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Blockchain technology and auditor: a scientific mapping and future research paths

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ABSTRACT

This study presents a systematic literature review (SLR) examining the relationship between blockchain technology implementation and the audit profession, particularly its implications for auditors' roles and practices. The review follows established SLR guidelines and focuses on peer-reviewed English-language articles in the fields of business, management, and accounting published between 2018 and 2024. After a rigorous screening process, 50 articles were selected for in-depth bibliometric and qualitative content analysis. The findings identify three main streams of research: (1) the impact of blockchain technology on the audit profession; (2) the integration of blockchain into accounting and auditing practices; and (3) emerging issues and future challenges in blockchain-based auditing environments. This study contributes by synthesizing current knowledge and proposing directions for future research on blockchain and auditing.

ABSTRAK

Penelitian menyajikan tinjauan literatur sistematis yang mengkaji hubungan antara implementasi teknologi blockchain dan profesi audit, khususnya implikasinya terhadap peran dan praktik auditor. Tinjauan ini mengikuti pedoman SLR yang telah mapan dan berfokus pada artikel ilmiah berbahasa Inggris yang ditelaah sejawat di bidang bisnis, manajemen, dan akuntansi yang diterbitkan pada periode 2018 hingga 2024. Setelah melalui proses penyaringan yang ketat, sebanyak 50 artikel dipilih untuk dianalisis secara mendalam menggunakan analisis bibliometrik dan analisis konten kualitatif. Hasil penelitian mengidentifikasi tiga arus utama penelitian, yaitu: (1) dampak teknologi blockchain terhadap profesi audit; (2) integrasi blockchain dalam praktik akuntansi dan audit; serta (3) isu-isu yang berkembang dan tantangan masa depan dalam lingkungan audit berbasis blockchain. Studi ini memberikan kontribusi dengan mensintesis pengetahuan terkini serta menawarkan arah penelitian masa depan mengenai blockchain dan auditing.

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1. Introduction

The development of IT globally continues to evolve, which has resulted in companies choosing to follow technological trends to remain competitive and ensure transparency in the field of professional accounting and auditing, especially in the era of blockchain technology (Rozario & Thomas, 2019). In an effort to maintain investor confidence, many companies have decided to follow IT trends, including blockchain (Schmitz & Leoni, 2019). The presence of blockchain in the business world is closely related to Bitcoin.

The popularity of blockchain began when Nakamoto (2008), in a seminal work, introduced the concept of a digital currency called Bitcoin. Bitcoin is a peer-to-peer electronic currency that eliminates the need for banking institutions by enabling internet payments to be transmitted straight between parties. In its implementation, a peer-to-peer network is used to time-stamp transactions by hashing them into a hash-based chain, forming an immutable record. This network, called blockchain, allows for recording transactions in real time and cannot be altered by anyone. Blockchain enables data privacy, information sharing between parties in the network, and programmable and automated process control (Dai & Vasarhelyi, 2017).

From an audit perspective, blockchain is predicted to interfere with the auditing process (Richins et al., 2017). Ledgers of both financial and non-financial information may be transferred more accurately and efficiently thanks to blockchain technology, thus enabling real-time auditing because all transactions are recorded in a distributed ledger that is historical, immutable, and real time (Dyball & Seethamraju, 2021). In short, the presence of blockchain technology offers an efficient solution to the audit process. In addition, Big 4 audit firms suggest that blockchain technology will significantly affect accountants and auditors as well as regulators and standard-setters (Deloitte, 2016; EY, 2017; KPMG, 2016; PwC, 2016, 2017), especially concerning the record-keeping process, including transaction origination, transaction processing, recording, reconciliation, auditing, and reporting (Coyne & McMickle, 2017).

Several scholars have tried to start a discussion on the concept of blockchain in accounting, including Cai (2021), who synthesized the early development of blockchain in companies by combining it with the Triple-entry accounting (TEA) concept of Ijiri (1986) and Grigg (2005). Kokina & Davenport (2017) suggested the early implementation of blockchain in Big 4 auditing firms. Other researchers have also tried to explain the existence of accounting and auditing in the blockchain era, such as Schmitz & Leoni (2019), Han et al. (2023), and Maffei et al. (2021). Furthermore, scholars have also started to combine blockchain auditing approaches with smart contract mechanisms (De Andrés & Lorca, 2021; Rozario & Thomas, 2019; Rozario & Vasarhelyi, 2018) and the cloud (Appelbaum & Nehmer, 2020). However, rather than addressing the issue of blockchain technology and auditing in general or developing blockchain-based auditing approaches, this research focuses on understanding how the literature on blockchain technology relates to the work and role of auditors. Previous research has explored various effects of blockchain technology, such as auditor acceptance, auditor professional change, and auditor technostress when facing this technology. Therefore, this study synthesizes the fragmented literature through an in-depth and systematic review.

This study collected 72 articles from the Scopus database that discuss the relationship between blockchain technology and auditors. After that, we read each abstract of the articles, performed several refinements, and decided on 50 articles to analyze comprehensively. The articles were then systematically reviewed using a mixed approach, integrating bibliometric analysis techniques and content analysis (Massaro et al., 2016; Mustikarini & Adhariani, 2022; Paul & Criado, 2020). Through bibliometric analysis, this research will map and visualize studies related to the impact of blockchain technology and auditors over 6 years, starting from 2018 to 2024. Based on bibliometric analysis, patterns of research development on blockchain technology and auditors and the underlying intellectual structure can be identified. Meanwhile, this research will critically analyze the articles published qualitatively through content analysis techniques.

The present study contributes to the existing body of literature concerning blockchain technology and auditors. First, this study provides an overview of blockchain technology and auditors research development, highlighting early groundbreaking works and the evolution of research over 6 years. This helps novice researchers understand the emergence of topics based on

specific periods. Secondly, through bibliometric analysis techniques, this study provides the knowledge base and intellectual structure of the emerging research streams related to blockchain technology's impacts on auditing. The intellectual structure will guide future research, comprehensively understanding the research streams and gaps. Thirdly, this study identifies journals, countries, articles, and authors that can inform future research. Identifying contributing countries provides insight into the institutional settings related to the idea and implementation of blockchain technology and auditing in different countries. Analyzing the most cited publications provides insight into studies that academics and practitioners value, which aids in developing blockchain technology implementation strategies and methodologies. Finally, this paper outlines the foundation for future research. This systematic literature review also provides future research directions related to blockchain technology, and auditors' work and roles.

This is how the rest of the article is structured. The research methodologies are described in Section 2. The results are explained in Section 3. The talks and the research agendas for the future are presented in Section 4. Section 5 provides this article's conclusion.

2. Research Methods

This research adopts SLR methodology (Massaro et al., 2016; Mustikarini & Adhariani, 2022) to explore and evaluate the field of study concerning the impact of blockchain technology adoption on auditors, recognize patterns and advancements in knowledge and attempt to propose prospective avenues for future research in this field. A systematic literature review aims to determine the influence of publications, prominent writers, and journals that publish many articles in the field. This project will combine bibliometric and content analysis methodologies in the SLR process.

