Systematic Review

Blockchain for Accounting and Auditing—Accounting and Auditing for Cryptocurrencies: A Systematic Literature Review and Future Research Directions

Ifigenia Georgiou [1], Svetlana Sapuric [1,*], Petros Lois [1] and Alkis Thrassou [2]

1   Department of Accounting, Economics and Finance, School of Business, University of Nicosia, 46 Makedonitissas Avenue, Nicosia CY-2417, Cyprus; georgiou.i@unic.ac.cy (I.G.); lois.p@unic.ac.cy (P.L.)
2   Department of Management, School of Business, University of Nicosia, 46 Makedonitissas Avenue, Nicosia CY-2417, Cyprus; thrassou.a@unic.ac.cy
*   Correspondence: sapuric.s@unic.ac.cy

Abstract: The aim of this study is to analyze and synthesize the key challenges that are prevalent in the application of blockchain in accounting and auditing, to study the approaches to account for cryptocurrencies, to study the effect of blockchain on the accounting and auditing profession, and to identify the current direction of research of blockchain in accounting and auditing, as well as identify potential avenues of future research. The research is based on 75 peer-reviewed academic studies on the topic of blockchain in accounting and auditing, followed by a descriptive and thematic analysis of the literature. Our results indicate that there is a need for more empirical studies to be carried out, which coincides with the notion of growing digitization and blockchain adoption in accounting and auditing. Based on our thematic analysis of the literature, we recommend that future research on blockchain in accounting and auditing should concentrate on the following specific areas: skills and education, governance, auditor independence, accounting standards and regulation, and the challenges faced by the accounting and auditing professions due to the adoption of blockchain technology.

Keywords: blockchain; accounting; auditing; cryptocurrency; digitalization; systematic literature

1. Introduction

On hearing the word "ledger" before Satoshi Nakamoto first used the word to describe blockchain in 2008[1], one would think of accounting. Indeed, the word that first appeared in Middle English to refer to the "breviary" is defined in the oldest surviving English language description of double entry bookkeeping, John Mellis' ([1588] 1980) "*A Brief Instruction, and manner, how to keep books of Accounts*" from 1588[2] as "a structured book of payments to prevent great error and confusion", a definition consistent with the standard definition of ledger to this day (Berg et al. 2018). Presumably, this is why conventional wisdom had it that accounting—and subsequently auditing[3]—would be one of the first applications of blockchain. This is reflected in a number of early non-academic articles; for example, Ovenden (2017) states: "Few really know how they will use [Blockchain], despite the fact that it has been hailed as the next big thing across many industries. In accounting, where there is a much clearer road to universal adoption, this is less of the case" (Ovenden 2017).

However, the steps toward blockchain's application to accounting have been slow and timid, definitely not as enthusiastic as one would expect. The first Big Four firm to take a step was Deloitte, which launched Rubix, their software blockchain platform, in 2014 (Perez 2015). It was not until the end of 2016 that EY, the first from the Big Four to do so, announced that it would start accepting Bitcoin as payment for its consulting services (Young 2016). Although some media headlines sound impressive, such as "PwC Has Just Been Named Top Recruiter [in Blockchain], Followed by Big 4 Auditing Firms" (Krystle 2019)[4] and

"...KPMG Partners with Microsoft, R3 on Telecoms Blockchain" (Kuhn 2019), it has been observed that the interest of the Big Four in blockchain is consistent, albeit limited, and it is a direct function of their clientele's base interest in blockchain (O'Neal 2019). Granted, the Big Four are not pioneers in blockchain technology adoption in accounting and auditing. They focus on the business of auditing clients' blockchain processes (Wolfson 2020). This is very different from applying blockchain technology to accounting and auditing.

Two reasons that have been cited as preventing the mass adoption of blockchain in accounting are, first, the laziness of the industry to adopt new technologies and second, the incompatibility of the existing accounting software packages with blockchain technologies (Yadav 2018). To this, we can add concerns about privacy and the difficulty of incorporating non-cryptocurrency values on the blockchain, issues that have recently started to be addressed by new technologies such as homomorphic encryption and sidechains, respectively. Furthermore, beyond technical challenges, Rückeshäuser (2017) raised concerns about the impact of blockchain on organizational restructuring, wondering whether we really want blockchain-based accounting, reminding us that this is not simply an issue of how advanced the technology is, but rather a multifaced, interdisciplinary organizational issue.

The questions on the topic of blockchain and accounting are many, while the academic literature addressing the topic is quite limited. Our systematic literature review focuses on 75 peer-reviewed academic studies, all published in scholarly journals that are included in the prestigious Academic Journal Guide (AJG) of the Chartered Association of Business Schools (CABS) or the Association of Information Systems (AIS) journal lists to ensure the quality of the sources. We include studies that were published up to June 2024 on the topic of blockchain and accounting and auditing. We perform thematic analysis of the studies utilizing a framework developed by Risius and Spohrer (2017) to make sense of the literature; specifically, this study aims to (1) construct a map of the academic research in the fields of business as well as behavioral, business-oriented information systems research by identifying the main issues on the topic, (2) identify the main challenges that inhibit the application of blockchain in accounting and auditing according to the academic literature, (3) look into the discussions pertaining to how we should account for cryptocurrencies, (4) look into the discussions on the blockchain and the accounting and auditing profession, and (5) identify the direction of research, along with directions for future research.

We first provide a descriptive analysis of the studies, followed by a thematic analysis. Our study finds that there is a growing call for more empirical studies to be undertaken to assess and measure the effects of blockchain adoption in accounting and auditing. Based on our thematic analysis, we find that the majority of the current studies focus on 'management and organization' and the level of analysis pertaining to 'Firms and industries'. Nonetheless, the need for future avenues of research is widespread, with a need for more empirical studies pertaining to specific areas relating to blockchain in accounting and auditing. Further, we identify challenges and discuss them within the framework, including functionality, data and process integrity, regulatory concerns (Appelbaum et al. 2022), difficulties in auditing blockchain-based assets, leading to resistance within the auditing sector (Pimentel et al. 2021), auditing standards that are currently inadequate for blockchain technology (Gauthier and Brender 2021), and professional skepticism along with perceived inadequacy of accounting standards that further hinder acceptance (Li and Juma'h 2022), organizational challenges such as complex integration and increased costs (Akter et al. 2024), the need for new audit procedures (Parmoodeh et al. 2023), issues of user trust and perceived risk (Fülöp et al. 2022), audit challenges pertaining to private and semi-private blockchains that compromise data reliability, security, and transaction transparency (Appelbaum and Nehmer 2020), implementation flaws that affect feasibility (Coyne and McMickle 2017), as well as addressing connectivity, data confidentiality, and security issues (Vincent et al. 2020).

This paper proceeds as follows. In Section Two, we define the conceptual boundaries of the review, and we describe our methodology in Section Three. In Section Four, we present our descriptive and thematic analysis of the literature. In Section Five, we discuss

the avenues for future research that emerge from the studies in our sample, and in Section Six, we conclude.

2. Conceptual Boundaries of the Review

With this review, we provide a survey of the state of research published in high-quality business journals on the topic of blockchain implementation in accounting and auditing. Thus, we are interested in the set of studies that focus on (a) issues pertaining to the application of blockchain technologies to the accounting and auditing process, (b) blockchain and the accounting and auditing profession, and (c) the treatment of cryptocurrencies by accounting. Further, as reflected in our quality criteria, this review focuses on the business literature since the Chartered Association of Business Schools (CABS) list (AJG, formerly ABS list) and the "Senior Scholar's Basket of Journals" published by the Association of Information Systems[5] list are used to define the quality criteria. Our study applies strict quality criteria for the journals from where we draw our study samples.

3. Methodology

We employ a systematic literature review methodology, as it provides a systematic process to search, evaluate, and analyze existing literature, to report on findings and evidence, and allows conclusions to be reached about what is known and not known in the area being researched (Denyer and Tranfield 2009). The systematic literature review follows pre-defined steps for collecting, analyzing the data, and writing the review.

3.1. Search Protocol

3.1.1. Question Formulation

The first step is to formulate the research questions. Those have been described in section one.

3.1.2. Inclusion Criteria

Following Vrontis and Christofi (2021), Dada (2018), and Wang and Chugh (2014), we apply three inclusion criteria to decide which studies to include in this review. The first criterion called for the determination of the search boundaries, the second criterion for the specification of the search strings, and the third criterion for defining the search timeframe. The research boundaries for this study were set as the following electronic database sources: (a) EBSCO Business Source Ultimate, (b) Emerald, (c) Science Direct, and (d) Google Scholar. The first three were chosen as they are well established in the literature and widely used by state-of-the-art systematic literature reviews (see Vrontis and Christofi 2021 for a list), while Google Scholar was used as an extra measure. Second, in line with Vrontis and Christofi (2021) and Kauppi et al. (2018), our list of terms is constructed in a way as to be on the inclusive rather than the exclusive side—i.e., we use generic terms rather than very specific ones. Although this tactic has the disadvantage that it can produce a high volume of search results that are irrelevant to the topic, it also has the advantage that it reduces the risk of excluding a search term that could possibly result in relevant studies. Third, taking into consideration that this is a new topic, and in order to capture all relevant literature, we start our search from 2009—Nakamoto's white paper introducing blockchain and Bitcoin was released toward the end of 2008—until June 2024, the stop point for our study.

3.1.3. Search Strategy

Title, subject terms, and abstract fields were searched for with EBSCO Business Source Ultimate, Emerald, and Science Direct. For Google Scholar, the only refinement option was "Title Only", which was deemed too limiting; thus, we left it open to also search the full text. Based on the research questions, appropriate keywords were identified, and search strings were formulated. After preliminary, exploratory pilot searches across numerous academic databases, the main keywords chosen were "blockchain", "Accounting", and "Cryptocurrencies"; we decided not to use "Auditing", since when we tried to do it, the

search results were flooded with papers on "Blockchain Auditing" which is an entirely different thing. To try and ensure the inclusion of relevant academic articles, we also used variations of the term "blockchain", which is sometimes also referred to as "Decentralized Ledger" OR "Distributed Ledger" OR DLT OR Blockchain OR "Block chain". The word "Bitcoin" was also used as an alternative to "Cryptocurrencies". The actual search string used is shown in Table 1, where we also provide the number of studies obtained from each source.

Table 1. Search Protocol and number of papers retrieved from each source. Search String used: (Accounting OR Accountancy OR "Financial Reporting" OR "Financial Disclosure") AND ((Blockchain OR "Decentralized Ledger" OR "Distributed Ledger" OR DLT OR "digital ledger") OR (Cryptocurrencies OR cryptocurrency OR "crypto currency" OR "crypto currencies" OR "crypto-currency" OR "crypto-currencies" OR "crypto asset" OR cryptoasset OR cryptoassets OR "crypto-asset" OR "crypto-assets")). Date range: 2009–2024 (June).

Database	Scope	Initial Search (before Applying Criteria)
EBSCO Business Source Ultimate	Title, subject terms, and abstract	458
Emerald	Title, subject terms, and abstract	519
Science Direct	Title, subject terms, and abstract	360
Total		1337

3.1.4. Exclusion Criteria

First, only publications in peer-reviewed academic journals that had full texts were included in this review; all other texts, such as book chapters, book series, conference papers, editorials, conference reviews, trade publications, and articles published in newspapers and/or magazines, were excluded. Further, we limited our review to studies in peer-reviewed journals listed in the latest (2021) Academic Journal Guide (AJG) published by the Chartered Association of Business Schools (ABS)[6] to ensure the quality of the resources. The "Senior Scholar's Basket of Journals" published by the Association of Information Systems list (American Information Systems (AIS) n.d.) was considered, albeit with no additional results, because the journals that indeed had papers that met our criteria were already included in the 2021 AJG. Moreover, the non-English language papers were excluded. The application of inclusion and exclusion criteria produced a list of 1337 references (Table 1).

3.1.5. Selecting Relevant Studies

We performed an initial screening of these 1337 studies. At this stage we carefully considered the titles and abstracts of the articles; in some cases, it was necessary to also review the introduction section of a paper. With this step, we wanted to ensure that the studies that remained were focused on the topic of blockchain and accounting. At this stage, we removed studies that merely included blockchain and accounting only as an example in passing reference among other examples, and the sample size was reduced to 111. In addition, 5 duplicates were removed, and as a result, 106 papers remained. We later applied the quality criteria; that is, we excluded studies that were not either in the AJG or the AIS list. This led to the exclusion of a further 38 studies, leaving us with 68 studies.

We reviewed the full text of these 68 studies. The number of studies was reduced to 64 when 4 studies were further removed after full-text review because it was judged that they did not contribute to the topic of blockchain and accounting in particular.

