selection is based on the approach of several major consulting organizations and research institutes, in particular, Anadolu University, [23], IAASB, [24], AICPA – CIMA, [25], ISACA, [26], EY, [27]. By highlighting the operational, IT, strategic, and innovative aspects, it provides a comprehensive perspective on the areas of the profession that may be most impacted by the technology.

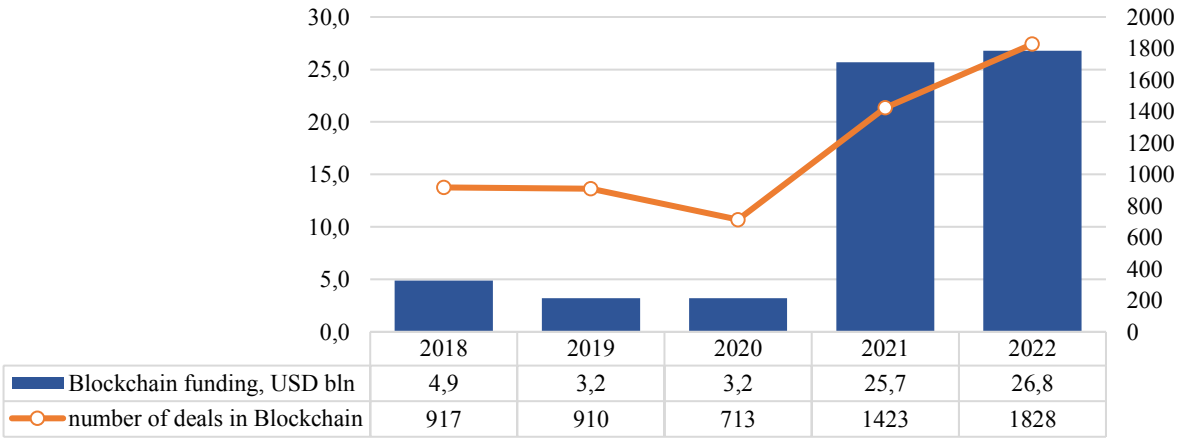
MS Excel package was used in the research to analyze sample data. The data were analyzed using thematic analysis, a method that identifies, analyses, and reveals patterns (themes) in the obtained data. Limitations of this study include potential interviewer mistakes or biases, as well as respondents' recall mistakes. Measures to overcome the research limitations include the use of a purposive sampling strategy and a focus on audit professionals.

Purposive Sampling Strategy involves selecting specific individuals for a study because they possess characteristics or knowledge that make them especially relevant to the research question. This can help in gathering rich, detailed data from participants who are most knowledgeable or experienced about the subject. By focusing specifically on audit professionals, the study narrows down its scope and can draw from the expertise and experience of this particular group. This ensures that the data collected is both relevant and informed. Summarizing and discussing with colleagues, and checking participants were applied in order to increase the validity and reliability of this research. Summing up with the participation of fellow researchers involves a discussion of the research process and the results obtained. By discussing findings and interpretations with fellow researchers, potential biases or misinterpretations can be identified and rectified. This collaborative approach can increase the objectivity and robustness of the analysis. Participant validation involves presenting results to participants to verify their accuracy. Participant validation encompasses presenting the findings back to participants to ensure that the researchers' interpretations align with the participants' intended meanings. This can help in validating the accuracy of the results and in enhancing the trustworthiness of the research.

4 Results

The dynamics of the market for blockchain-based technological solutions show stable growth over a long period of time. This is reflected in the dynamics of financing volumes of investment deals in the field of blockchain, [28]. The data are presented in Figure 1.

The trends in blockchain project financing and the number of transactions in the blockchain field from 2018 to 2022 will be analyzed. As regards blockchain project funding, the dynamics of financing volumes show a downward trend from 2018 to 2020, decreasing from $4.9 billion in 2018 to $3.2 billion in 2019 and 2020. However, in 2021 we see a significant increase in funding to $25.7 billion, or an annual increase of more than 800%, which indicates a significant surge in interest and investment in blockchain technology. The trend of increasing financing volumes continued and amounted to $26.8 billion in 2022.



	2018	2019	2020	2021	2022
Blockchain funding, USD bln	4,9	3,2	3,2	25,7	26,8
number of deals in Blockchain	917	910	713	1423	1828

Fig. 1: Global blockchain funding and deals dynamics, USD billion, number of deals, 2018-2022
Source: compiled based on CBInsights data, [28].

There is also an upward trend in the number of blockchain transactions. The trend analysis showed that the number of transactions in the blockchain sector largely reflects the financing trend. The number of transactions decreased from 917 in 2018 to 713 transactions in 2020. However, the number of deals further increased significantly in 2021 to 1,423 transactions, representing an annual increase of 199.6%. This trend continued in 2022 when the number of transactions in the blockchain sector further increased by +28.5% to 1,828 transactions.