Bibliometric analysis techniques play a role in investigating and mapping the literature that has been published in journals in various scientific disciplines. Aria and Cuccurullo (2017) suggested that bibliometric analysis is a tool to investigate trends in the literature that are still within the boundaries of one domain utilizing statistical and mathematical methodologies. Bibliometric analysis utilizes statistical and quantitative analysis to conduct a literature review of published research (Zupic & Čater, 2015). This technique has two main objectives: performance analysis and knowledge mapping. Performance analysis evaluates how well individual scholars and institutions conduct research and publish their findings. Knowledge mapping investigates the structure and dynamics of scientific areas. Bibliometric analysis is used because it has strong quantitative technical capabilities and efficiently assesses many studies. Furthermore, the bibliometric analysis provides a systematic, transparent, and reproducible literature assessment (Aria & Cuccurullo, 2017), helps researchers reference the most influential papers and maps research areas with fewer biases bias (Zupic & Čater, 2015), identify leading researchers and articles in a particular field (Agarwal et al., 2016), and provides more objective and reliable analysis (Mustikarini & Adhariani, 2022).

The content analysis was conducted by qualitatively assessing the selected literature to extract information and acquire insight into its substance. The textual material from the process could be coded into qualitatively relevant pieces of data. Integrating bibliometric analysis and content analysis techniques may respond to the research questions appropriately. The research approach consists of five phases, adopted from Dumay & Cai (2015), namely:

- research questions definition;
- compose the protocol for the research;
- ascertain the documents to analyze;
- create a framework for coding; and
- carry out a content analysis and dialogue, suggesting avenues for future study.

Research questions definition

Defining the three primary research questions is the first stage in conducting a systematic literature review (Massaro et al., 2016) that in our study can be stated as follows:

- *RQ1. How is the auditing literature developing according to the prominent adoption of blockchain technologies?*
- *RQ2. What is the literature's focus on the impact of blockchain technology on auditors?*

- *RQ3. What are the implications of our research on the impact of blockchain technology on auditors and future research agendas?*

Determining the "state of the art" in the literature regarding the new phenomena of blockchain technology's effect on auditors is the goal of the RQ1. The *RQ2* is more focused on understanding the impact of blockchain technology on auditors related to their roles and works. Ultimately, the RQ3 directs the researchers' discourse and offers perspectives and ramifications concerning blockchain technology and its influence on auditors.

Compose the protocol of the research

The research protocol, which calls for identifying information sources, techniques, procedures, and instruments for study summaries and analyses, is the subject of the second phase (Popay et al., 2006). The most pertinent articles were examined to establish a solid backdrop. Additionally, as the primary sources of article access for this analysis, we gathered literature from Scopus databases.

Ascertain the documents to analyze

Finding the articles to include in the literature review in terms of the database and research string to utilize is the goal of this stage. Scopus was the scientific database from which the papers were extracted. More than 20.000 peer-reviewed journals and articles are covered in detail by the Scopus database (Mishra et al., 2017).

We conducted a keyword search using relevant bibliographic data. The keyword search used the following queries: (TITLE-ABS-KEY (“blockchain*”) OR TITLE-ABS-KEY ("blockchain technolog*") AND TITLE-ABS-KEY (auditor*)). From the query, it can be seen that there are two parts in the final keyword. The first part is (“blockchain*” OR “blockchain technolog*”) describes articles that address the domain of blockchain technology. The second section (“auditor*”) illustrates articles that discuss the impact of blockchain technology on auditors, related to their works and roles in the auditing process. Using the search parameters "title, abstract, keywords," the screening of the results revealed that the business, management, and accounting domain is a well-known topic of study (Table 1).

We eliminated duplicates and non-English-language publications after reviewing the abstracts and titles of the retrieved results to determine which ones best fit our study objectives. We gathered papers that were printed in scholarly journals. Our ultimate outcome is derived from 72 scholarly articles. After the abstract was reviewed, a final list of fifty papers was considered. The justification for the exclusion standard was that most papers did not analyze the report's concept in conjunction with the characteristics of blockchain technology and its implications for auditors.

Table 1. The primary SLR standard implemented

Criteria	Description
Field	Business, management, and accounting
Literature type	Articles
Literature language	English
Period	2018-June 2024 (past 6 years)
Keywords	Group of keywords by blockchain, blockchain technology, and auditor
Screening I	Article title, abstract, keywords
Screening II	Text mining

Create a framework for coding

Determining which things in the chosen articles to investigate was the goal of the coding framework's fourth stage. We selected the following elements for coding in this study:

- Publication timing: how the quantity of publications changes over time.
- Geographic distribution of papers: the dispersion of papers across nations.
- Journals: articles published and citations obtained from journals
- Author and citation analysis: total number of articles cited worldwide; annual citation count.
- Pertinent keywords and subjects: the most commonly utilized keywords by authors

Cluster and descriptive analyses will be conducted on fifty papers that meet the analysis criteria. Descriptive analysis aims to show several publication characteristics, including the evolution of published papers over time and distribution by country. Articles contributing to related topics will also be analyzed (Massaro et al., 2016). Moreover, the impact of each paper is assessed by counting the number of citations. Lastly, the authors' collaboration and citations are identified.

The most frequently used keywords were extracted using occurrence analysis. Researchers manually coded the articles using the Scopus database, and VOSviewer was used to examine the data. Using two methods, co-occurrence and bibliographic coupling analysis, A tool for building and viewing bibliometric networks and clusters is called VOSviewer (Eck & Waltman, 2009). Co-occurrence analysis assesses an article's relatedness based on the authors' shared terms (Eck & Waltman, 2009). To include papers with at least two keyword occurrences, we established a threshold of "Author's keywords" in VOSviewer as the unit of analysis (Lombardi & Dumay, 2017). In the meantime, the quantity of shared references is used in bibliographic coupling analysis to assess the relationship between articles (Boyack & Klavans, 2010). With a paper criterion of at least five citations from a document, we selected "document" as the unit of analysis in VOSviewer (Leydesdorff & Opthof, 2010; Lombardi & Dumay, 2017). All VOSviewer studies used fractional counting (Leydesdorff & Opthof, 2010; Lombardi & Dumay, 2017).

Carry out a content analysis and dialogue, suggesting avenues for future study

The 50 papers chosen for the SLR were subjected to content analysis and critical discussion to suggest potential areas for future research. The VOSviewer clusters, which help identify future study directions and understand developing research areas and gaps, also served as the basis for the content analysis. The next part will provide a detailed description of the SLR results.

3. Results and Discussion

The primary purpose of the systematic literature review (SLR) data collection is to answer the study questions that have been pre-posed. The remaining portion of this section is separated into two sections: content analysis, which includes a detailed examination of the chosen papers, and bibliometric analysis of the chosen papers.

Descriptive analysis

The evolution of articles

Figure 1 illustrates the progression of published publications from 2018 to 2024. The number of articles published tends to trend in different directions, as the picture illustrates. In 2018, two articles were published; thereafter, the number increased steadily, reaching a peak of 17 articles in 2021. There was a downturn in 2022, with only 8 papers published. Over the course of six years, the greatest number of articles (21 articles) were released in 2023. Since the data for 2024 was collected as of June 24, 2024, it is still partial.