3.1.6. Further Search Processes

We added 7 studies based on the experience of the authors, and further, we manually searched the reference lists of the resulting 71 studies. This process produced 4 additional studies that satisfied our criteria and were included in our final sample of 75 studies. Figure 1 shows the number of papers excluded and included at each stage.
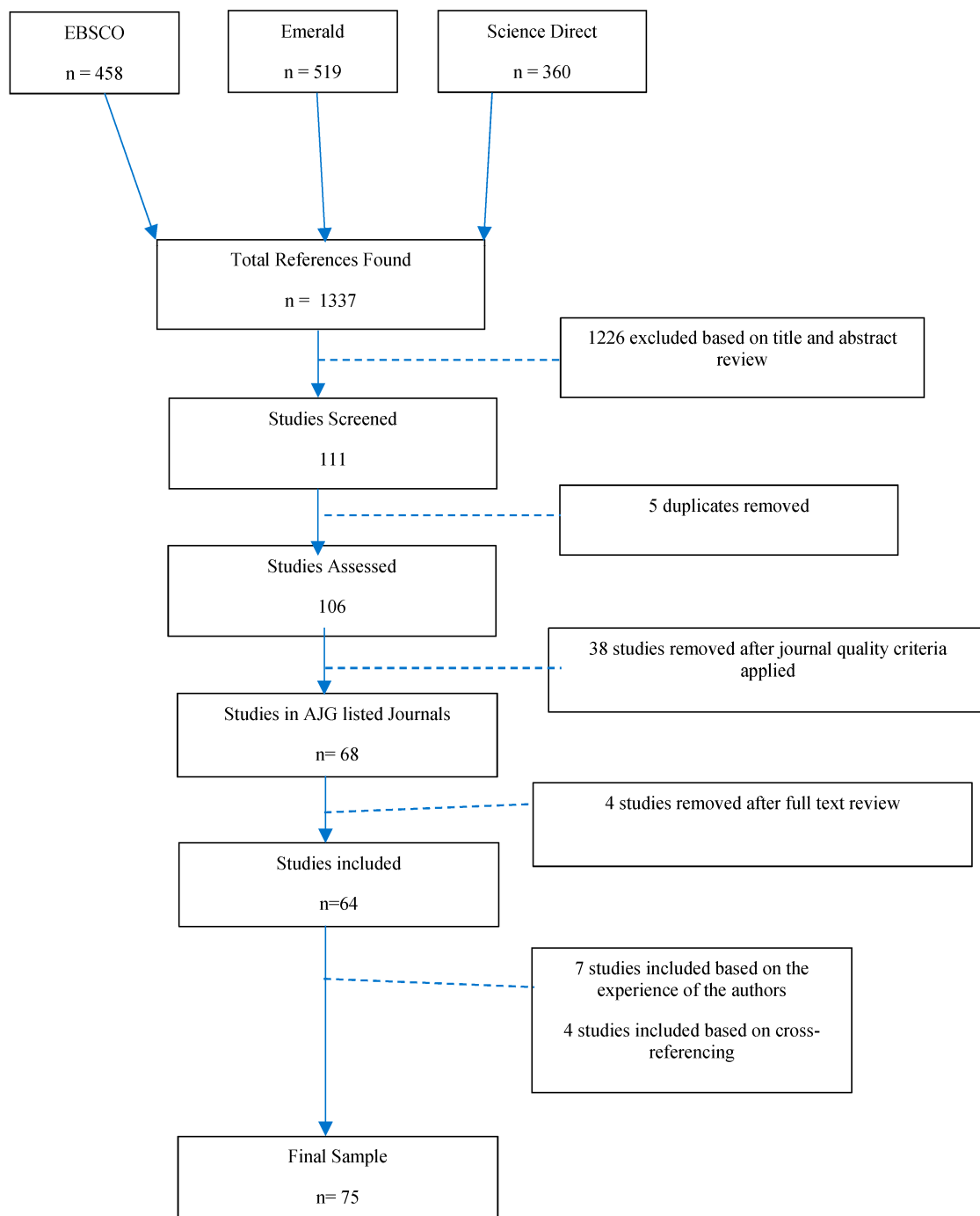
Figure 1. Application of the Review Process.

4. Results and Discussion

As discussed in the previous section, our analysis entails a total of 75 studies in the field of accounting, auditing and blockchain. We categorize the studies in our sample according to various criteria used by Vrontis and Christofi (2021). Our results aim to establish a framework of the current literature in the field of accounting, auditing and blockchain. Consequently, based on these analyses, possible directions for future research will be identified.

4.1. Descriptive Analysis of the Literature

The majority of the studies in our sample (91%) are published in journals with an AJG ranking of either 1 or 2, as shown in Table 2. In addition, the largest number of studies (16 studies) were published in the Journal of Emerging Technologies in Accounting.

Table 2. Journals included in the sample.

Publication Outlet	AJG Ranking	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total	%
Information Systems	4				1						1	1%
Accounting, Auditing and Accountability Journal	3						2				2	3%
Critical Perspectives on Accounting	3								1		1	1%
Journal of Accounting and Public Policy	3						1				1	1%
Journal of Accounting, Auditing, and Finance	3								1		1	1%
Journal of International Accounting, Auditing and Taxation	3				1						1	1%
The British Accounting Review	3								1		1	1%
Accounting and Finance	2				1						1	1%
Accounting Research Journal	2								1		1	1%
Australian Accounting Review	2		1		3	1	1				6	8%
Current Issues in Auditing	2			2	1						3	4%
Current Issues in Auditing	2					1					1	1%
International Journal of Accounting Information Systems	2			1	1				2	1	5	7%
International Journal of Accounting Information Systems	2					2					2	3%
International Journal of Auditing	2						1		1		2	3%
International Journal of Disclosure and Governance	2				1						1	1%
Issues in Accounting Education	2					1	1				2	3%
Journal of Accounting and Organizational Change	2					1					1	1%
Journal of Accounting Education	2								1		1	1%
Journal of Business Economics and Management	2							1			1	1%
Journal of Intellectual Capital	2				1						1	1%
Journal of Organizational Change Management	2						1				1	1%
Managerial Auditing Journal	2						1				1	1%
Research in International Business and Finance	2								1		1	1%
Australasian Accounting, Business, and Finance Journal	1			1							1	1%
Cogent Economics and Finance	1								1		1	1%
Higher Education, Skills, and Work-Based Learning	1								1		1	1%
Intelligent Systems in Accounting, Finance, and Management	1		1	1	1						3	4%
Journal of Emerging Technologies in Accounting	1		2		4	3		3	4		16	21%
Journal of Emerging Technologies in Accounting	1					1					1	1%
Journal of Financial Reporting and Accounting	1						1	2			3	4%
Journal of Forensic and Investigative Accounting	1					1			1		2	3%
Journal of Information Systems	1		1			1	1	1	1		5	7%
Meditari Accountancy Research	1	1			1						2	3%
Meditari Accountancy Research	1					1					1	1%

Figure 2 shows the studies in our sample categorized by field of research of journal publication as outlined by the Association of Business Schools (ABS) AJG of 2021[7]. The field of research according to publication categories is (i) Accounting, (ii) Information Management, (iii) Finance, (iv) Management and Development Education, (v) Ethics, Corporate Social Responsibility Management, (vi) Organizational Studies, (vii) Economics, and (viii) International Business and Area. From our total sample of 75 studies, more than half, specifically 39 (52%), are categorized in the Accounting field and 19 (25%) in the field of Information Management. In addition, there are seven (9%) studies in the field of Finance and six (8%) in the publication field of Management Development and Education. Finally, the fields of Ethics, Corporate Social Responsibility Management, Organizational Studies, Economics, and International Business and Area consist of one study each from our total sample.
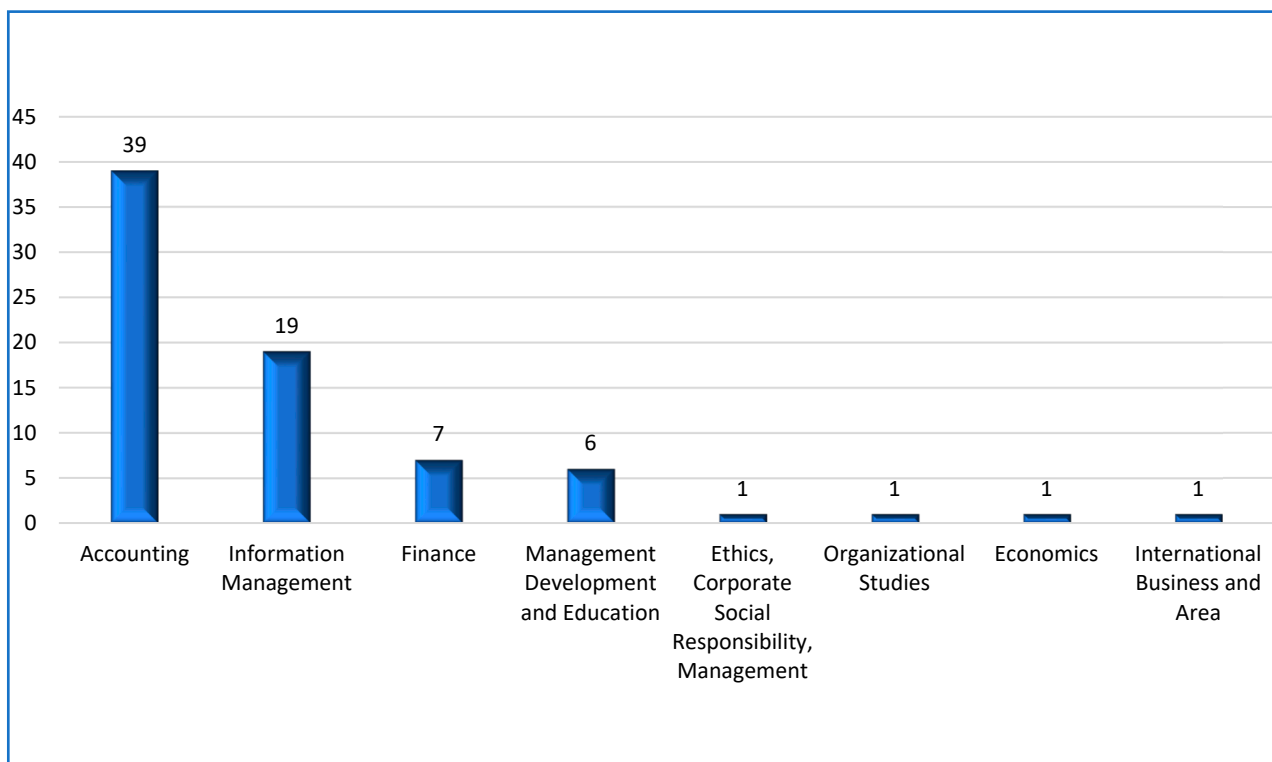

Figure 2. Number of Studies per Field of Research.

Indeed, the unification of blockchain and accounting, along with blockchain application within the accounting industry, has been slow in comparison to the field of mainstream finance. The first publication encompassing the two fields was carried out in 2016 by Ram et al., which examines the accounting standards for the digital currency bitcoin. As depicted in Figure 3, the number of articles published has been increasing since 2016, with five articles published in 2017 and 2018, respectively. Nonetheless, 2019 exhibited a large increase in the articles published, with the majority of our sample (30%, *n* = 16) of articles being published in 2019. In fact, we see a slight decrease in published articles for the years 2020 and 2021, with twelve and thirteen articles published in each year, respectively. This trend also continues in 2022 and 2023, with a fall in publications of eight and ten articles published each year, respectively. We expect this trend to continue until the end of 2024, as currently, there have been five publications for the first six months of 2024, which is the end of our sample period.
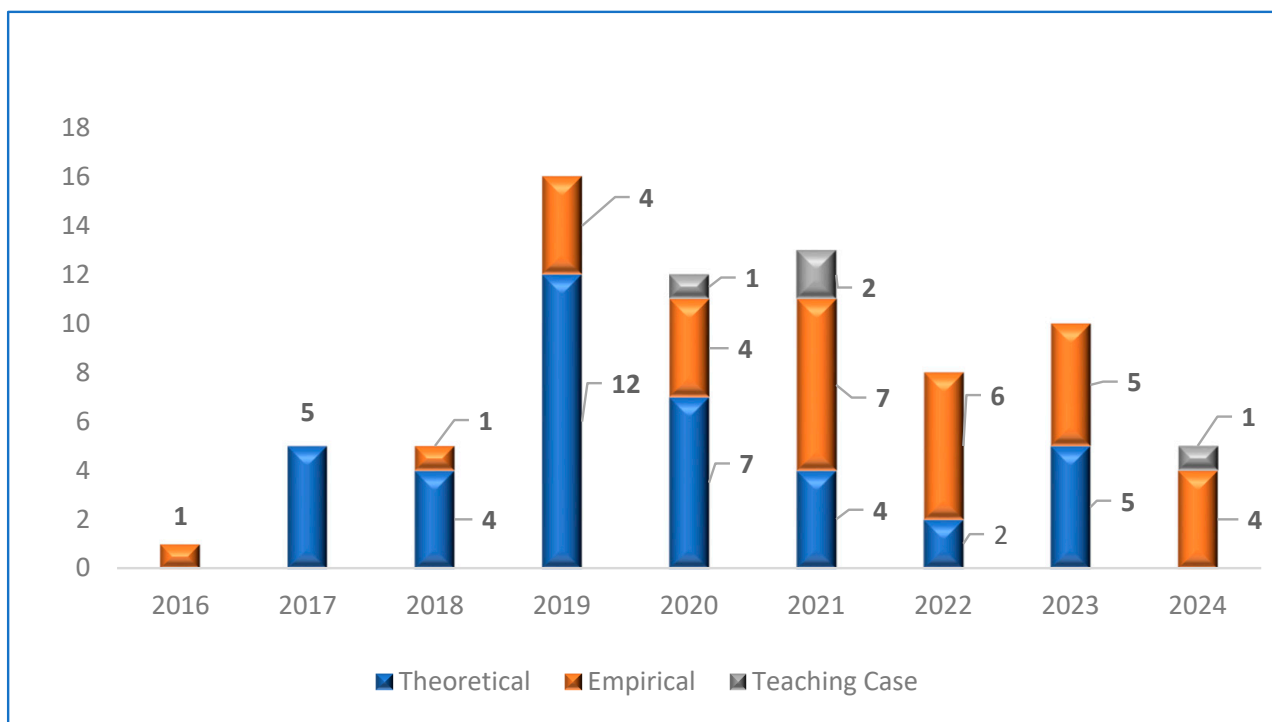
Figure 3. Total Articles According to Type and Year.