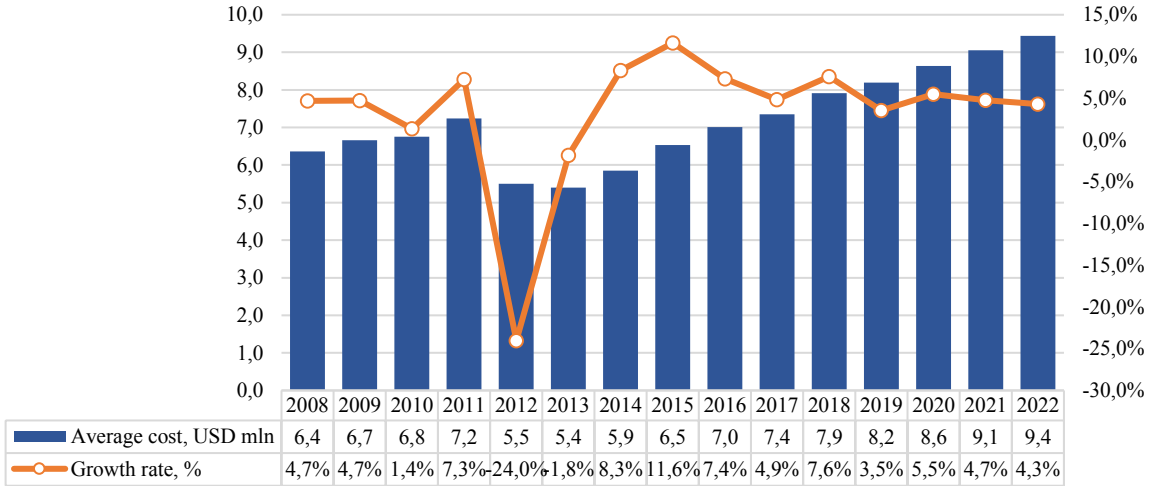
After a period of declining interest in blockchain in 2019 and 2020, a significant revival of the dynamics of blockchain-based project technology was recorded in 2021 and 2022. This may indicate the growing interest and adoption of blockchain technology, including environments of professional services, in particular, audits. The reasons for this trend can be connected to certain drivers, e.g. increase in companies and economy sectors realizing the potential of blockchain technology, breakthrough achievements directly in blockchain technology itself, and the growth of consumer demand for blockchain-based solutions.

At the same time, the scale of cyberthreats, which can be combated by blockchain technology due to the use of its unique tools based on decentralization, cryptography, identification, and verification, is steadily growing. According to the analytical platform Statista, [29], the average loss from a data leak is $9.44 million for American companies and organizations. At the same time, the level of this indicator is steadily increasing during the 15-year observation period of 2008-2022, as Figure 2 demonstrates.

For the analyzed period, the data show a general trend of increasing average costs caused by data leakage. This is an increase of $3.0 million, or 1.47 times the level of data losses compared between 2022 and 2008. The mean expense associated with a data breach has exhibited a consistent upward trend, escalating from $6.4 million in 2008 to $9.4 million in 2022. This figure denotes a mean yearly expansion rate of 3.34%. Nevertheless, there have been oscillations seen in the annual increase rate. As an illustration, the financial implications of a data breach showed a decline of 24% in 2012, followed by a subsequent increase of 8.3% in 2014.

The data shows a definite upward trend in data breach costs for businesses, with rare year-over-year declines. This growing trend underscores the need for proper cybersecurity measures and policies in companies and organizations. That also encompasses the need for relevant audit IT infrastructure, supporting blockchain-related change.

The needs and opinions of sampled auditors were studied considering the identified trends in the development of auditing under the influence of blockchain. Interviewing a sample of auditors revealed that the auditors consider the impact on the operational work of auditors as the priority area of the impact of blockchain. Accordingly, the auditors need to improve the component of IT skills. It is also necessary to change internal regulatory documents and audit methodology to consider the impact of blockchain. According to the auditors, there is a real potential for real-time audits. Moreover, according to the respondents, it is possible to improve the complex audit services with high added value in terms of more effective detection of fraud and consulting on the accounting of digital assets. Figure 3 presents the results of the study.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Average cost, USD mln	6,4	6,7	6,8	7,2	5,5	5,4	5,9	6,5	7,0	7,4	7,9	8,2	8,6	9,1	9,4
Growth rate, %	4,7%	4,7%	1,4%	7,3%	-24,0%	-1,8%	8,3%	11,6%	7,4%	4,9%	7,6%	3,5%	5,5%	4,7%	4,3%

Fig. 2: Average cost of a data breach for U.S. companies and organizations, USD mln, 2008-2022
Source: compiled based on Statista data, [29].