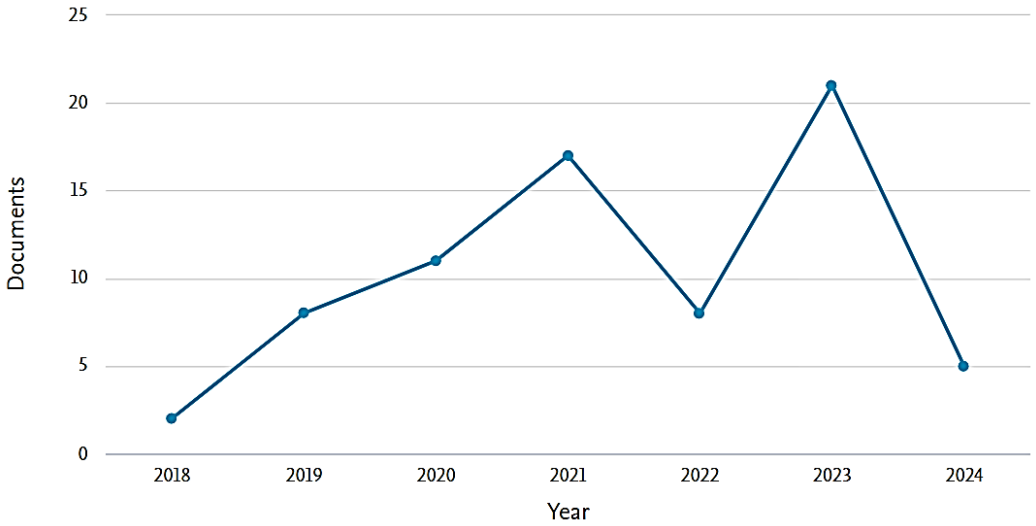


Figure 1. Article evolution over time

The subject areas of articles

This section describes how the papers are distributed based on the subjects that were examined. The primary fields of study include business, management, and accounting, together with finance, econometrics, and economics, as seen in Figure 2. This indicates that the use of blockchain technology in auditing is primarily observed in business, management, and economics domains. It then moves to the fields of economics, econometrics, and finance when audit clients use blockchain technology to create transparent and reliable data, lower the risk of fraud, and effectively enable continuous and real-time auditing.

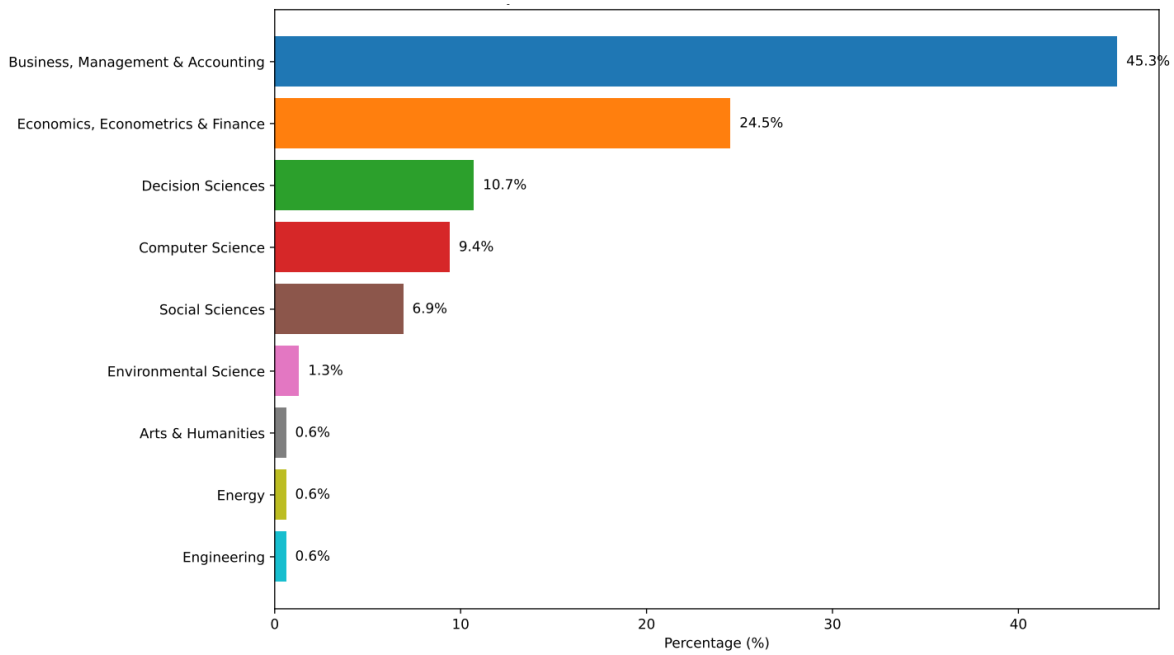


Figure 2. Article by subject area

Geography of the articles

The geographic distribution of publications by nation and the relative citations by country are displayed in Figure 3. Each author who is from a different country has a point. The total number of articles and citations is determined by considering the authorship participation of a country, university, or author center. The impact of blockchain technology on auditors is the research issue on which this study focuses, and this analysis helps us understand which countries have contributed the most to this field of study. A total of 35 countries have contributed to this area of study. This demonstrates the dispersal of research across national boundaries, with the United States, Italy, Jordan, and the United Kingdom being the most productive countries. There is evidence to support this claim:

- The top three countries in terms of publications are the United States (26 articles), Italy (6 articles), and Jordan (6 articles).
- The USA (529 citations) is one of the top three countries regarding citations. Australia (333 citations) and Italy (374 citations).

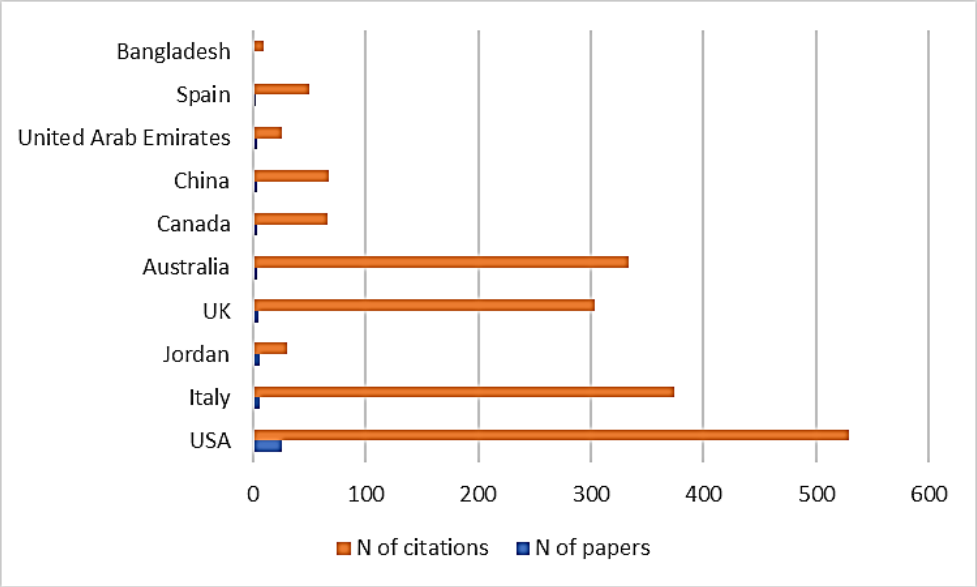


Figure 3. Article geography based on the quantity of publications and citations in each nation

Table 2. Top ten nations for each publication and citation count

Country	N of papers	N of citations
USA	26	529
Italy	6	374
Jordan	6	30
UK	5	304
Australia	4	333
Canada	4	66
China	4	68
United Arab Emirates	4	26
Spain	3	50
Bangladesh	2	10

Journals

For researchers and authors, the quantity of publications on a certain topic is crucial (Dumay & Cai, 2015). The 50 articles we chose for our analysis demonstrate the possibility of investigating research subjects. The Journal of Emerging Technologies in Accounting published the most articles on blockchain technology in auditing, with seven articles, followed by the International Journal of Accounting Information Systems with five articles, and the Journal of Information Systems with four articles. This is indicated in Table 3. The VOSviewer-created network of co-cited sources, which meets the criteria of 10 citations for sources published during the last six years, is depicted in Figure 4.