The majority of the studies in our sample are theoretical (52%, *n* = 39), as shown in Figure 3. All the theoretical studies used a qualitative methodology, primarily based on discussions. The remaining articles are either characterized as empirical (42%, *n* = 32) or as a teaching case study (5%, *n* = 4). The methodologies adopted in the empirical studies are divided between qualitative and quantitative, with two studies following a mixed-methods approach. The studies based on qualitative designs have adopted methodologies of case studies, cyber ethnography, and discussions. Moreover, the four empirical studies that have adopted a quantitative design have applied surveys and computational design performance tools. It is interesting to note that the number of empirical studies has been increasing, with 2021 and 2022 having a majority of its studies empirical in nature. This may be due to the fact that the incorporation or at least the discussion of blockchain application in the accounting profession has been growing, thus allowing more empirical studies—which also include surveys—to be undertaken.

In order to show the impact of the studies in our sample on their journal publication, we report the number of citations per study of our sample as of 20 June 2024. This can be seen in Table 3. Until the end of our sample study, the paper by Dai and Vasarhelyi (2017) received the most citations, with a total of 951. The study is theoretical in nature and explores the potential applications and utilization of this blockchain in the accounting and auditing profession. The ten articles that are ranked in the top quartile according to the highest citations are Dai and Vasarhelyi (2017), O'Leary (2017), Kokina et al. (2017), Coyne and McMickle (2017), Wang and Kogan (2018), Liu et al. (2019), Qasim and Kharbat (2020), Cai (2021), and Tiberius and Hirth (2019).

We further investigate the authorship demographics of each study in our sample, as shown in Figure 4. Only twelve studies in our sample (16%) are carried out by one author, with the majority (84%) of the studies being co-authored by two or more. One possible reason for this is the interdisciplinarity of the topic.

Table 3. Number of Citations per Study in Sample.

Publication	No. of Citations	Publication	No. of Citations
Dai and Vasarhelyi (2017)	951	Gietzmann and Grossetti (2021)	41
O'Leary (2017)	380	Gomaa et al. (2019)	40
Kokina et al. (2017)	365	Tang and Tang (2019)	40
Coyne and McMickle (2017)	327	Dyball and Seethamraju (2021)	37
Wang and Kogan (2018)	310	Weigand et al. (2020)	37
Liu et al. (2019)	302	Alsalmi et al. (2023)	36
Qasim and Kharbat (2020)	196	Dyball and Seethamraju (2021)	32
Cai (2021)	194	McGuigan and Ghio (2019)	28
Tiberius and Hirth (2019)	192	Qasim et al. (2022)	26
Tan and Low (2019)	191	Beigman et al. (2023)	23
Karajovic et al. (2019)	165	Al Shanti and Elessa (2023)	21
Rozario and Thomas (2019)	148	Appelbaum et al. (2022)	19
Roszkowska (2020)	142	Stratopoulos (2020)	18
McCallig et al. (2019)	138	Dunn et al. (2021)	17
Kend and Nguyen (2022)	136	Vincent and Barkhi (2021)	17
Tan and Low (2017)	123	Kaden et al. (2021)	16
Sheldon (2019)	108	Kinory et al. (2020)	16
Carlin (2019)	99	Stern and Reinstein (2021)	16
Ram et al. (2016)	96	McAliney and Ang (2019)	15
Ferri et al. (2021)	94	Liu et al. (2022)	14
Appelbaum and Nehmer (2020)	84	Hampl and Gyönyörová (2021)	13
Smith and Castonguay (2020)	83	Li and Juma'h (2022)	12
O'Leary (2018)	71	Ozlanski et al. (2020)	11
Abu Afifa et al. (2022)	69	Parmoodeh et al. (2023)	8
Sheldon (2018)	69	Gomaa et al. (2023)	6
Alles and Gray (2020)	65	Smith (2020)	6
Dai et al. (2019)	65	Hubbard (2023)	5
Centobelli et al. (2021)	63	Juma'h and Li (2023)	5
Casciello et al. (2021)	62	Davenport and Usrey (2023)	2
Pimentel et al. (2021)	61	Marei et al. (2023)	2
Fülöp et al. (2022)	53	Akter et al. (2024)	1
Vincent et al. (2020)	53	Autore et al. (2024)	1
Al-Htaybat et al. (2019)	52	Brandon et al. (2024)	1
Abdennadher et al. (2021)	51	Dupuis et al. (2023)	1
Gauthier and Brender (2021)	47	Campbell et al. (2023)	0
Stein Smith (2018)	46	Fortin and Pimentel (2024)	0
O'Leary (2019)	44	Lee et al. (2024)	0

In addition, we report the number of institutions that the authors of the studies belong to. Thirty-five studies (47%) have authors belonging to one institution, and 29 (39%) studies have authors who are part of two institutions. The remaining four studies are carried out by authors belonging to three or more institutions.
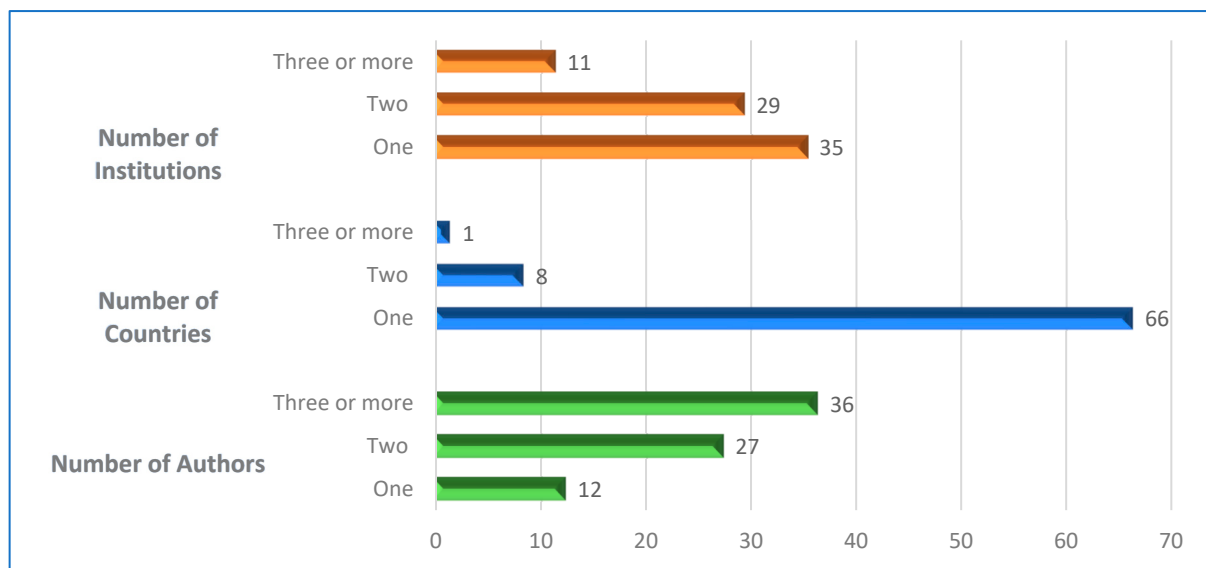
Figure 4. Authorship Characteristics.

Moreover, we also examine the number of countries that the authors, and thus institutions, in our sample of studies belong to. Our results suggest that our sample is dominated by papers deriving from one country, amounting to 88% ($n = 66$), in comparison to two countries with an amount of 11% ($n = 8$). Therefore, the majority of our studies belong to one institution and originate from one country.

Our sample of articles consists of more than 175 authors, with the majority of authors belonging to one country and one institution, as indicated in Figure 4. We also identify the first author's geographical location, and our results (Figure 5) indicate that the majority of first authors come from the United States ($n = 38$), followed by smaller contributions from Australia, Italy, Jordan, Saudia Arabia, Singapore, and the United Arab Emirates (UAE). As shown in Figure 5, the remaining countries have only one article each.
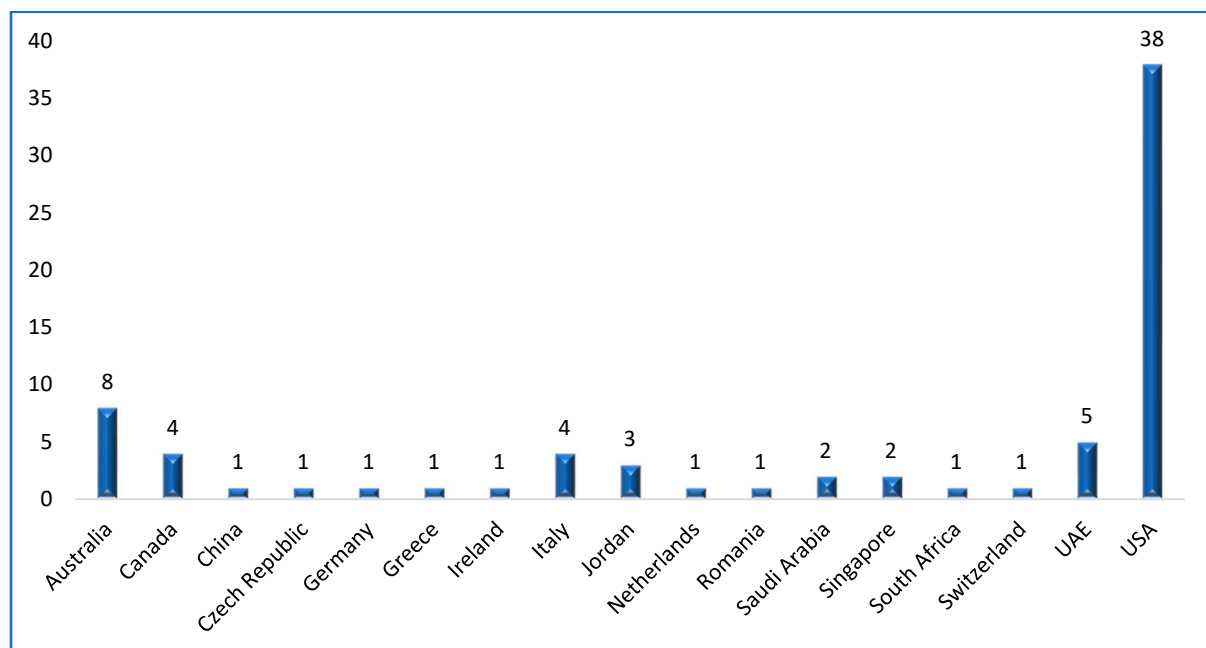

Figure 5. First Author Geographical Location.

Categorizing the geographical location of the authors into continental regions (Table 4), our results depict that 56% of the studies undertaken in the area of blockchain and accounting come from America, followed by 17% coming from Asia. The next continental regions are Europe and Oceania, with 15% and 9% of articles published, respectively. Despite the fact that our results indicate that there are studies in blockchain and accounting from Europe, Asia, and Oceania, they remain limited and are very much dominated by studies from North America.

Table 4. Studies according to region: Author Location by Region.

Region	No. of Articles/Studies	Percentage of Total Sample
Africa	1	1%
America	42	56%
Asia	13	17%
Australia	1	1%
Europe	11	15%
Oceania	7	9%
Grand Total	75	100%

As most of the studies in our sample are theoretical in nature, the studied populations within each one of the theoretical articles are not indicated or not available. As for the empirical studies, shown in Figure 6, the larger part is divided between populations studied in Australia (*n* = 5), USA (*n* = 11), UAE (*n* = 3), Vietnam (*n* = 2), and on a global scale, that is, multiple regions (*n* = 2). Germany, Italy, Romania, Switzerland, and Canada each have one research study conducted, while two studies provide no indication of the geographical location of the sample studied. This result highlights the need for more studies on blockchain and accounting to be undertaken in different countries and on samples from more diverse geographical populations such as the European, Asian, Australian, and African markets.
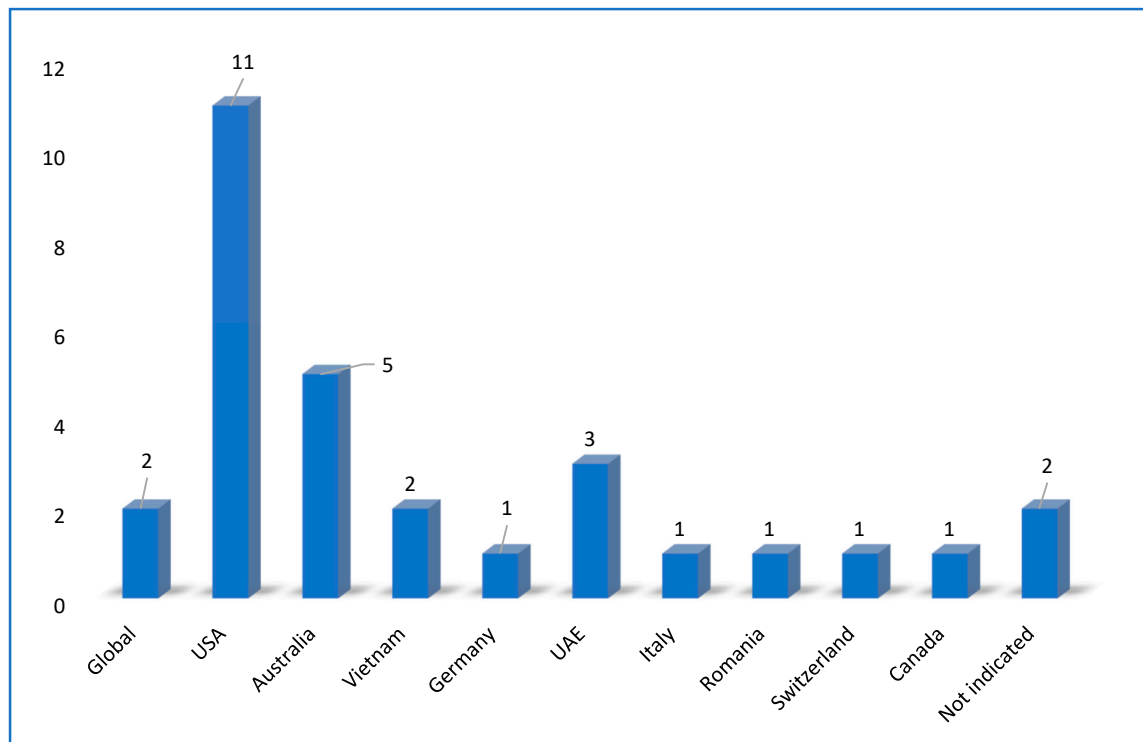

Figure 6. Studied Populations by Empirical Studies.