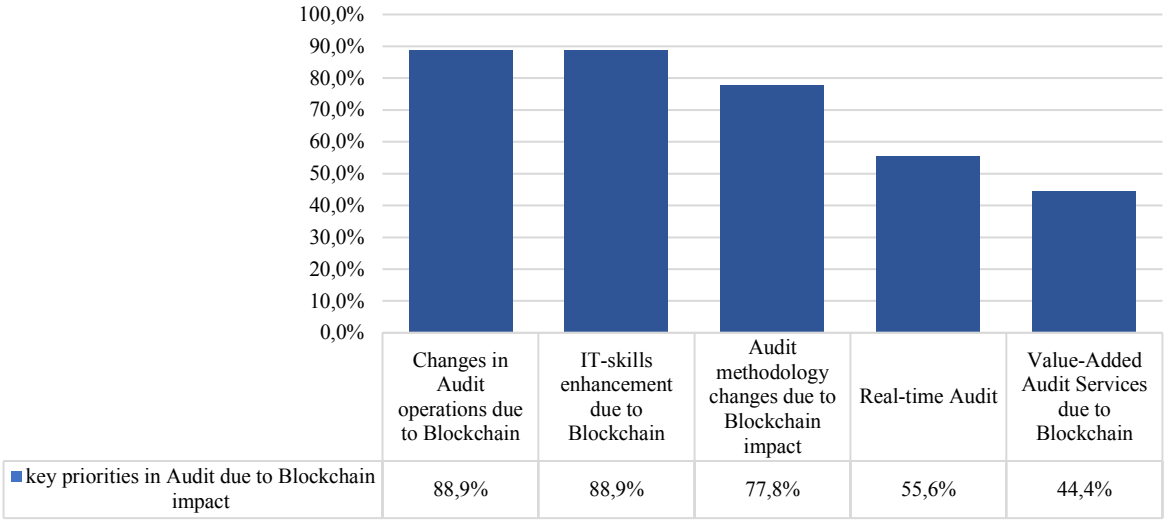


Fig. 3: Key priorities in Audit due to Blockchain impact – Interview research results for a sample of auditors concerning changes in Audit due to Blockchain, % of respondents, 2022
Source: compiled based on sample data.

The presented table illustrates the primary focal points within the field of audit, specifically in response to the influence exerted by blockchain technology. The priorities have been arranged in accordance with the proportion of participants who expressed the significance of each priority. Notably, the highest-ranked priorities are "Changes in audit operations due to blockchain" and "IT-skills enhancement due to blockchain". The obtained data illustrates the substantial influence of blockchain technology on the field of audit. Most participants expressed the significance of directing attention toward modifications in audit operations, information technology competencies, and audit methodology. The reason for this is attributed to the nascent and dynamic nature of blockchain technology. Thus, auditors must modify their audit methodologies to adequately evaluate the risks and controls inherent in blockchain-based systems and transactions.

It is noteworthy to mention that a considerable proportion of respondents (44.4%) hold the belief that blockchain technology would empower auditors to deliver audit services with additional value. Thus, auditors perceive blockchain as a potential avenue for enhancing the caliber and effectiveness of their audits, while also offering novel and inventive offerings to their clientele.

In summary, the conclusion is that this set of changes in the auditor's work due to the use of blockchain can be considered as a real guide to actions when forming a plan for changes in the work of audit companies and plans for adaptation to the new technological environment for the short- and long-term.

The use of blockchain in audit processes can cause changes in the financial results of audit companies. Economic and statistical analysis of financial reporting data of the 4 world's largest auditing companies revealed the potential economic effect of using blockchain (Table 3).

Table 3. The forecasted economic effect of Blockchain implementation in audit

indicator	Deloitte	PwC	EY	KPMG
Revenue for 2022, USD bln	59.3	50.3	45.2	34.6
Compound Annual Growth Rate, %	6.5%	3.9%	5.4%	3.7%
Scenario Analysis for Blockchain impact on forecasted Revenue growth for 2023-2025, %				
Best Case Scenario, (+4 p.p. growth), %	10.5%	7.9%	9.4%	7.7%
Base Case Scenario, (+2 p.p. growth), %	8.5%	5.9%	7.4%	5.7%
Worst Case Scenario, (0 p.p. growth), %	6.5%	3.9%	5.4%	3.7%

Source: compiled based on Statista data, [30].