Table 3. Most Relevant Journal

Sources	Articles	Citations
Journal of Emerging Technologies in Accounting	7	194
International Journal of Accounting Information Systems	5	228
Journal of Information Systems	4	98
International Journal of Digital Accounting Research	3	87
ACM Transactions on Management Information Systems	2	24
Current Issues in Auditing	2	63
Journal of Financial Reporting and Accounting	2	8
Journal of Organizational Change Management	2	25

Journal of Risk and Financial Management	2	2
Academy of Accounting and Financial Studies Journal	1	2
Accounting Perspectives	1	25
Accounting Review	1	0
Asian Review of Accounting	1	2
Auditing	1	0
Australian Accounting Review	1	194
British Accounting Review	1	1
Development and Learning in Organizations	1	14
Financial and Credit Activity: Problems of Theory and Practice	1	4
Intangible Capital	1	13
International Journal of Accounting and Information Management	1	0
International Journal of Auditing	1	5
International Journal of Management Practice	1	27
Issues in Accounting Education	1	6
Issues in Information Systems	1	3
Journal of Governance and Regulation	1	2
Journal of Innovation and Entrepreneurship	1	1
Journal of Innovation Economics and Management	1	11
Management and Accounting Review	1	7
Meditari Accountancy Research	1	53
Risks	1	12

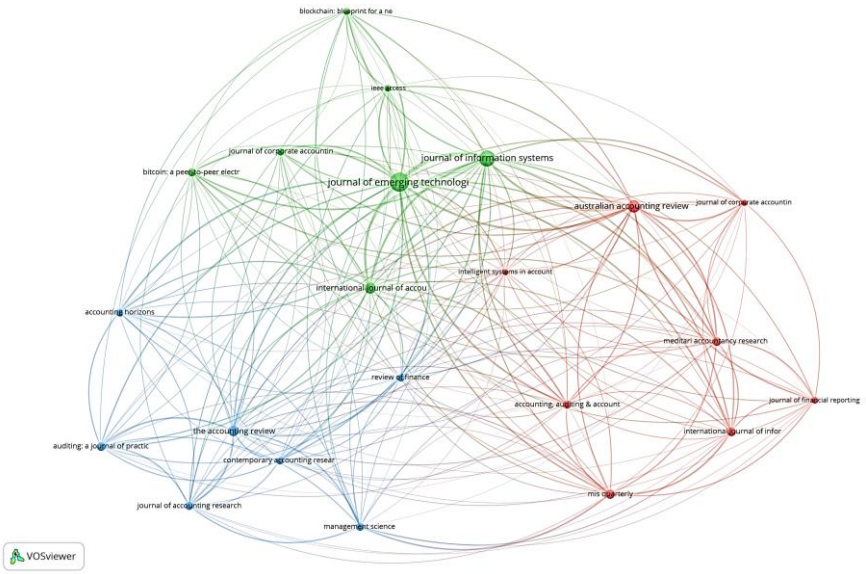


Figure 4. Network of co-cited sources

Trend number of articles and citations per year

The top 10 publications published over the monitored period (2018–2024) are shown in Table 4 along with the journal name, publication year, and number of citations. The last two columns calculate the total global citation and total citation per year of the articles. Evidence explains that the most cited article is that of Schmitz and Leoni entitled "Accounting and Auditing at the Time of Blockchain Technology: A Research Agenda". In addition to being the first paper in the TCY ranking, this literature review paper is from 2019.

Table 4. Top 10 articles per citation

Authors	Title	Year	Source title	TGC	TCY
Schmitz, J; Leoni, G.	Accounting and Auditing at the Time of Blockchain Technology: A Research Agenda	2019	Australian Accounting Review	196	32.67
Han, H; Shiwakoti, R.K.; Jarvis, R; Mordi, C; Botchie, D.	Accounting and Auditing with Blockchain Technology and Artificial Intelligence: A Literature Review	2022	International Journal of Accounting Information Systems	102	51
Rozario, A.M; Vasarhelyi, M.A.	Auditing with Smart Contracts	2018	The International Journal of Digital Accounting Research	88	12.57
Rozario, A.M; Thomas, C.	Reengineering the Audit with Blockchain and Smart Contracts	2019	Journal of Emerging Technologies in Accounting	80	13.33
Sheldon, M.D	A Primer for Information Technology General Control Considerations on a Private and Permissioned Blockchain Audit	2019	Current Issues in Auditing	61	10.17
Ferri, L; Spano, R; Ginesti, G; Theodosopoulos, G.	Ascertaining auditors' intentions to use blockchain technology: evidence from the Big 4 accountancy firms in Italy	2020	Meditari Accountancy Research	53	10.60
Smith, S.S; Castonguay, J.J.	Blockchain and Accounting Governance: Emerging Issues and Considerations for Accounting and Assurance Professionals	2020	Journal of Emerging Technologies in Accounting	46	9.20
Appelbaum, D; Nehmer, R.A.	Auditing Cloud-Based Blockchain Accounting Systems	2020	Journal of Information Systems	44	8.80
Dai, J; He, N; Yu, H.	Utilizing Blockchain and Smart Contracts to Enable Audit 4.0: From the Perspective of Accountability Audit of Air Pollution Control in China	2019	Journal of Emerging Technologies in Accounting	37	6.17
Alles, M; Gray, G.L.	"The first mile problem": Deriving an endogenous demand for auditing in blockchain-based business processes	2020	International Journal of Accounting Information Systems	32	6.40

Topics and common keywords

The primary keywords that the 50 articles under analysis covered are defined in this section. Silverman (2013) stated that keyword analysis is a technique for the in-depth analysis of vast volumes of text without sacrificing focus on smaller bits of information. Social network analysis is used to categorize and examine keywords. This kind of analysis produced two clusters: one that the software generated using a threshold that brought together phrases that had to appear at least twice, and the other involved picking only pertinent keywords and eliminating terms like methodology and study. Table 5 and Figure 5 show the findings of the clusters and keywords. Table 5 lists the

keywords we detected in our sample and their correlations when they occur simultaneously at least twice.

Five primary clusters are revealed by the keyword clustering analysis, as shown in Figure 5. Using the degree centrality measure, Figure 5's sphere sizes represent the articles' relative relevance; larger circles are connected to more articles. According to McCulloh et al. (2013), the agents with the majority of direct links to and from other agents are identified by their degree of centrality.