In addition to the descriptive analyses of the 75 articles in our sample, we examine and classify the articles as per the accounting area of analysis (Figure 7). The application of blockchain and the accounting areas of 'financial reporting' and 'auditing' contributed 35% (n = 26) of the articles in our sample, with the area of auditing comprising double the amount of articles in comparison to financial reporting. We find that 35% (n = 26) of articles fall under the category of 'general'. The majority of the 'general' accounting articles are theoretical, having applied a qualitative methodology with discussion-based implications of blockchain technologies on the accounting profession. In addition, ten articles are categorized as 'profession'. The focus of these articles is on the impact of blockchain on the accounting and auditing profession, including the challenges to be faced and the 'readiness' of the profession, touching upon the topics of regulations, procedural changes, accountant–client relationships, and technological changes. Furthermore, it is interesting to note that from 2020, a rising number of articles in our sample (n = 9) are focused on the impact of blockchain on the educational aspect in the field of accounting. The nine articles are written as teaching cases, with the objective of outlining the need for universities and higher institutions to incorporate the application of blockchain in the accounting and auditing professions in their curriculum. Finally, two articles in our sample focused on examining the implication of blockchain technologies on CSR reporting. Based on these results, there is an obvious need for more studies to be undertaken on the implications of blockchain in more specific areas of accounting and auditing. As a growing number of empirical studies have been published recently, we expect that this trend will continue, with fewer theoretical studies carried out. Therefore, as blockchain applications are more widely used in the accounting and auditing profession, we expect that more empirical studies focusing on specific areas of accounting and auditing will surface.
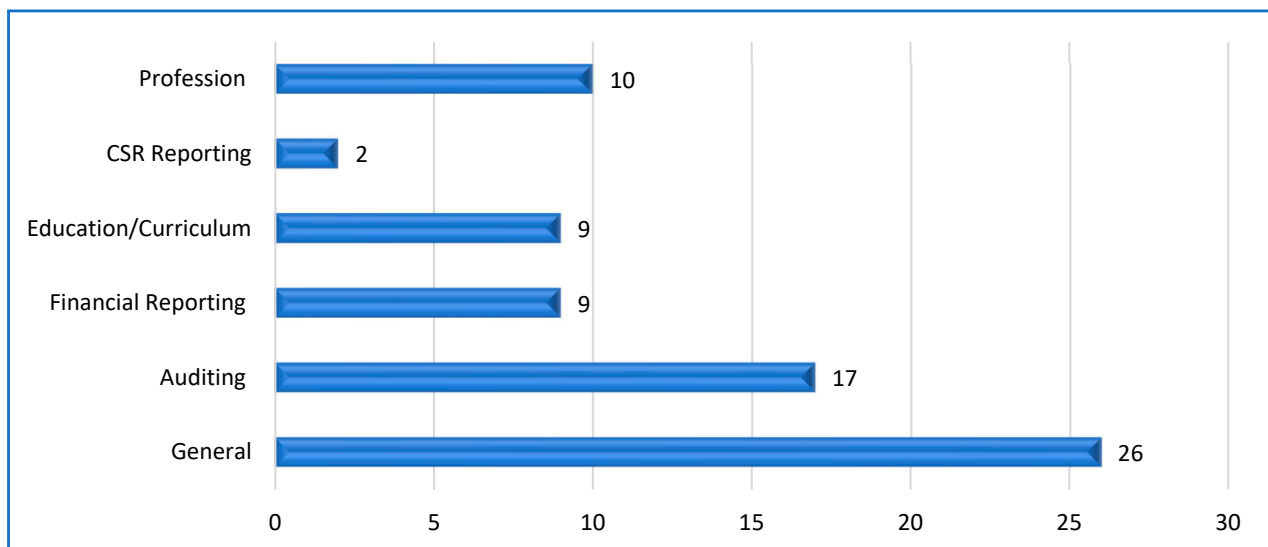

Figure 7. Number of Studies in Sample Accounting Area of Analysis.

4.2. Thematic Analysis of the Literature

This section of the study focuses on the thematic analysis of the literature; there is a need for a framework to categorize the studies, as blockchain research appears to be scarce, disconnected, and focused on a limited number of topics (Risius and Spohrer 2017). This is, in particular, the case for research carried out in blockchain and accounting; thus, we utilize the framework developed by Risius and Spohrer (2017) to categorize the papers in our study. Subsequently, we provide an analysis of each theme, followed by an overview of the research focus and findings of reviewed papers, in order to understand the direction and focus of literature in the area of blockchain accounting and auditing. The framework, as shown in Table 5, differentiates between four levels of analysis: (1) 'Users

and Society', (2) 'Intermediaries', (3) 'Platforms', and (4) 'Firms and Industries' across three activities: (1) 'Design and Features', (2) 'Measurement and Value', and (3) 'Management and Organization' (Risius and Spohrer 2017).

Table 5. Thematic Framework.

Level of Analysis	Activities		
	Design and Features	**Measurement and Value**	**Management and Organization**
Users and society	Abu Afifa et al. (2022) Ferri et al. (2021) Gomaa et al. (2019) Kaden et al. (2021) Li and Juma'h (2022) McCallig et al. (2019) Qasim et al. (2022) Stratopoulos (2020) Wang and Kogan (2018)	-	Al-Htaybat et al. (2019) Campbell et al. (2023) Dunn et al. (2021) Dyball and Seethamraju (2021) Dyball and Seethamraju (2022) Casciello et al. (2021) Pimentel et al. (2021)
Intermediaries	Dai et al. (2019) Gomaa et al. (2023) O'Leary (2019) Stein Smith (2018) Weigand et al. (2020)	Vincent et al. (2020)	Alles and Gray (2020) Parmoodeh et al. (2023) Vincent and Barkhi (2021)
Platforms	Fortin and Pimentel (2024) Kinory et al. (2020)	Centobelli et al. (2021) Liu et al. (2022) Rozario and Thomas (2019) Tang and Tang (2019)	Akter et al. (2024) Appelbaum and Nehmer (2020) Appelbaum et al. (2022) Gietzmann and Grossetti (2021) Liu et al. (2019) McAliney and Ang (2019) O'Leary (2017) O'Leary (2018) Sheldon (2019)
Firms and industries	Abdennadher et al. (2021) Al Shanti and Elessa (2023) Fülöp et al. (2022) Coyne and McMickle (2017) Stern and Reinstein (2021)	Autore et al. (2024) Cai (2021) Carlin (2019) Dai and Vasarhelyi (2017) Karajovic et al. (2019) Kend and Nguyen (2022) Kokina et al. (2017) Lee et al. (2024) Marei et al. (2023) McGuigan and Ghio (2019) Qasim and Kharbat (2020) Roszkowska (2020) Sheldon (2018)	Alsalmi et al. (2023) Beigman et al. (2023) Brandon et al. (2024) Davenport and Usrey (2023) Gauthier and Brender (2021) Hampl and Gyönyörová (2021) Hubbard (2023) Ozlanski et al. (2020) Ram et al. (2016) Smith (2020) Smith and Castonguay (2020) Tan and Low (2017) Tan and Low (2019) Tiberius and Hirth (2019)

The "Users and Society" level refers to individuals who use blockchain applications and the consequences that blockchain technology has on society (Risius and Spohrer 2017). In our accounting and blockchain context, users are the accountants, the auditors, as well as their clients. The "Intermediaries" level refers to service providers in addition to applications and processes. Since accounting and auditing applications require input from outside the blockchain, in our analysis, we focus on applications that allow interoperability with other systems, smart contracts to automate the interaction among different entities, and off-chain applications. The "Platforms" level refers to the different blockchains and systems (e.g., Ripple, Ethereum, Hyperledger), different types of blockchains (e.g., permissioned vs. permission-less), as well as cross-system interactions (e.g., integrating blockchain systems with each other or into established systems). The "Firms and Industries" level refers

to the organizations and industries that are affected by blockchain technology or adopt blockchain solutions themselves (e.g., financial markets, public services), as well as how business models will evolve in the blockchain industry. In this study, we focus on the accounting and auditing industry.

Subsequently, each of the four levels of analysis is further applied across the various blockchain activities, which are 'Design and Features', 'Measurement and Value', and 'Management and Organization'. The activities pertaining to "Design and Features" refer to the design features of blockchain systems and the differential impact that different characteristics (e.g., consensus mechanisms, privacy settings, transparency, immutability, decentralized control) might have on achieving desired goals. The "Measurement and Value" activities relate to the benefits but also the costs that blockchain-based solutions entail. The "Management and Organization" activities focus on the governance of decision rights in blockchain environments, as well as strategies and tactics utilized by actors in blockchain systems. Some examples include tackling risks, the development and implications of different consensus mechanisms, legal consequences, organizational strategies, and accounting and auditing standards-related issues.

4.2.1. Design and Features: Users and Society

This area pertains to the topic of how different blockchain characteristics, such as decentralized control, immutability, transparency, security, privacy, trustless transactions, etc., are perceived by users, how users interact with them, whether they are likely to use them, that is, adopt the technology or not, and why, and what features will contribute to its dissemination to the society (Risius and Spohrer 2017). Studies in this area fall into three broad sub-categories: studies about what drives the profession's intention adoption of blockchain technology (see Ferri et al. 2021; Abu Afifa et al. 2022; Li and Juma'h 2022), studies focusing on the very serious issue of the tradeoff between the transaction transparency and public access features of blockchain versus the need for privacy and confidentiality (see Wang and Kogan 2018; McCallig et al. 2019), and teaching and learning papers on how to facilitate accounting students' learning about blockchain and its features (Gomaa et al. 2019; Stratopoulos 2020; Kaden et al. 2021; Qasim et al. 2022).

Ferri et al. (2021) examined the factors that motivate auditors to use blockchain technology based on the views of Big Four employees in Italy and found that the main predictors of auditors' intention to use blockchain are performance expectancy, i.e., how much they perceive that blockchain technology will improve their working conditions and social influence, that is, the user's social circle's opinion on blockchain technology, and moreover, at a lesser extent, auditors' effort expectancy, that is, perceived ease of use. Abu Afifa et al. (2022) surveyed accountants from Vietnam to investigate the accounting profession's intention to use blockchain and found that the main drivers are performance expectancy, which is, in turn, affected by accounting information quality, and effort expectancy, which is, in turn, affected by the user's computer self-efficacy and experience with blockchain. Both performance and effort expectancy are affected by trust; the intention to use blockchain by accountants is, to a lesser extent, affected by social influence. Li and Juma'h (2022) examined how blockchain features must fit the task needs of auditors to boost acceptance by utilizing a survey of 112 auditors based in the US to find that not all blockchain features hold the same level of importance. Timestamping is crucial for shared databases while preventing double-spending is vital for other tasks. Additionally, they found that auditors' perceptions of blockchain features and task needs are influenced by their accounting knowledge, software knowledge, and technology awareness (Li and Juma'h 2022). Abu Afifa et al. (2022) used an extended UTAUT model to investigate accountants' intention to use blockchain. The model includes factors like accounting information quality, job relevance, trust, computer self-efficacy, and compatibility to provide incentives for blockchain adoption among accountants.

Wang and Kogan (2018) focused on the trade-off between transaction transparency and confidentiality when adopting blockchain in accounting and auditing, an issue that is

considered a barrier to adoption; they designed an innovative blockchain-based transaction processing system utilizing zero-knowledge proof and homomorphic encryption, and they tested its computational performance against relational databases. McCallig et al. (2019), also concerned about the issue of balancing public access—and thus transparency—with privacy and confidentiality, developed a blockchain-based accounting information system (AIS) that enhances the representational faithfulness of accounting data by mimicking the audit function. Emphasis is given to the ability of the accounting system to enhance representational faithfulness as part of the audit and to balance public blockchains with privacy (McCallig et al. 2019).

Four papers focusing on teaching accounting students about blockchain also fell under the "Design and Features: Users and Society" category, as their aim is to depict how an accountant or an auditor can utilize blockchain technology, focusing on the design features of the technology. Gomaa et al. (2019) offer a teaching example involving transaction execution that emphasizes the roles of internal and external auditors and encourages conversations regarding blockchain technology. Based on the premise that accounting students do not wish to become programmers or cryptographers, Stratopoulos (2020) offers an outline for preparing students for the impact of blockchain on the accounting profession. It covers the fundamentals of blockchain, emphasizes the value of learning about it, and includes interactive exercises to clarify technical knowledge. In contrast, Kaden et al. (2021) provide an approach to teaching blockchain technology to accounting students that is code-based and less theoretical in order to increase students' comprehension of the subject. Qasim et al. (2022) explored the implications of market digital transformation in the United Arab Emirates (UAE) for the undergraduate accounting curriculum.