According to the basic scenario, the 4 largest audit companies expect an average annual growth rate of 6.9% from the use of blockchain. In monetary terms, this economic effect amounts to an average revenue of $72.1 billion per company as of the forecast year of 2025.

Summing up, we should note that in terms of improving the auditor's work through the use of blockchain, it is important to pay attention not only to the potential for a significant transformation of

audit methods but also to the prerequisites for the effective adoption and use of blockchain technology. This transformational transition to blockchain-based auditing must be appropriately managed to meet the needs of auditors and audit company clients. An additional serious challenge is the provision of adequate professional training and education of auditors, which shall help stakeholders understand and adapt to developing technologies, in particular, blockchain technology.

5 Discussions

The present analysis aims to elucidate the precise implications of blockchain technology in the field of auditing, with particular attention given to the problems and possibilities encountered by the primary stakeholders involved. The results collected will be discussed in more depth.

This research suggests that the utilization of blockchain technology is crucial in facilitating transformative shifts in traditional auditing methodologies. Technological advancements have a significant influence on both the operational and strategic aspects of the auditing process. This assertion is supported by the findings of several prior investigations. The focus of this study is to examine the efficient utilization of blockchain technology in the context of audit and back-office services, [1]. This premise is supported by a previous study, [2], which investigated a blockchain-based auditing method designed to preserve the integrity of large-scale data. This notion of blockchain-based transparent auditing, emphasizing security and transparency, was further substantiated in, [4], [31]. The findings of this study are corroborated by a previous study, [6], which also explores the utilization of blockchain technology for safe, decentralized, and automated auditing techniques. This thesis is supported by a study conducted by the authors, [8], which specifically examines the topic of audit compliance in the context of blockchain technology.

This research study centers on the utilization of blockchain technology within the field of auditing, exploring many potential applications and scenarios. This study investigates certain circumstances pertaining to the application of the technology. This study identifies the primary advantages of utilizing blockchain technology to streamline and automate audit procedures. The decentralized nature of blockchain allows for the establishment of a safe and transparent accounting system, which has the potential to greatly enhance the efficiency of the audit process. The finding is substantiated in reference, [9], which pertains to the utilization of blockchain technology in the field of auditing, specifically in the context of risk analysis and management. The authors in, [10], [32], [33], offer further validation by examining the effects of blockchain technology on the field of auditing, specifically focusing on security. The study explores the potential opportunities and challenges that arise in the daily routine of auditors due to blockchain, and consequently, the necessary data security management skills that auditors must acquire in response to these effects. Further validation of the chosen outcome in this research is provided by a previous investigation, [11], which examined a public audit system utilizing blockchain technology. This analysis focused on the technological attributes of blockchain and its implications for information security within the audit domain. This discovery is further substantiated by a study that investigated a distributed auditing system based on blockchain technology, with the aim of enhancing transparency and dependability in network management systems. Previous researchers, [18], [34], corroborate the findings pertaining to the utilization of blockchain technology for the purpose of conducting public audits on large-scale data stored in cloud environments.

In contrast to previous research, the present study specifically underscores the necessity for a comprehensive and thorough examination of auditors' requirements for the modifications arising from the influence of blockchain technology on their professional responsibilities. This research centers on the significance of conducting a comprehensive examination of the requirements of auditors within the framework of alterations resulting from the influence of blockchain technology. Moreover, this research examines the prospective economic impact on the long-term expansion of audit firm revenues considering the influence of blockchain technology. This is significant in terms of justifying auditors' commitment to investing in the advancement of these ground-breaking technologies.

6 Conclusions

This research indicated key development areas of blockchain technology for the auditors, both in terms of operational work and strategic tasks. This task is difficult due to the wide influence of the technological factor on the change in the work approaches of client companies and auditors, as well as uncertainty in terms of blockchain regulation and

new auditing standards due to changes caused by the influence of blockchain.

Blockchain technology usage requires the adaptation of auditors who will face the consequences of its influence on their professional activities. The study of the needs of auditors in the context of the use of blockchain revealed the need for changes in the operational work of auditors (88,9% of respondents), as well as improvement of IT competencies (88,9% of respondents) and audit methodology (77,8% of respondents). In strategic terms, there is a potential to apply audit tools in real-time and provide services with higher added value, for example, more effective fraud detection, and consulting on the accounting of digital assets. These changes lead to a potential economic effect from the use of blockchain by auditors. According to estimates of the impact of blockchain for the 4 largest audit companies in the world under the basic scenario, an average annual growth rate of 6.9% is expected for the period 2023-2025. This economic effect is an average income of $72.1 billion per audit company for the projected 2025.

Future research will be concerned with the analysis of directions of strategic and operational changes in auditing under the influence of blockchain in the audit methodology and organizational structure of audit companies.

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