Table 5. Keyword occurrence

Cluster 1 (red)	Cluster 2 (green)	Cluster 3 (blue)	Cluster 4 (yellow)	Cluster 5 (purple)
Auditors	Audit evidence	Accounting	Assurance	Audit
Cryptocurrencies	Blockchain technology	Auditing	Cryptocurrency	Oracle problem
Jordan	Innovation	Blockchain	Internal auditing	Service organization
Technology acceptance model	Professional skepticism	Triple-entry accounting	Smart contracts	
Technostress	Trust	UAE		
UTAUT		Bitcoin		

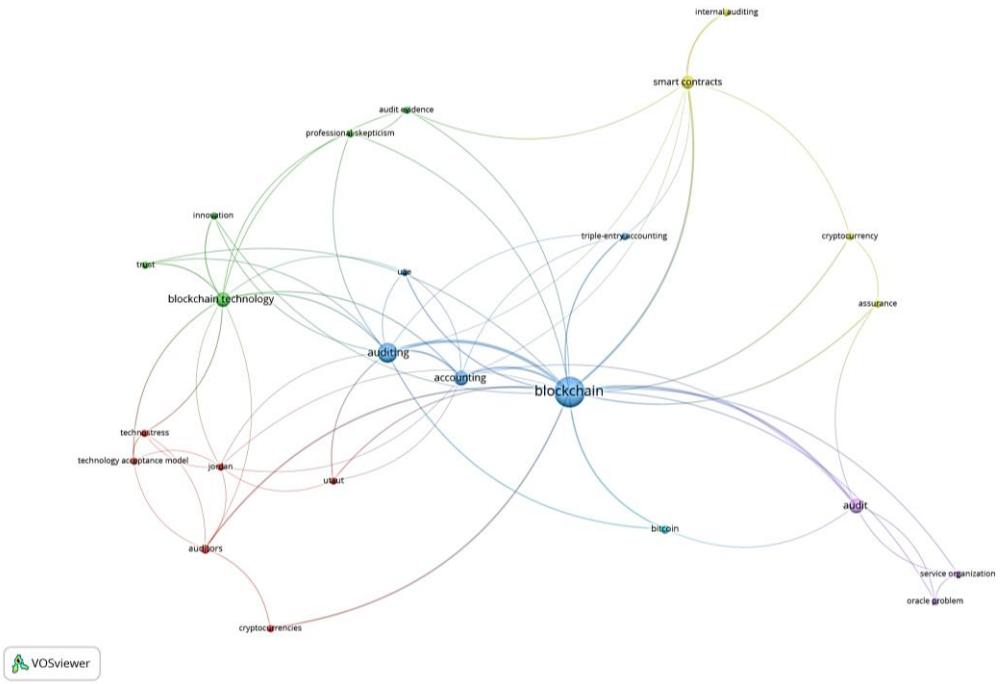


Figure 5. Keywords' cluster (author's keyword) VosViewer

Clustering and content analysis

The 50 publications that were part of the data sample were used to begin the content analysis phase, which began with the bibliographic coupling. Table 6 displays the five clusters that this analysis produced. After that, a content analysis of the sample articles is carried out in order to fully comprehend the primary topics of growing study. Three research areas can be identified by this content analysis. Based on their content and focus, the papers are reorganized into three primary study topics, not just from the bibliographic coupling. It is considered reaching better representation. Research area 1 includes the papers in clusters 1 and 5, as they have comparable themes based on content analysis of the abstract and text of each study. In the meantime, research area 2 includes the papers in cluster 2 since their themes are comparable to those of cluster 4. Finally, three main research areas are summarized as follows:

- *Research area 1*: Blockchain technology and its impacts on the audit profession
- *Research area 2*: Integrating blockchain technology into accounting and auditing practices
- *Research area 3*: Future issues of blockchain technology and auditing

Table 6. Bibliographic clustering by authors

Cluster 1 (red)	Cluster 2 (green)	Cluster 3 (blue)	Cluster 4 (yellow)	Cluster 5 (purple)
Appelbaum (2022)	Abdennadher (2022)	Alkafaji (2023)	Appelbaum (2020)	Alshurafat (2023)
Dunn (2021)	Han (2023)	Corradini (2022)	Dai (2019)	Ferri (2020)
Elommal (2022)	Maffei (2021)	De Andres (2021)	Parmoodeh (2023)	
Li (2022)	Pedreno (2021)	Desplebin (2021)	Rozario (2018)	
Sheldon (2021)	Schmitz (2019)	Gomaa (2019)	Rozario (2019)	
Sheldon (2019)	Vincent (2020)	Hsieh (2022)		
Smith (2020)				

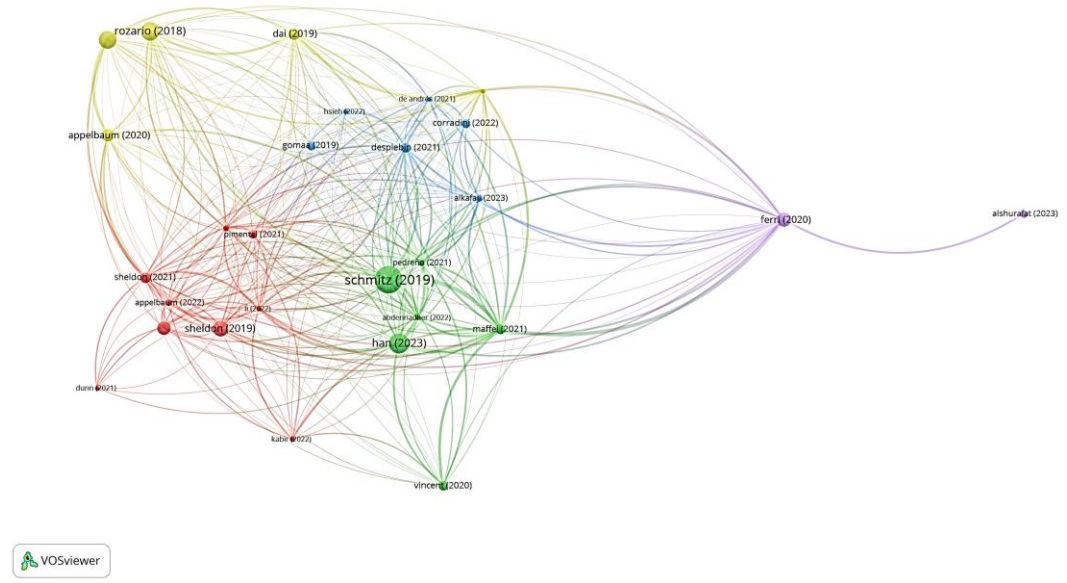


Figure 6. Bibliographic clustreing of documents

Research area 1: Blockchain technology and its impacts on the audit profession

With 11 papers covering the years 2019–2023, the first research area has the most articles overall. These studies have mostly concentrated on the advent of blockchain technology, which presents potential and challenges for the audit profession. This field of study was developed in response to a publication by Nakamoto (2008). In that paper, Nakamoto introduced distributed ledger technology (DLT) to facilitate Bitcoin transactions and a digital currency application known as Bitcoin. Blockchains, which are cryptographically linked blocks, are the units of data that the DLT concept packages. A blockchain study was initiated using Nakamoto's concept.