Design and Features: Intermediaries

Based on the Risius and Spohrer (2017) framework, this area clusters on the implementations of automated transaction management, focusing on the blockchain application layer that provides intermediary services, such as blockchain-based applications (Smith 2018; O'Leary 2019) and smart contracts (Weigand et al. 2020; Dai et al. 2019).

The topic of being able to attest and report on the information produced as a result of business and transactional purposes is raised by Smith (2018), who studies applications and developments that are built on top of current blockchain programming. It also emphasizes the necessity for practitioners to have a thorough understanding of these emerging trends and the implications of their implementation. O'Leary (2019) focuses on the problem that blockchain systems for information distribution, preservation, and capture usually integrate the application, database, and presentation tiers into one ledger, making it often unable to query the ledger for information. According to O'Leary (2019), databases and blockchain applications, which are now frequently combined, should be created and managed independently. Additionally, there is the matter of agents. According to O'Leary (2019), databases and blockchain applications, which are now frequently combined, should be created and managed independently. Agents also have the challenge of accommodating numerous blockchains according to their requirements and trade partners, as the majority of blockchain applications seem to be private. Private blockchains, according to some, are unlikely to satisfy the demands of every industry member engaged, as they were not taken into account throughout the design process, restricting its applicability. This is because private blockchains are often created to fulfill the needs of the consortium (O'Leary 2019). According to O'Leary (2019), implementing a database that blends database administration with blockchain functionality, such as BigchainDB, is advised.

Weigand et al. (2020) show how smart contracts can facilitate the implementation of the concise representation of both consensual and enterprise-specific parts of business exchange transactions by introducing a decentralized ledger technology (DLT)-based shared ledger solution in a formal way and compliant with Financial Reporting Standards in order to increase the quality of the contents from an accounting perspective. Dai et al. (2019) investigate how blockchain technology and smart contracts can re-engineer existing audit

procedures in order to enable Audit 4.0 by pointing out that blockchain and smart contract technologies support addressing two key issues in the implementation of Audit 4.0, namely data integrity and correct operation of intelligent auditing modules; the continuous audit of government officials' performance on air protection will lead to enhanced accuracy, reliability, and objectiveness of the audit, and moreover, reduced workload (Dai et al. 2019).

Further, Gomaa et al. (2023) introduce and demonstrate the feasibility of a framework to streamline transaction reconciliation between involved stakeholders by recording transactions on the blockchain before updating ERP systems, creating a single source of truth; this approach ensures all parties have access to the same details, reducing costs and time.

Design and Features: Platforms

The category of 'Design and Features: Platforms' covers the different technological mechanisms on which different types of blockchains rely, platforms, and networks on the fabric layer, thus focusing on consensus mechanisms, permissioning, scalability, decentralization, levels of anonymity and interoperability, as well as their interdependencies (Risius and Spohrer 2017).

Kinory et al. (2020) present a proposal for a curriculum that is based on hands-on training to teach accounting students the basics of modeling a blockchain network utilizing the Hyperledger Composer.

Fortin and Pimentel (2024) examine Bitcoin as a cryptocurrency and payment system that leverages blockchain technology to create a new accounting regime. It explores the design features of Bitcoin, such as its verification and validation system, which are built upon social practices and accounting language. The study also discusses how these features aim to replace trust in individuals with trust in systems, highlighting the importance of human interactions in the effectiveness of Bitcoin.

Design and Features: Firms and Industries

The sub-category of 'Design and Features: Firms and Industries' focuses on specific features that are relevant for and can impact the accounting and auditing industries and how they need to be designed.

Coyne and McMickle (2017) focus on identifying the challenges that hinder the implementation of the blockchain as a financial reporting tool, specifically the difficulty of transaction verification on the blockchain, a problem that appears because of the difficulty of representing non-digital assets on the blockchain. Blockchain-based digital currencies only exist on the blockchain, while economic transactions exist outside of accounting records. Moreover, Coyne and McMickle (2017) point out that the immutability of blockchain—the feature that makes it secure—is not fully available or reliable in an accounting setting.

Abdennadher et al. (2021) find that the UAE auditors they interviewed recognize that blockchain will impact the accounting profession in the aspects of transaction recording, storing evidence, and security of business transactions, thus changing the audit process and strategy. By complementing traditional auditing, blockchain can provide a low-cost and decentralized audit process and automated audit evidence; in the view of the interviewed auditors, the accounting of the companies themselves will not be changed, and accountants and auditors will be involved in the development process.

Stern and Reinstein (2021) describe how accounting and other business faculty can incorporate blockchain into the curriculum either as a separate course or integrated into an existing course to learn—beyond the basics—to evaluate the feasibility of use cases and to consider the potential impact of blockchain and other shared ledgers on accounting and auditing, among other learning objectives.

Al Shanti and Elessa (2023) investigate how digital transformation, specifically through blockchain technology, can enhance accounting information quality and corporate governance in the banking sector. By combining theoretical insights and field data, the study examines the design features of blockchain—such as transparency, immutability, and decentralized control—that are crucial for improving the accuracy and reliability of accounting

information. The research underscores the importance of integrating blockchain systems with existing banking operations to realize these improvements, highlighting the need for careful design to ensure compatibility and effectiveness.

Fülöp et al. (2022) explore the current state and future trends of digitization in accounting, focusing on the implementation responsibilities within the profession. Utilizing the Technology Acceptance Model (TAM) along with considerations of trust and perceived risk, the study analyzes accountants' views on the digitization of financial activities. The research points to the necessity of designing blockchain features that build user trust and mitigate perceived risks, which are essential for the adoption of digital services in accounting. Additionally, the study highlights the importance of ensuring data security, ease of use, and compatibility with existing accounting systems to support the transition to digital accounting practices.

4.2.2. Measurement and Value: Users and Society

'Users and Society' are a further sub-category under the 'Measurement and Value' analysis. This pertains to the benefits and costs of blockchain systems for individuals and society. It is interesting to note that a substantial number of studies mention, in passing, benefits to accountants or how the auditing profession may be rendered redundant; however, no study's focus falls into this category, probably because the lack of real-life application cases did not allow analysis to this level of detail.

Measurement and Value: Intermediaries

This section, in our case, is relevant to the questions of how blockchain systems can maximize their role as transaction intermediaries with an emphasis on the value propositions and the limitations of blockchain technology compared to established intermediary services. Moreover, it touches on how the links of a company—CPA firms in our case—with other participants on the chain of the auditing process can be managed, how the CPA firm can connect to the blockchain, and how connecting other participants, such as clients and associates and supply chains can be achieved. Specifically, in 2020, Vincent, Skjellum, and Medury created a blockchain architecture that would allow CPA firms to be connected to a blockchain in a way that would encourage client firms to adopt blockchain technology by significantly lowering the costs associated with replacing outdated information systems and give auditors access to trustworthy digital audit evidence for the purpose of providing audit and assurance services. The architecture may be expanded to accommodate different use cases and extend to supply chain actors, other CPA firms, customers, and regulators. It also enables auditors to develop continuous audit procedures for their clients without having to make significant expenditures in software integration. According to Vincent et al. (2020), their primary concerns with the design were twofold: first, how CPA firms can obtain trustworthy audit evidence, and second, how to maintain the security and confidentiality of client firms' data given a distributed, decentralized, and unchangeable ledger like the blockchain.

Measurement and Value: Platforms

The next sub-category under the analysis of 'Measurement and Value' is 'Platforms', with studies examining how blockchain systems can enhance their dissemination among users and linkage with other systems, and the complementary benefits of blockchain systems to established information systems, as well as about different platforms and their added value.

Tang and Tang (2019) offer a policy and system viewpoint paradigm and design of a distributed carbon ledger (DCL) system as a response to the present corruptible and ineffective systems of governance used for climate change management. By putting forth this blockchain-based system, they demonstrate how its implementation can fortify the corporate accounting system for the management of carbon assets and enable the incorporation of national emission trading schemes that incorporate the corporate, non-

profit, and governmental sectors into a single, artificial mechanism. By using blockchain technology, the issues of stakeholder mistrust and conflicts of interest that were burdening the system are resolved.

In order to improve audit quality and close the expectations gap between regulators, financial statement users, and auditors, Rozario and Thomas (2019) propose an external audit blockchain that supports smart audit procedures. They see auditing changing through workflow automation, but more significantly, through improving audit efficiencies and effectiveness, transparency, and financial reporting overall. The capacity of smart audit methods to autonomously reveal audit results in almost real-time on the immutable blockchain ledger is highlighted by Rozario and Thomas (2019). This helps to address the expectation gap that exists between auditors, users of financial statements, and regulators. Although the authors suggest using an external audit blockchain supported by smart contracts and audit procedures to improve the quality of audits, audit judgment is anticipated to continue to be an important part of financial statement audits because, despite the significant changes in practice, the audit framework of the future is likely to include both on- and off-the-blockchain audit procedures.

Centobelli et al. (2021) study the advantages of blockchain to the accounting profession, including transparency, which comes with the challenge of security and privacy, pointing out that transparency and, at the same time, security and effectiveness can be improved by a private and permissioned blockchain that controls access to authorized data; transparency over time is also enhanced by the immutability feature of blockchains, disintermediation and automatic processes. The combination of all the qualities of blockchain, such as immutability and decentralization, is what gives it an advantage over other database options.

Liu et al. (2022) use transaction cost theory to examine the impact of blockchain on accounting and auditing, focusing on information timeliness, quality, and auditing costs; blockchain's ability to record, track, and manage transactions offers advantages that can lower transaction costs. A use case in a food supply chain illustrates blockchain's potential for tracing goods and recording transactions.

Measurement and Value: Firms and Industries

The final sub-category under the framework analysis of 'Measurement and Value' is 'Firms and Industries'. Indeed, this is where most studies pertaining to measurement and value fall, as it refers to the impact of blockchain on the accounting and auditing industry. Most of these studies are not empirical since the hands-on application of blockchain in accounting and auditing does not exist. Instead, these studies either offer conjecture on the impact, taking into consideration the known parameters, or seek the views of stakeholders through interviews.

One of the earliest studies on the topic of blockchain and accounting was by Kokina et al. (2017) where they discussed both the opportunities as well as the limitations of blockchain technology for the accounting industry. The same can be said for Dai and Vasarhelyi (2017), who aimed to provide an initial discussion on how blockchain can turn the accounting ecosystem into a real-time, verifiable, and transparent one and transform current auditing practices, resulting in a more precise and timely automatic assurance system.

Sheldon (2018) focuses on the widespread misconduct in the accounting field and describes how blockchain can help with a function that is currently highly centralized: the aggregation and sharing of instances of practitioner misconduct in the field among many relevant parties across the nation in almost real-time. Blockchain allows the creation of an irreversible record of misconduct and makes it easier for important players in the field to collaborate and share information as peers without running the risk of one party controlling the ledger.

Tiberius and Hirth (2019) examine changes in auditing practices expected by German auditing professionals within the next five to ten years. They stress that blockchain would render auditing redundant and state that they were surprised by their own findings that accounting professionals are currently in denial about the changes that blockchain and

other technologies, such as big data analytics and artificial intelligence, would have no sizeable impact on their profession. In fact, accounting and auditing professionals who participated in the study believe that these technologies would not replace the auditor but would have a supporting role.

The authors Karajovic et al. (2019) analyze the implications of blockchain technology in the accounting profession and its broader industry based on the few "first-movers" in the field. They also discuss how this technology will streamline accounting processes, particularly as it gets closer to reaching critical mass. These insights provide light on the potential impact of blockchain technology on the accounting system. Blockchain technology may be utilized by CPAs and bookkeepers to manage a business's records, transactions, and performance. Additionally, other accounting industry players can apply the technology to enhance client satisfaction.

Carlin (2019) provides a review of the history of double-entry bookkeeping, including a reference to an unsuccessful proposal in the past for its replacement with a triple-entry system, and argues that blockchain technology can drive accounting beyond double-entry. It describes what triple-entry accounting on the blockchain would look like: companies may only need to make one internal entry for particular accounts, with the opposite item being recorded in a shared ledger that is accessible to the public. Finally, according to Carlin (2019), the development of blockchain technology may cause a significant change in accounting, as double-entry accounting did when it first appeared and gained traction.

McGuigan and Ghio (2019) investigate how technologies such as blockchain can enhance the role of accounting in artistic spaces of visualization, curation performance, and disruption and argue that art's ability to protest, challenge, open, and inspire may be instrumental in humanizing technological advances, transforming the accounting profession by opening up its disruptive potential.

There is a call for radical changes in the accounting curriculum to strike a balance between existing accounting knowledge and information technology skills relevant to the accounting profession (Qasim and Kharbat 2020). Qasim and Kharbat (2020) propose a curriculum redesign to incorporate blockchain technology, business data analytics, and artificial intelligence, as these technologies will play a role in the accounting profession, thus calling for radical changes in the accounting curriculum. Specifically, for blockchain, the suggested curriculum covers, beyond the basics, the understanding of the use of blockchain in performance measures and accountability and how it can contribute to improving processes and operations. Relevant to this is the study by Marei et al. (2023) that investigates the understanding of cryptocurrencies among newly certified public accountants (CPAs) and accounting graduate students, finding that recent graduates and CPAs have limited awareness due to insufficient exposure during their education, while students in forensic courses are more knowledgeable. The research, based on semi-structured interviews, highlights the need for better education and resources on cryptocurrencies in accounting curricula (Marei et al. 2023).

Kend and Nguyen (2022) conducted interviews with pertinent players within the Australian audit market to gain their perspectives on the effects of emerging technology. The study specifically examined the effects of blockchain technology and discovered that big data analytics, robots, and artificial intelligence had a favorable influence on audits. However, the attendees did not seem to be persuaded that blockchain technology might be used in auditing procedures.

Roszkowska (2020) focuses on the audit-related drivers of financial statement fraud and offers guidance on how new FinTech technologies, such as blockchain, can improve this and enhance the reliability of financial information for equity investments. They discover that blockchain, the Internet of Things, smart contracts, and artificial intelligence can all be used in concert to achieve this goal, as they have the potential to significantly improve the accuracy of financial statements and transform the way businesses run.

Cai (2021) points out that blockchain has led to the emergence of the method of triple-entry accounting that will enhance trust and transparency issues, thus fundamentally

improving accounting. Therefore, businesses will only need to complete one internal entry in a blockchain-based accounting system, with the opposite entry being recorded on a shared ledger that is accessible to the public.

Autore et al. (2024) examine the impact of corporate blockchain adoption on financial reporting behavior, finding that while blockchain features like immutability and real-time data sharing can enhance data integrity, the hype and increased expectations may lead firms to manage earnings upward. Empirical evidence from the supply chain context shows that supplier firms' earnings management increases after their customers adopt blockchain, indicating unintended consequences of blockchain adoption on financial reporting.

Lee et al. (2024) evaluate the benefits and costs of blockchain applications in tax compliance systems, providing empirical evidence and policy implications for promoting blockchain technology in this context. Specifically, they examine the impact of blockchain technology on taxpayer compliance among US taxpayers using a panel data model and an agent-based simulation model. It identifies critical factors such as IRS efficiency and increased punishment that can enhance blockchain's effectiveness in reducing the tax gap.

4.2.3. Management and Organization: Users and Society

The area of 'Management and Organization: Users and Society' concentrates on the understanding of liberties and restrictions that come with blockchain technology applications, such as legislation and risks that need to be taken into consideration.

Al-Htaybat et al. (2019) explore the intersection of accounting practices and new technologies as a form of intellectual capital, that is, knowledge and skills, utilized with the aim of supporting value creation and realizing sustainable development goals. They point out that the application of blockchain technologies will require the adaptation of existing as well as the adoption of new policies, such as individual agent engagement, self-audit, elimination of central control, and smart contracts if the technology is to be universally adopted and applied as an improved reporting and governance structure to enhance transparency.

Pimentel et al. (2021) focus on the problem of the hesitation of auditing firms to audit companies that hold a significant amount of crypto assets. The study provides a critical analysis of the perceived obstacles to auditing such firms and maps them to traditional auditing practices to persuade professionals that auditing such companies is challenging but to a lesser extent.

Dyball and Seethamraju (2021) verify through interviews with auditors that clients that use blockchain technology are considered to be riskier, where fundamental and control risks are amplified. They recommend two plausible audit strategies: (1) increasing the amount of indirect and entity-level evidence and (2) combining direct, indirect, account-level, and entity-level data.

In a teaching scenario focused on the auditing implications of Bitcoin and blockchain, Dunn et al. (2021) included students in planning and risk assessment for an online shop audit. Understanding how audit methods have changed to address risks, how financial statement auditors use service auditor reports, and the function of management experts in an audit are also highlighted.

Casciello et al. (2021) examine the advantages and disadvantages of integrating blockchain technology into accounting and auditing procedures in order to identify potential new risks and problems. They observe that blockchain is challenging professionals to learn the new accounting and auditing systems, reinvent traditional practices, and learn how to utilize blockchain instead of being overwhelmed. The importance of the human factor, the unreplaceable professional conscience, and experience is exemplified.

Juma'h and Li (2023) investigate the factors influencing auditors' intention to use blockchain technology. It finds that auditors' knowledge about blockchain positively impacts their intention to use it, while professional skepticism has no effect, and perceived adequacy of accounting standards negatively affects their intention. The study, based on a

survey of 118 US auditors, highlights the need to improve accounting standards to promote blockchain adoption among auditors.

Another risk is human biases, as Campbell et al. (2023) point out. Using a survey of AICPA members, they examine how blockchain technology impacts auditors' evaluation of audit evidence and their professional skepticism, focusing on the potential biases (Goldilocks Effect, Halo Effect, and Hype Effect) that can influence auditing practices. The results indicate that survey respondents are mainly influenced by the Halo Effect, showing a tendency toward positive automation bias in evaluating management assertions.

Management and Organization: Intermediaries

This section is devoted to the role of intermediaries in the management and the organization of processes in a blockchain-based accounting system.

Alles and Gray (2020) concentrate on the issue of making sure that the data on the distributed ledger of the blockchain are isomorphic with the real-life data that it claims to represent. This issue only develops when the blockchain is utilized to store data about physical goods, particularly those that have a service component, as opposed to native digital data, which is the case of native cryptocurrencies, such as Bitcoin, on the blockchain. The authors contend that auditors will play a function as middlemen in a blockchain-based system until it is possible to store a "digital twin" of the object.

Distributed ledgers and smart contracts, as noted by Vincent and Barkhi (2021), make it more difficult to distinguish between trading partners' systems. Instead, they highlight how these technologies affect internal control and corporate risk assessments.

Parmoodeh et al. (2023) also examine the role of intermediaries in managing and organizing processes within a blockchain-based accounting system. Specifically, they explore the prospects of blockchain technology (BCT) on audit practice through semi-structured interviews with practitioners from both Big Four and non-Big Four firms. The findings highlight significant themes related to audit practice, procedures, and the challenges of adopting BCT. The adoption of BCT is seen to potentially transform audit procedures by enhancing automated verification processes, reducing audit budget time, and diminishing the need for physical observation. Additionally, BCT could facilitate analytical procedures and significantly reduce fraud detection costs by providing a tamper-proof, immutable audit trail, thereby impacting the management and organization of audit processes.

Management and Organization: Platforms

This section is about the management and organization implications of the different features of blockchain types such as permissioning systems, and their incentive and consensus mechanisms.

O'Leary (2017) contends that private and cloud-based blockchain configurations would predominate over public blockchains as the "best" method for capturing accounting or supply chain transactions. It is also noted that a lot of the suggested uses for blockchain technology are comparable to current methods of processing transactions through technology, which raises the possibility that hybrid systems combining blockchain and current technology will eventually be created.

As part of an audit of internal control over financial reporting, Sheldon (2019) examines the risks associated with private and permissioned blockchains. He also addresses areas of attention for auditors to take into account, as well as risk areas that blockchain could eliminate.

According to O'Leary (2018), blockchain transaction processing will provide reliable information in situations where there is a "single truth" feed of information flow, no ability to do off-blockchain transactions (or a significant penalty cost), and limitation to a single identity for each enterprise on the blockchain. O'Leary (2018) points out that in order for a firm to put its information disclosure in the hands of someone else, as happens when capturing transactions using blockchains, it will require incentives, such as a mandate (e.g., by a government or some entity with market power) or a large penalty cost (e.g., lack of

access to some resource), and if, on the other hand, there is a mechanism (e.g., a fine) that limits off-blockchain transactions. Moreover, O'Leary (2018) warns that each entity on the blockchain would need to be constrained to a single "presence" because otherwise, there can be "wash transactions" (when an entity buys and sells its own order), which can be used to mislead others.

Focusing heavily on permissioned blockchains, Liu et al. (2019) present a comparison between the opportunities and challenges emerging from permissionless versus permissioned blockchains with respect to their application to accounting and auditing. In the context of permissioned blockchains, auditors do have a role to play; auditors' role will not be testing transactions directly, but instead testing controls pertaining to the blockchain and auditing the blockchain—client incentives, code quality, protocol changes, and power allocation among peers, as blockchain technology does not necessarily assure the reliability of organizations' financial reports; the actual transaction happens off-chain—therefore, the effectiveness of internal controls surrounding blockchain is critical (Liu et al. 2019). Therefore, according to Liu et al. (2019), auditors should become competent in blockchain technology and blockchain governance and actively participate in blockchain development with an emphasis on risk control, as well as develop their advisory role. Sheldon (2019) also focuses on private and permissioned blockchains, considering their risks within an organization.

McAliney and Ang (2019) note that organizations need to be ready for governance issues pertaining to data integrity, security, availability, usability, and analytics. They also stress the need for drafting policies regarding data that exist on public and permissioned blockchains. The authors emphasize that organizations must consider the immutability and transparency of data on these blockchains, and they offer a decision-making framework to help them choose between blockchain, Google Sheets, and traditional relational databases for accounting. The authors contend that no single technology can solve all business problems.

In accounting transactions that lend themselves to a permissioned blockchain, Appelbaum and Nehmer (2020) consider the audit issues of data security, reliability, and transparency in transactions.

Gietzmann and Grossetti (2021) demonstrate how traditional accounting expertise is still applicable in the transition from centralized to decentralized ledger systems, highlighting its importance in the design of practical distributed systems.

Appelbaum et al. (2022) explore why blockchain, despite its desirable features for business applications and auditing, has not seen widescale adoption over a dozen years after its introduction. It examines functionality, data and process integrity, and regulatory concerns as potential reasons for this lag and provides a framework of questions for researchers and practitioners to address these issues.

Akter et al. (2024) examine the organizational factors that drive and hinder the adoption of blockchain in accounting using the technology–organization–environment (TOE) framework. By analyzing interview data from blockchain experts and accountants, the study identifies nine context-specific factors that influence blockchain adoption. These factors highlight the challenges and lack of knowledge regarding the usage and benefits of blockchain, its complex integration with existing accounting systems, and the increased costs associated with adoption.

Management and Organization: Accounting–Auditing Firms and the Accounting–Auditing Industry

The final theme, according to our framework, corresponds to the blockchain and the managerial and organizational aspects of firms and the industry and its guidance, including standard setting.

According to Ram et al. (2016), there are no accounting standards that provide guidance on how to identify and quantify virtual currencies or that establish a conceptual framework for accounting for Bitcoin that is based on stewardship and neoliberalism ideas.

In addition, Tan and Low (2017) note that there is a dearth of official guidance from standard setters regarding the financial reporting of Bitcoin transactions. They argue that the accounting concept of accurate representation in the context of Bitcoin requires different interpretations of the economic content for financial reporting. Trading firms treat Bitcoin as a foreign currency and measure revenue or costs in the same manner as the reporting currency, whereas digital currency exchanges treat Bitcoin as a commodity according to tax regulations. They find that financial reporting for Bitcoin does not need the adoption of new accounting standards. Furthermore, even in the event that new standards are released, the due process would take many years.

According to Gauthier and Brender (2021), there is a growing demand from auditors for information technology auditing standards, and there is a mismatch in timing between the rapidly evolving IT environment and the regulators' slow release of new standards or updates to existing ones. The authors explore how the existing auditing standards fit the emerging use of blockchain, as it may impact the type and volume of information available to auditors and how audits are conducted.

Tan and Low (2019) point out that in a blockchain-based accounting information system (AIS), the role of accountants will evolve and change; however, accountants will remain relevant and necessary. Although they will not be in charge of a blockchain-based accounting information system, they will probably still be in charge of businesses' financial reporting as required by law. They will also probably still have an impact on decisions about things like validators' selection and accreditation, and they will still act as last-resort validators. In a blockchain-based AIS, audit evidence must still be obtained before an audit opinion can be rendered. Blockchain-based AIS by itself does not ensure that financial reports are accurate and fair, even though digitizing the validation process decreases the mistake rate and the cost of vouching and tracing, and the immutability of blockchain data lowers the incentive and chances for fraud. Audit quality is anticipated to increase in a blockchain-based AIS with lower error rates and fewer incentives for accounting fraud. When blockchain-based AIS becomes accessible, this prediction will need to be empirically verified.

The qualifications and training of accounting and auditing professionals needed for blockchain application to these fields emerge as another area of worry for the field and the industry at large. It appears that determining the new abilities and competencies that accountants need to possess in order to stay valuable and relevant is urgently needed (Ozlanski et al. 2020). A teaching scenario is presented by Ozlanski et al. (2020) to help aspiring auditors comprehend the impact disruptive technology will have on their field. In addition to considering a number of core auditing topics, including audit evidence, financial statement claims, and analytical processes, students gain an understanding of the impact that emerging and disruptive technologies will have on the auditing industry.

By addressing financial data integrity issues, Smith and Castonguay (2020) explore the impact of blockchain technology on assurance and financial reporting and offer guidance for organizations and auditors using blockchain technology. The authors highlight the need for audit committees to be equipped to tackle obstacles that arise during the preparation of financial statements. They also recommend that audit policies, internal control protocols, and counterparty risk assessment procedures be modified to promote the adoption of blockchain technology. Specifically, these modifications should address the growing regulatory framework surrounding the dissemination of financial data.

With their study, Smith (2020) hopes to provide useful business insights for integrating blockchain technology and delineate how blockchain affects risk assessment procedures. Any attestation or assurance engagement revolves around risk assessment methods, which seem to be the areas where blockchain is most likely to have a major first influence. They talk about how more data is saved, verified, and shared through a distributed and decentralized system while still maintaining the integrity of the audit and attestation process.