Some academics have attempted to look into the potential for businesses and organizations to deal with the adoption of blockchain technology, even if most blockchain-related studies so far have focused on conceptual notions. According to Appelbaum et al. (2022), blockchain hasn't been widely accepted in corporate operations in more than a decade after the concept of Bitcoin first surfaced. However, his research attempts to put some of the practitioners' and researchers' worries into context, which could have caused a delay in adopting blockchain technology. Dunn et al. (2021) created a modular case on the audit implications of Bitcoin and blockchain for graduate and undergraduate students' audit and assurance learning as a more tangible step in starting a widespread

blockchain implementation. The learning objectives of the modular case are to (1) identify material misstatement risks; (2) link material misstatement risks to pertinent financial statement assertions; (3) explain changes in audit procedures in response to risks; (4) comprehend how financial statement auditors use auditor's report services; and (5) comprehend management specialists and their role in audits.

Numerous scholarly investigations have examined the impact of blockchain innovation on the audit industry, specifically concerning the difficulty of guaranteeing audit quality for customers using blockchain technology and the implementation of blockchain within audit companies. Elommal & Manita (2022) carried out a qualitative investigation involving a sample of 17 auditors and discovered that blockchain technology would provide auditors with the following benefits: (1) population-based auditing; (2) audit process streamlining; (3) control testing as opposed to transaction testing; (4) continuous audit processes; (5) more strategic audit roles; and (6) new consulting services development. The difficulties and problems associated with blockchain innovation have also been the subject of additional research, which has looked into blockchain governance, auditor adoption of blockchain technology, and blockchain oracle problems.

Smart contracts and the blockchain oracle problem are closely related. Third-party agents known as "oracles" are those who are not part of the blockchain network and who gather exogenous data (data from external events), temporarily store it, and then transform it into a format that smart contracts can understand before sending it to the appropriate smart contract to inform its execution (Sheldon, 2021). For smart contracts to function, external event results produced by oracles are frequently necessary (Diedrich, 2016). Oracles ' collection and transfer of exogenous data is the largest danger to preserving accurate data in the blockchain ecosystem (Delphi, 2017). In an effort to give auditors a general overview of how to handle Oracle concerns on engagements, including the assessment of internal control over financial reporting, Sheldon (2019, 2021) attempted to do so. The study's conclusions offer auditors important guidance on how to handle oracle problems. Oracles are service providers that clients utilize to watch actual events connected to the execution of smart contracts, and auditors ought to view them as such. Additionally, auditors must talk to their clients regarding Oracle serving as a service business and ensure the client utilizes Oracle with auditable internal controls. Additionally, auditors should advise clients to exercise caution and select less vulnerable data sources.

An equally important issue is related to auditor acceptance of blockchain technology. This aspect of acceptance is important to ensure that the blockchain system and infrastructure designed can meet the needs of the auditor's duties. Li & Juma'h (2022) suggest that not all blockchain features are equally important, but there are two important features: timestamping for shared databases and double-spending prevention. Furthermore, the acceptance aspect of blockchain technology is important to prevent technostress due to the use of blockchain technology. Studies conducted by Ferri et al. (2020) and Alshurafat et al. (2023) with the TAM and UTAUT models provide recommendations that the preparation of blockchain infrastructure really needs to consider aspects of perceived usefulness and perceived ease of use from the auditor's side as a user, as well as the auditor's effort expectations in relation to implementing this technology.

As for the governance aspects of blockchain in the context of auditing and accounting, there are several recommendations from Smith & Castonguay (2020). In order to handle the increased regulation surrounding the distribution of financial data, blockchain-using organizations should first modify their internal controls and counterparty risk assessment policies and procedures. Meanwhile, their audit committees should be ready to handle these issues prior to the preparation of financial statements. Second, external auditors need to evaluate the use of blockchain technology as a risk to financial reporting and weigh the benefits and drawbacks of using blockchain-based reporting systems, including the possibility for more timely and trustworthy audit evidence and better internal control testing.

Research area 2: Integrating blockchain technology into accounting and auditing practices

The integration of blockchain technology into accounting and auditing procedures is the main emphasis of this field of study. The earliest article in this research area was written by Schmitz & Leoni in 2019. Schmitz & Leoni (2019) responded to the revolutionary presence of blockchain in the financial industry by conducting a literature review on the urgency and impact of blockchain in

accounting practices. The widespread adoption of blockchain technology will transform the profession of accountants and auditors. Accountants and auditors must expand their expertise and knowledge related to blockchain to anticipate and meet the demands of their clients, especially clients who use blockchain technology. The focus of the audit profession will change from labor-intensive audit activities like manual data extraction and audit preparation tasks to strategic activities like in-depth analysis and data mining as a result of blockchain technology, which makes continuous auditing possible. Technical knowledge of smart contracts and encoded accounting rules and regulations is also crucial for the auditing profession, as it will be required to monitor and supervise their implementation.

Subsequently, studies in this research area evolved towards exploratory studies. Abdennadher et al. (2022) explored the impact of blockchain technology on the accounting and assurance profession in the United Arab Emirates by involving 19 accountants, internal auditors, external auditors, and risk managers. The results demonstrated how blockchain affects the accounting industry in terms of transaction recording, evidence storage, and offering a safe environment for commercial transactions. For auditors, blockchain is capable of changing audit processes and strategies. Blockchain can provide automated audit-proof and a low-cost, decentralized audit procedure to supplement traditional auditing. Parmoodeh et al. (2023) also took an institutional setting in the United Arab Emirates but focused on Big Four and Non-Big Four firms. From the results of interviews with practitioners, it was found that the application of blockchain can affect audit procedures to be more efficient, including external confirmation, can be improved with an automated verification process, reducing physical observations because blockchain technology can observe in real-time, facilitating analytical procedures by combining blockchain with other analytical tools simultaneously, and blockchain can provide an audit trail that cannot be tampered with and cannot be changed through distributed ledger architecture.

Furthermore, the articles in this research area offer innovations that have been developed related to blockchain in accounting and auditing. Building on Nakamoto (2008) blockchain concept, Appelbaum & Nehmer (2020) used design science research to develop a permissioned blockchain that is B2B or B2C, private or semi-private, and cloud-based. Dai et al. (2019) explored the potential of blockchain and smart contracts to re-engineer audit procedures to enable Audit 4.0. In his research, Dai et al (2019) designed and implemented a system to facilitate accountability audits related to air pollution control for Chinese government officials. Crowdsourcing was used to gather, validate, and evaluate data on air quality. Blockchain technology and smart contracts were used for ongoing auditing.

Furthermore, Rozario & Thomas (2019) and Rozario & Vasarhelyi (2018) engineered audits with blockchain and smart contracts. The smart contract-based concept can autonomously carry out audit procedures on behalf of auditors and disclose the results. This concept can potentially improve audit quality and fulfill information requests from various interested parties for more timely and transparent audit reporting.

Research area 3: Future issues of blockchain technology and auditing

The studies from this field of study concentrate on the primary concerns about how blockchain technology will affect accounting and auditing in the future. Desplebin et al. (2021) identified three key emerging challenges with blockchain's role in accounting and auditing: (1) the change of accounting methodologies; (2) significant advancements in accounting and auditing; and (3) significant advancements in the job, competencies, and training of auditors. Blockchain technology could lead to several changes, including a reduction in the work that accountants and corporate finance managers do on a long-term basis, a reduction in the amount of work that goes into preparing annual audits, and an easier way to trace back historical operations. Real-time access to financial data could also result in audits that are conducted in real-time. These evolutions have not necessarily eliminated the accounting and auditing profession. Auditors still play a role in auditing financial statements, mainly in terms of controls such as verifying the legality and relationship between the parties involved in the transaction and classifying transactions in the financial statements. In addition, the auditor's job has not disappeared, but there has been a shift from technical to analytical.