The main question addressed by Hampl and Gyönyörová (2021) is whether fiat-backed stablecoins fall under the definition of cash or cash equivalents under the rules

of international financial reporting standards. To this end, they examine the legal and general terms and conditions of the chosen stablecoins as well as cryptocurrency exchanges, comparing their risk characteristics to those of fiat currency, money market indexes and instruments, and traditional cryptocurrencies. Nine out of the eleven stablecoins satisfy the objective requirements of cash equivalents based on their material substance, and utilizing a broad interpretation of IAS 7, they may be reported as cash equivalents.

Alsalmi et al. (2023) investigated the classification issues and accounting practices for digital currencies, including central bank digital currencies (CBDCs) and privately issued cryptocurrencies like Bitcoin, and found that current accounting standards do not adequately cover digital currencies and highlights the need for new standards to provide guidance on their identification, classification, measurement, and presentation. Existing standards should be amended to incorporate digital currencies and ensure consistent global accounting practices.

Hubbard (2023) examines potential financial accounting treatments for cryptocurrencies, comparing the benefits and shortcomings of each method. The study proposes an intangible asset revaluation model and aims to inform standard setters and financial statement preparers about the most appropriate accounting treatment for cryptocurrencies.

Davenport and Usrey (2023) examine the regulatory environment and tax classification complexities of crypto assets, which are crucial for firms and industries dealing with these digital assets. It discusses the implications of different tax classifications and the need for multiple classifications to provide equitable tax treatment.

Beigman et al. (2023) focus on the concept of fair value, arguing that the fragmentation of cryptocurrency markets and the global dispersion of trading venues make it challenging to identify a principal market. The primary objective of the study is to present a methodology for dynamically designating principal markets and deriving fair value prices for financial reporting using this designation.

Brandon et al. (2024) created a case study that involves determining the appropriate financial accounting treatment and reporting implications for Bitcoin, which requires students to apply the recently formalized FASB authoritative financial reporting guidance for cryptocurrencies such as Bitcoin to three different clients: a Bitcoin miner, a Bitcoin trader, and a retailer accepting Bitcoin as payment. Students found the case realistic, interesting, and challenging, encouraging critical thinking about the new guidance's impact on different types of clients.

Table A1 in Appendix A provides an overview of the research focus and findings of reviewed studies. In addition, an account of the theories used by the reviewed studies is given in Table A2 in Appendix A.

5. Future Research Agenda

In this section we present the most cited areas for future work that can be conducted by researchers in the fields of accounting and auditing. Research that falls within other spheres of expertise—such as computer science or cryptography, for example—has not been emphasized. A full account of the suggestions made by the studies examined in this review can be found in Table A3. It is important to note that the papers that did not have avenues of future work were excluded from this analysis (a total of 41 studies). Furthermore, we present the future work areas according to our thematic framework (see Section 4.2 and Table 5), where the studies are differentiated between the four levels of analysis: (1) 'Users and Society', (2) 'Intermediaries', (3) 'Platforms', and (4) 'Firms and Industries' across three activities: (1) 'Design and Features', (2) 'Measurement and Value', and (3) 'Management and Organization'.

Users and Society: This level of analysis refers to the use of blockchain by accountants, auditors, and their clients and the effects that blockchain technology has on society. Following our thematic framework, we further divide the studies under this level according to the activities. Our analysis results in four studies within the activity of 'Design and Features'. Abu Afifa et al. (2022) propose to apply the model to SMEs as they are more familiar with

accounting digitization. Ferri et al. (2021) suggest studying the auditors' perceptions of blockchain technologies and applying the Technology–Organization–Environment (TOE) framework to assess the acceptance of blockchain technologies across countries. McCallig et al. (2019) add that more specific areas of the uses of blockchain in accounting should be further explored, such as working capital management and the implementation of the Ethereum blockchain. Wang and Kogan (2018) also emphasize the benefits to users in terms of design and automation through the adoption of smart contracts.

Consequently, our analysis of the level of 'Users and Society' brings our attention to the following studies under the activity of 'Management and Organization'. The study by Dyball and Seethamraju (2021) and Vincent and Barkhi (2021) point out that the perspectives of auditors from standard-setting bodies and regulators should be taken into consideration via interviews. Al-Htaybat et al. (2019) argue that further research needs to concentrate on the practical implications, in particular, the integration of blockchain in the realization of SDGs. Juma'h and Li (2023) suggest exploring how auditors' acceptance of permissioned and permissionless blockchains may differ across various auditing contexts.

Intermediaries: Future research under this level of analysis calls for new research on the interaction of accounting and other service providers, systems, and smart contracts. Our analysis further differentiates the studies across three prominent activities, resulting in four studies in the activity of 'Design and Features'. Weigand et al. (2020) stress for new research to study the effects of distributed ledger technologies on auditing, while Dai et al. (2019) propose a number of future avenues, such as the development of smart audit and reporting contracts and whether the emerging technologies in accounting and auditing may hinder auditor independence. Another study that proposes to explore the use of other distributed databases in a virtual organization is by O'Leary (2019), while Smith (2018) points to the importance of being informed in the wider use of blockchain. Gomaa et al. (2023) suggest focusing on technical implementation and security issues of proposed frameworks.

In terms of 'Management and Organization', Vincent and Barkhi (2021) point out that the governance of blockchain technology should be considered separately from the governance of individual companies and to further study the implications of multi-company blockchain and smart contract frameworks.

Platforms: These studies primarily investigated different types of blockchains and cross-system interactions.

Fortin and Pimentel (2024), under the sub-category of 'Design and Features', suggest that future research should look into the evolution of Bitcoin under recent Bitcoin Core Developers and its mainstream adoption, exploring potential ideological fragmentation within the community. Additionally, research should investigate how firms reconcile traditional accounting regimes with the Bitcoin regime, particularly for Bitcoin ETFs and crypto exchanges overseen by financial regulators. Analyzing how these companies navigate competing social practices to recognize economic value will be crucial as Bitcoin's usage and its impact on the accounting profession continue to evolve.

Under the sub-category 'Measurement and Value', Rozario and Thomas (2019) propose an external audit blockchain that supports smart audit procedures with the aim to improve audit quality and narrow the expectation gap between auditors, financial statement users, and regulatory bodies; they envision a transformation of auditing by automating workflows but more importantly, by enhancing audit efficiencies and effectiveness, transparency and financial reporting as a whole. On the other hand, Tang and Tang (2019) suggest research into the application of blockchain on climate change and the more specific topics of carbon financing, carbon assurance, and decarbonization. In addition, there is a call for research to be extended toward empirical testing of the application of different types of blockchains through the methods of surveys, interviews, and case studies (Centobelli et al. 2021). Liu et al. (2022) suggest empirical testing for cost reduction as data become available within the proposed transaction cost theory proposed.

In terms of 'Management and Organization' under 'Platforms', O'Leary's (2019) study proposes to explore the use of other distributed databases in a virtual organization, while Smith (2018) points to the importance of being informed in the wider use of blockchain. In the same year, O'Leary (2018) proposed to establish a continuous monitoring system for blockchains in general. Akter et al. (2024) suggest gathering data from actual users in the accounting domain to validate the use and anticipated adoption of blockchain in accounting and to understand the conditions under which blockchain adds value, such as specific types of blockchain and accounting areas. Additionally, future studies should employ quantitative techniques to validate the key drivers of blockchain accounting adoption identified at the organizational level and determine their relative significance. Moreover, research should explore blockchain accounting adoption across various industries, markets, and geographic regions to contextualize findings within different legal, political, and cultural jurisdictions.

Firms and Industries: As illustrated in Table 5, a lot of the studies in our sample are devoted to the role of firms and industries within the processes in a blockchain-based accounting system. Research on the governance of the blockchain itself is also needed. Within the 'Design and Features' activity of blockchain application, a study by Coyne and McMickle (2017) suggests research into how to bring the assurance and consensus mechanisms of a public blockchain to a private blockchain—for example how to give 50 percent of the computing power to the auditor—in order to achieve cost savings for the firm and assurance for investors; it is necessary that researchers evaluate different consensus mechanisms (e.g., the efficiency of proof-of-stake or any improved versions versus proof-of-work as a verification method). Fülöp et al. (2022) suggest analyzing the model of adopting services offered by Industry 4.0 within the financial accounting field in greater detail.

Cai (2021) argues for future research to be devoted to investigating the regulatory barriers and security risks associated with triple-entry accounting through a practical methodology of interviews, surveys, and case studies. The author further suggests conducting a study of blockchain applications involving economics, technology, and psychology. Furthermore, Carlin (2019) calls for academic research and educational development beyond double-entry accounting and toward triple-entry blockchain applications in accounting.

The impact of blockchain on the level of quality and efficiency within accounting and auditing is another area for future research. Kend and Nguyen (2022) stress the need for empirical tests to assess whether the level of audit and accounting quality is maintained through blockchain applications.

Another point of interest for future research is how real-time transaction recording impacts accounting and auditing procedures and, in turn, modifies the scope of accountants' and auditors' roles. According to Kokina et al. (2017), more research is necessary to track how blockchain technology changes the way accountants work. This includes identifying what new tasks these technologies will allow accountants to perform, what tasks they will replace, and how they will collaborate with these technologies. Research on the new roles that Initial Coin Offerings generate for accountants in terms of financial reporting and guidance is recommended by Moll and Yigitbasioglu (2019).

Research on the governance of the blockchain itself is also needed. Karajovic et al. (2019) suggest that for future studies, it will also be necessary to create new governance structures to guarantee moral decision-making and efficient crisis management. Castka et al. (2020) point out that it is important to investigate to what extent technology-enhanced auditing affects the governance of audits. Kokina et al. (2017) state that further research is required to comprehend the developing regulatory framework around the blockchain ecosystem from the regulators' point of view. Academics studying auditing should also look at how to create internal controls for blockchain applications.

Research to understand what skills and education the professionals involved will need in order to be able to support the adoption of and play a role in a blockchain accounting and auditing system is needed. Dai and Vasarhelyi (2017) add that we should find out

specifically what training should be provided in order to help professionals understand, design, and audit smart contracts.

Dai and Vasarhelyi (2017) urge research into the impact of blockchain adoption on accounting standards, specifically into how accounting standards should be changed, whether there should be parallel standards created for the transformation to blockchain accounting and auditing, and what standards should be created to enforce the audit of smart contracts. The authors point out that research into what standards should be created to enforce the audit of smart contracts is needed.

Indeed, the way the IT ecosystem is changing and how slowly regulators are issuing new standards or modifying existing ones are not keeping up with each other (Gauthier and Brender (2021)). The authors thus argue for future research to incorporate newer IT auditing standards to mirror the rapid application of blockchain in auditing. On the other hand, Hampl and Gyönyörová (2021) call for further research to be undertaken on the reporting methods of fiat-backed and other types of stablecoins.

Another point of interest for future research would be the issue of auditor independence and how this—and audit fees—would be affected by the possibility of having real-time access to client blockchain (Moll and Yigitbasioglu 2019). Research should investigate whether auditor independence would be impaired by the application of blockchain technology (Dai et al. 2019).

Autore et al. (2024) call for the investigation of motivating factors for blockchain adoption, such as real-time financial reporting and reduced accounting manipulation, to measure the variation in blockchain usage among firms.

Interestingly, Hubbard (2023) suggests exploring the implications of firms using cryptocurrency as an investment strategy compared to using it as a medium of exchange and analyzing the strategic implications of both methods.

Indeed, based on our analysis of the studies in our sample and specifically the future research suggested by these studies, there are a number of avenues to be explored. In particular, there is a call for research in (i) skills, training, and education to support the adoption of blockchain in accounting and auditing, (ii) governance of blockchain, (iii) evolution of the accounting and auditing professions and responsibilities as a result of blockchain adoption, (iv) auditor independence, and (v) the impact of blockchain adoption on accounting standards. We, therefore, develop a conceptual framework for our research (Figure 8) that interlinks the outcomes of our study emerging from the descriptive and thematic analyses, respectively, and leading to future areas of research in blockchain in accounting and auditing.