In addition to the transformation of accounting techniques and profession, the role of internal and external auditors in transaction execution and tax implications is also an important future issue

related to blockchain technology. Gomaa et al. (2019) developed a case of a transaction execution scenario involving blockchain and its tax implications. The case presents the following: (1) a summary of the procedures needed to create a digital wallet; (2) an explanation of why adding cryptocurrency to the wallet is necessary to transact on the blockchain; (3) an outline of transaction execution, wherein accounting consulting services are rendered in exchange for cryptocurrency; (4) techniques for examining current transactions, highlighting the role of internal and external auditors; (5) a clarification of the significance of handling cryptocurrencies, given that the IRS recognizes them as property; and (6) reflections on the relationship between a company's ERP system and transaction information on the blockchain.

Cryptocurrency transactions are also a future issue in auditing in the era of blockchain adoption. Today, more and more entities are engaging in cryptocurrency investments and accepting them as payment options. However, cryptocurrencies have properties that are different from those of typical financial instruments, which pose new risks and issues. External auditors need to provide reasonable assurance on financial statements that include material cryptocurrency activity (AICPA, 2022; CPAB, 2018, 2019). Therefore, auditors are faced with the challenge of obtaining reasonable and sufficient audit evidence for audits of financial statements involving crypto-assets. Hsieh & Brennan (2022) summarized the issues to consider when auditing crypto asset transactions at each stage of the audit, from audit planning and audit evidence collection to completion. In the audit planning stage, there are several issues and risks to consider, including evaluating the competence and blockchain knowledge of the auditors involved in the audit team, understanding the objectives and operating strategies of the entities involved in crypto asset transactions, understanding the variety of smart contracts, DeFi, oracles, and blockchain protocols at the client, evaluating the client's knowledge and skills related to blockchain and crypto assets, identifying blockchain and crypto asset risks in the entity's financial reporting, such as information security risks and private key management risks. At the evidence-gathering stage of the audit, auditors need to identify several issues and risks, among others: Identifying significant accounts and disclosures related to crypto asset transactions and their relevant assertions (existence or occurrence, completeness, valuation or allocation, rights and obligations, and presentation and disclosure), Test design and operating effectiveness of controls over private keys (the generation, usage, authorization, storage, etc.) and wallets. Examine the architecture and functionality of the controls on wallets and private keys (their creation, use, authorization, storage, etc.). Examine the layout and functionality of the controls over the exchange of digital assets with centralised service providers (exchanges, custodians, etc.), and comprehend the accounting policy for the recognition of revenue for transactions involving crypto assets, and carry out the necessary tests. In terms of the completion stage, auditors must be aware of the following risks and issues: estimating the impact of future events on crypto assets, carrying out the necessary audit procedures, and deciding whether to disclose those events, if necessary. Compile and assess any misstatements about cryptocurrency asset transactions that were found during the audit. If there is a substantial impact on the audit of the financial statements, identify the issues of cryptocurrency asset transactions as a Critical Audit Matter in the auditor's report.

Discussion and future research agenda

The key conclusions and consequences of the theory and practices from the three research topics are covered in this part. The next subsections include the organized response to this question, which advances towards implications.

Implication 1. How is the auditing literature developing according to the prominent adoption of blockchain technologies?

Blockchain is a hot conversation topic, especially in the domain of information systems. Many believe blockchain's emergence is closely related to the seminal paper written by Satoshi Nakamoto (2008), who gave the idea of Bitcoin. Bitcoin is an electronic currency that enables online payments through a peer-to-peer network. The network timestamps transactions by hashing them into a hash-based chain, forming an immutable record that forms a chain known as the blockchain. A blockchain is a digital ledger, a collection of records with verifiable integrity (Kokina & Davenport, 2017). The system records transactions using a globally dispersed network of computers, making transactions unchangeable once authorized. Through a process known as mining, it uses the processing capacity

of participating computers to validate transactions using protocols. Node users or miners take part in the creation and validation of blocks in exchange for rewards.

Blockchain technology continues to evolve and has increasingly attracted the attention of the accounting and auditing profession in recent years, especially as cryptocurrencies have gradually been adopted in business. Non-authoritative audit guidance about cryptocurrency transactions has been made available to auditors by auditing standard setters and professional organizations, including the Public Company Accounting Oversight Board (PCAOB), the American Institute of Certified Public Accountants (AICPA), Chartered Professional Accountants Canada (CPA Canada), and the Canadian Public Accountability Board (CPAB). This guidance focuses on specific phases of the overall financial statement audit (Hsieh & Brennan, 2022).

The benefits of blockchain, such as the capacity to create a thorough audit trail and examine exceptions produced by the full population of transactions rather than simply a sample, are what have attracted the attention of the audit profession (Kokina & Davenport, 2017). Kokina & Davenport (2017) explained that blockchain provides an opportunity to conduct audits on an ongoing basis with a high level of confidence due to the immutable nature of transaction records in the blockchain system. Furthermore, Baron (2017) added several benefits of blockchain in auditing, including The creation of smart contracts, transaction authentication, asset ownership monitoring, traceable audit trails, automated audit procedures, and registration and inventory systems for all assets from raw materials to intellectual property are all examples of smart contract technology. The Big Four accounting firms, such as Deloitte, PwC, EY, and KPMG, began research and development to get ready to deal with blockchain after realizing its advantages. The AICPA and the Big Four accounting firms convened in August 2016 to discuss the possibility of establishing a distributed ledger consortium to test blockchain-based accounting solutions (Del Castillo, 2016; Kokina & Davenport, 2017).

From a theoretical perspective, the rise of blockchain in the auditing literature indicates the evolution of audit theory from a traditional ex post verification model to a real-time assurance framework. Blockchain challenges the classic principal–agent problem by providing transparent, tamper-proof records that lessen information asymmetry between auditors and clients. This change helps refine auditing theory, where blockchain is seen as a trust-building mechanism that replaces traditional intermediaries. The theoretical discussion increasingly views auditors not just as verifiers, but as validators of algorithmic and digital ecosystems.

Practically, this development means that auditors need to improve their technological skills to work effectively with distributed ledger systems. Audit firms should invest in blockchain-based assurance tools that support ongoing auditing and data integrity checks. Additionally, professional organizations should provide formal guidance on blockchain transaction auditing standards, ensuring that the permanence of records complies with ethical and regulatory standards.

Implication 2. What is the literature's focus on the impact of blockchain technology on auditors?

The intersection of two distinct fields, blockchain technology and auditing, does not necessarily lead to focused results in the main content analyzed so far. When discussing and trying to combine these two disciplines, it is essential to involve experts from both areas: technology or information systems specialists and accounting experts, especially those involved in auditing. The Journal of Emerging Technologies in Accounting is the most widely referenced source for publications in this field. All articles published in this journal examine the implementation and practices related to the latest accounting technologies. The journal contains seven articles that explore the relationship between blockchain technology and auditors' roles and responsibilities, totaling 194 citations. Most articles on the impact of blockchain technology on auditors highlight that the evolution of blockchain does not eliminate the auditor profession but rather shifts the nature of auditors' work from technical to analytical.

Theoretically, this research extends the socio-technical systems theory by recognizing auditors as adaptable actors within a technology-mediated audit environment. Blockchain redefines auditor expertise not by replacing the profession, but by highlighting cognitive flexibility and interpretive judgment in reviewing algorithmically verified data. The literature emphasizes that the auditor's role shifts into a data assurance specialist, responsible for validating blockchain protocols and

interpreting complex digital transactions. This enhances the theoretical understanding of auditor competence and repositions auditing as a knowledge-intensive analytical profession.

From a practical perspective, adopting blockchain technology requires redefining the auditor's skillset. Audit firms need to create training and certification programs that focus on smart contract auditing, cryptographic assurance, and blockchain analytics. Professional associations should promote collaboration between auditors and IT specialists to develop cross-disciplinary audit methodologies. Additionally, auditors must learn to operate within hybrid environments where traditional audit evidence coexists with blockchain-verified data, ensuring that professional skepticism remains essential to audit judgment even in highly automated settings.

Implication 3. What are the implications of our research on the impact of blockchain technology on auditors and future research agendas?

The implementation of thematic clustering, content analysis, and impact citations in the analysis has yielded intriguing findings on future research directions within this innovative framework concerning the influence of blockchain technology on the duties and responsibilities of auditors. We suggest that future research agendas emphasize three primary research areas and issues in the concluding section of this report.

This study offers several theoretical contributions to the intersection of auditing and emerging technologies. First, it expands audit innovation theory and socio-technical systems theory by positioning blockchain as a disruptive technological foundation that changes how auditors understand trust, evidence, and assurance. Traditional auditing frameworks rely on centralized data systems and post-hoc verification, while blockchain introduces a distributed trust model, shifting the auditor's role from information verifier to validator of algorithmic integrity. This reframing enhances auditing theory by recognizing that "trust" can be technologically embedded rather than solely institutionally built.

Second, the research advances the institutional theory of auditing by showing how external pressures, such as technological change, professional norms, and regulatory adjustments, prompt the reorganization of audit practices and skills. The adoption of blockchain questions traditional institutional logics in auditing (e.g., dependence on sampling and manual checks), encouraging theoretical investigation into how professional legitimacy changes in technology-driven settings. Lastly, this study creates a theoretical path for developing a blockchain-based audit assurance framework, where audit quality depends not only on auditor expertise but also on technological governance and protocol trustworthiness. This encourages future researchers to explore how distributed ledger features (immutability, consensus, transparency) relate to auditing principles like independence, objectivity, and professional judgment.

From a practical perspective, this study offers several actionable insights for auditors, regulators, and educators. First, it emphasizes the need for capacity building and curriculum updates within the auditing field. Auditors must gain new skills in blockchain analytics, smart contract verification, and cybersecurity risk assessment. Professional organizations such as the AICPA, IFAC, and PCAOB should include blockchain assurance modules in their certification and ongoing education programs to ensure that future auditors have both accounting expertise and technological fluency. Second, for audit firms and practitioners, the findings stress the importance of developing hybrid audit models that combine blockchain data verification with traditional audit methods. Using blockchain-assisted audit tools can improve efficiency, data integrity, and real-time verification, reducing audit lag and the risk of fraud. Firms that actively invest in blockchain-enabled audit systems will establish a competitive edge by providing continuous assurance services instead of just periodic audits.

Third, regulators and standard-setters should establish clear auditing standards and guidance tailored to blockchain environments. This includes creating procedures for verifying blockchain transaction authenticity, assessing smart contract controls, and addressing potential audit risks linked to decentralized systems. Additionally, academic and industry collaboration should be enhanced to develop testing sandboxes for blockchain auditing, facilitating pilot studies that evaluate practical challenges and ethical issues in blockchain assurance. These efforts will help close the gap between theoretical discussion and real-world implementation, ensuring that

blockchain adoption improves rather than diminishes the credibility and reliability of the auditing profession.

Research area 1: Blockchain technology and its impacts on the audit profession

Building on this research, future studies should focus on exploring blockchain's role in improving the transparency and efficiency of the audit process. Developing smart contracts that can automatically record and verify financial transactions is a promising research opportunity. This could help auditors to minimize the risk of verification errors. In addition, research should also examine how the integration of blockchain technology affects audit regulations and standards.

The relationship between blockchain and future auditors' skills and competencies is also an interesting idea to research. This includes understanding blockchain technology, cybersecurity, and data analytics of blockchain-based systems. Future research needs to identify how education and training in auditing should evolve to meet the demands of these developments, including reorganizing how auditing curricula in higher education deal with the development of auditing in the blockchain era.

Research area 2: Integrating blockchain technology into accounting and auditing practices

The focus of future research on integrating blockchain technology into accounting and auditing practices could be the development of an effective blockchain implementation framework. An important innovation is the exploration of how blockchain can create immutable financial records that impact the reliability and accuracy of financial statements. In addition, innovation can also be done by developing a model for using smart contracts in various accounting processes, such as payroll, inventory management, and tax reporting. The implementation of smart contracts will automate and secure transactions more efficiently.

Research area 3: Future issues of blockchain technology and auditing

In the future, implementing blockchain technology will raise various interesting issues that need further research. One of them is the integration of blockchain with other disruptive technologies, such as AI and IoT, to improve system efficiency and security. Research can explore how blockchain can verify and manage data from IoT in a secure and transparent manner. In addition, research could focus on developing audit frameworks for blockchain environments, including developing algorithms for transaction verification and proving ownership of digital assets, such as cryptocurrencies.

4. Conclusion

This study uses a systematic literature review that combines bibliometric citation analysis approaches and qualitative content analysis to assess six years of research on the impact of blockchain technology on auditors' work and roles. Bibliographic information was gathered from the Scopus database, containing 50 final published articles. Journal of Emerging Technologies in Accounting, International Journal of Accounting Information Systems, and Journal of Information Systems are the most influential sources in blockchain technology and auditor research, according to an assessment of 50 publications. The USA dominates research in this area, followed by Italy and Jordan.

Furthermore, we elaborated on the evolution of blockchain technology and auditor research from 2018 to 2024 using data visualization and content analysis of bibliographic data. We also highlighted three major research streams in this field: blockchain technology and its impacts on the audit profession, integrating blockchain technology into accounting and auditing practices, and future issues of blockchain technology and auditing.

This study is certainly not without limitations. First, it collected articles for analysis from the Scopus database, excluding other databases, so some information is not captured in this study. Second, it uses a time range starting from 2018, meaning that research on blockchain technology from earlier years may not be included in this SLR. Third, it analysed 50 articles, which is relatively few and cannot provide broad generalisations about blockchain technology and auditors. Fourth, variations in institutional and national contexts were not explored in depth; although the study shows contributions from 35 countries, differences in regulations, technological readiness, and the

audit environment were not extensively analysed. Finally, we did not examine the theoretical aspects used by researchers in each paper.

Based on these limitations, we suggest that future studies incorporate other databases, such as Web of Science, Google Scholar, Crossref, and others, to gather additional data and broaden the analysis. We also recommend that future research explore articles published before 2018 (i.e., 2010-2018) and after 2024. Additionally, future studies should expand the scope of the analysed articles. Furthermore, future research should examine in greater depth the differences in regulations, technological readiness, and the audit environment across countries. Lastly, future investigations should analyse the theories employed by researchers. These limitations serve as a reminder for readers to be cautious when generalising our findings.

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