Notably, since most of the studies so far are theoretical, there is a need for more empirical studies on the topic of blockchain and accounting and auditing and the impact of its application (see, for example, Tan and Low 2019; Tiberius and Hirth 2019; Ram et al. 2016; Moll and Yigitbasioglu 2019; McGuigan and Ghio 2019), and especially case studies (see Bonsón and Bednárová 2019; Castka et al. 2020; Cai 2021; O'Leary 2017, 2019).
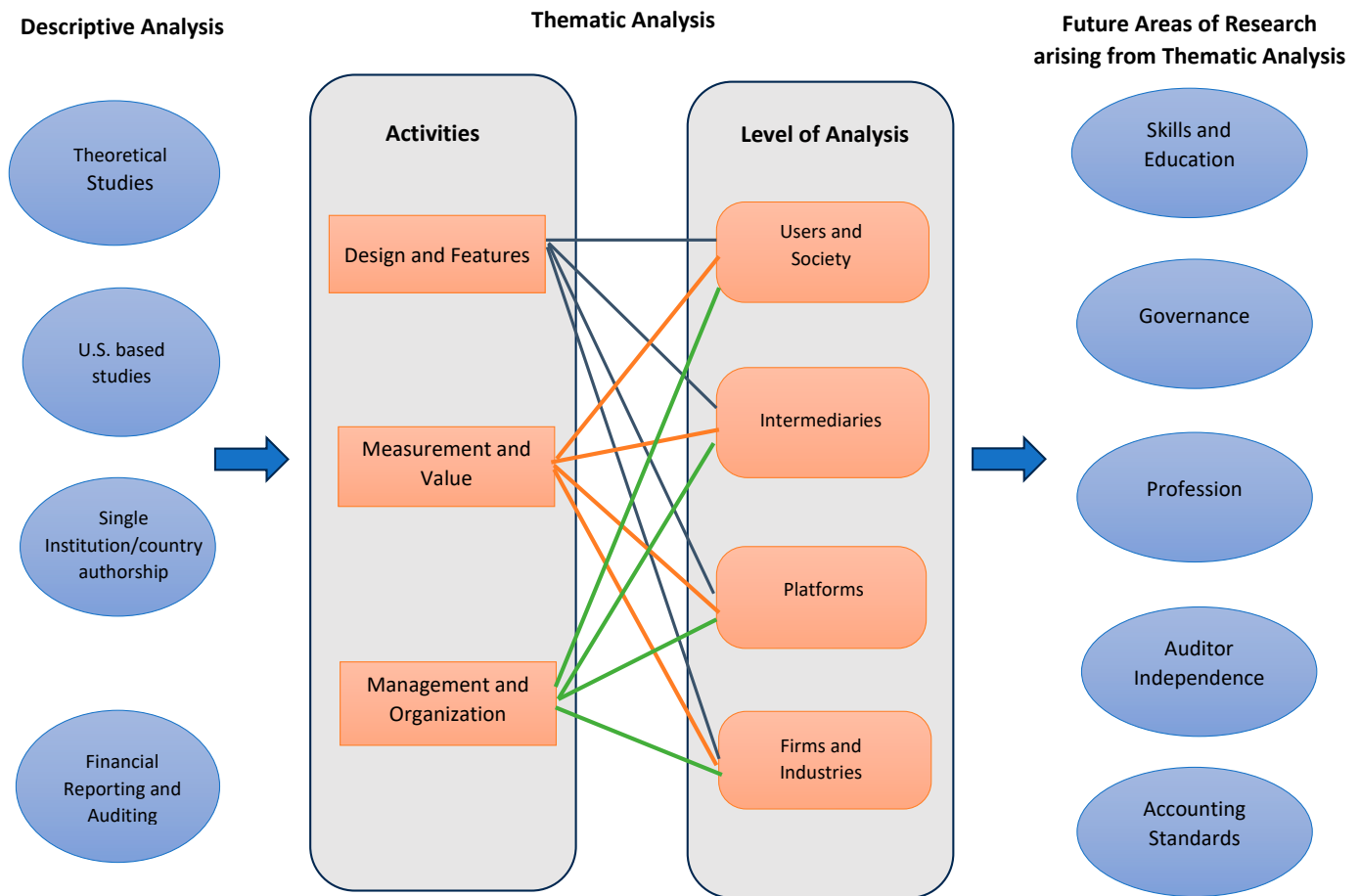
Figure 8. Conceptual Framework of Research.

6. Conclusions

The adoption of blockchain in accounting and auditing has been a slow process, which can be attributed to the reluctance of the industry to adopt new technologies and the incompatibility of the existing accounting software packages with blockchain technologies (Yadav 2018). Simultaneously, the academic literature on the topic of blockchain adoption in accounting and auditing is indeed limited. However, the adoption of blockchain and its impact on accounting and auditing has been growing, and so has the number of studies. Consequently, for this reason, we develop a systematic literature review that encompasses 75 peer-reviewed high-quality academic studies. Our sample includes studies that were published up to June 2024 on the topic of blockchain and accounting and auditing. We perform thematic analysis of the studies utilizing a framework developed by Risius and Spohrer (2017) to (1) construct a map of the academic research in the fields of business, as well as behavioral, business-oriented information systems, research by identifying the main issues on the topic, (2) identify the main challenges that inhibit the application of blockchain in accounting and auditing according to the academic literature, (3) look into the discussions pertaining to how we should account for cryptocurrencies, (4) look into the discussions on the blockchain and the accounting and auditing profession, and (5) identify the direction of research, along with potential avenues for future research.

We initially categorized our sample of studies according to the criteria suggested by Vrontis and Christofi (2021), which resulted in a descriptive analysis of the literature pertaining to blockchain in accounting and auditing. The results show that the majority of studies in our sample are of a theoretical nature and have been published in the last four years. Nonetheless, the results do indicate that a steadily rising number of empirical studies have been published in the last two years; however, more such empirical studies are needed for the progression and smoother adoption of blockchain in accounting and auditing.

In addition, a larger portion of our sample of studies are US-based. This gives a rise in interest for research to be carried out on other economies in order to assess and provide useful comparisons on the methods and effects of the adoption of blockchain on accounting and auditing.

Furthermore, we carry out a thematic analysis on the sample of our studies following the methodology of Risius and Spohrer (2017), with the goal of understanding the direction and focus of literature in the area of blockchain accounting and auditing. Our framework categorizes the studies between four levels of analysis: (1) 'Users and Society', (2) 'Intermediaries', (3) 'Platforms', and (4) 'Firms and Industries' across three activities: (1) 'Design and Features', (2) 'Measurement and Value', and (3) 'Management and Organization'. We provide a comprehensive analysis of each of the studies in our sample based on their level of analysis and activity. Our categorization results in the majority of the studies focusing on 'Management and Organization' and the level of analysis pertaining to 'Firms and Industries'. This shows that within the accounting and auditing field, the adoption of blockchain technology and the impact of such on organizations and industries is the most widely researched area.

Moreover, we recognize the main challenges inhibiting the application of blockchain in accounting and auditing. These include functionality, data and process integrity, and regulatory concerns (Appelbaum et al. 2022). Auditors face significant challenges in auditing blockchain-based assets, which has led to resistance in the sector (Pimentel et al. 2021). Current auditing standards may not adequately address the emergent use of blockchain technology, creating a barrier to its adoption (Gauthier and Brender 2021). Additionally, factors such as professional skepticism and perceived adequacy of accounting standards negatively impact auditors' acceptance of blockchain (Li and Juma'h 2022). Organizational challenges, including complex integration with existing systems and increased costs, further hinder blockchain adoption in accounting (Akter et al. 2024). The adoption of blockchain technology in audit practice also faces challenges related to its implementation and the need for new audit procedures (Parmoodeh et al. 2023). Moreover, the status quo and development tendencies of digitization in accounting highlight issues of user trust and perceived risk (Fülöp et al. 2022). Audit issues related to private and semi-private blockchains, such as data reliability, security, and transaction transparency, also pose significant challenges (Appelbaum and Nehmer 2020). Finally, the feasibility of using blockchain as an accounting ledger is questioned due to multiple implementation flaws (Coyne and McMickle 2017), and designing a blockchain architecture for CPA firms involves addressing connectivity, data confidentiality, and security challenges (Vincent et al. 2020).

In addition, based on our thematic framework on the focus on the current literature, we analyze the potential avenues of future research in the area of blockchain accounting and auditing. As blockchain applications are more widely used in the accounting and auditing profession, there is a call for more empirical studies focusing on specific areas of accounting and auditing. Our results indicate that there is an obvious need for more studies to be undertaken on the implications of blockchain on more specific areas of accounting and auditing, such as skills and education, governance, the nature of accounting and auditing jobs, auditor independence, and accounting standards.

During the preparation of this work the author(s) used ChatGPT and QuillBot on Tables A1 and A3 in order to re-phrase and re-formulate the content. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Overview of Reviewed Papers' Research Focus and Findings.

Citation	Key Research Focus	Key Research Findings
Abdennadher et al. (2021)	To examine how auditors and accountants view the use of blockchain technology in the United Arab Emirates following the government's announcement that it will move 50% of all government transactions onto a platform based on blockchain technology by 2021.	Blockchain affects the accounting industry in terms of transaction recording, evidence storage, and offering a safe environment for conducting business. It alters auditors' approach and procedure, holds promise for augmenting traditional auditing, and will automate accounting practices. Accounting professionals and auditors will become aware of and involved in blockchain development in assurance services.
Abu Afifa et al. (2022)	To apply an expanded Unified Theory of Acceptance and Use of Technology (UTAUT) to examine the accountant's desire to implement blockchain.	Intention to adopt blockchain is positively influenced by performance and effort anticipation but less by social influence. Trust positively impacts ambition to adopt blockchain, effort, and performance expectations. Job relevance negatively impacts performance anticipation, while accounting information quality has a favorable influence. Computer compatibility and self-efficacy positively impact effort expectations. Compatibility has no bearing on the decision to adopt blockchain.
Abu Afifa et al. (2022)	Investigate the intention to use blockchain from the accountant's point of view using an extended UTAUT model.	External constructs like accounting information quality, job relevance, and trust influence blockchain adoption.
Akter et al. (2024)	Examine the organizational factors that drive and hinder the adoption of blockchain in accounting.	Nine context-specific factors influence blockchain adoption; challenges include lack of knowledge and complex integration with existing systems.
Al Shanti and Elessa (2023)	Explore the impact of digital transformation, specifically blockchain technology, on the quality of accounting information and corporate governance in banks.	Digital transformation toward blockchain can enhance accounting information quality and strengthen corporate governance.
Al-Htaybat et al. (2019)	Investigate how accounting procedures and emerging technologies like blockchain connect as intellectual capital to promote value creation and achieve Sustainable Development Goals.	Gaining an in-depth understanding of new technology can improve interpretation capacity. Integrated reports can better represent new business models and enable greater disclosure.
Alles and Gray (2020)	Focus on the need for auditing to overcome the "first-mile problem" (FMP) in ensuring data on the blockchain matches actual data.	Training auditors can help overcome the FMP, but there is no guarantee that traditional auditors will meet the increased demand for new auditors.
Alsalmi et al. (2023)	Investigate the classification and accounting practices for digital currencies.	Current accounting standards do not cover digital currencies adequately; there is a need for new standards to avoid inconsistent global approaches.
Appelbaum and Nehmer (2020)	Analyze how auditors might examine business transactions connecting to a private or semi-private blockchain.	Blockchains covered in the study would be private or semi-private, business-to-business or business-to-consumer, and housed in a private, semi-private, or public cloud. Each blockchain would have unique protocols for operation and validation.

Table A1. *Cont.*

Citation	Key Research Focus	Key Research Findings
Appelbaum et al. (2022)	Explore reasons behind the lag in widescale adoption of blockchain technology for business operations and accounting.	Identifies functionality, data and process integrity, and regulatory concerns as potential explanations for the lag in adoption. Provides a framework of questions to address concerns delaying blockchain implementation.
Autore et al. (2024)	Investigate the association between blockchain adoption and firms' financial reporting behavior.	Blockchain adoption may increase earnings management due to hype and reduced monitoring.
Beigman et al. (2023)	Present a methodology to dynamically designate principal markets and derive fair value prices for cryptocurrencies.	Principal market identification is challenging due to market fragmentation; proposes a dynamic designation methodology.
Brandon et al. (2024)	Examine the financial accounting and reporting issues surrounding cryptocurrencies.	Students found the case realistic, interesting, and challenging; appropriate financial accounting treatment for Bitcoin varies by client type.
Cai (2021)	Using a case study methodology, the study integrates traditional triple-entry accounting with blockchain technology.	Businesses will only need to make one internal entry for certain accounts using blockchain technology, with the other entry noted on a shared public ledger. Triple-entry accounting on the blockchain can significantly enhance accounting by resolving transparency and trust issues.
Campbell et al. (2023)	Examine the effects of automation bias in auditing blockchain environments.	Predominantly influenced by the Halo Effect, indicating a propensity for positive automation bias across management assertions.
Carlin (2019)	Present an overview of blockchain technology development, which can advance accounting beyond double entry.	Blockchain will change accounting, introducing blockchain-based record-keeping with profound effects on financial reporting, auditing, and management accounting. Academics need to study implementation difficulties and develop educational frameworks.
Centobelli et al. (2021)	Using an ecosystem viewpoint, this article attempts to develop and assess a blockchain platform for the accounting industry.	Distributed record storage on a blockchain platform increases process status information flow transparency, boosting operational efficiency. Using a mix of off-chain and on-chain solutions is no longer necessary when data is recorded on the blockchain platform.
Coyne and McMickle (2017)	Investigate if blockchain might replace existing accounting ledgers as a more secure option.	Blockchain transaction verification cannot be done to an adequate degree in accounting. Blockchain's security features are not entirely functional or dependable in an accounting context.
Dai and Vasarhelyi (2017)	Investigate the uses of blockchain technology in the accounting and auditing profession.	Presents an accounting and assurance approach built on blockchain for more automation of assurance and accounting.
Dai et al. (2019)	Provide a framework for using smart contracts and blockchain technology to rethink audit practices and enable Audit 4.0.	Data integrity and proper operation of intelligent auditing modules are major challenges. A framework for utilizing smart contracts to execute Audit 4.0 is provided. Real air quality data gathered through crowdsourcing are validated and analyzed using blockchain and smart contracts.

Table A1. *Cont.*

Citation	Key Research Focus	Key Research Findings
Davenport and Usrey (2023)	Examine the complexities and regulatory environment for crypto assets to provide guidance on their tax classification.	One tax classification for crypto assets is not sufficient; different classifications provide more equitable tax treatment.
Dunn et al. (2021)	This case is designed for either undergraduate or graduate auditing and assurance courses, focusing on the auditing implications of blockchain technology and Bitcoin.	N/A
Dupuis et al. (2023)	Provide a holistic overview of digital assets for auditing faculty, students, and practitioners.	Contextualizes digital assets within monetary systems, outlines auditing challenges and management assertion complexities, and highlights fraud risk factors. Explores innovations in digital currency markets.
Dyball and Seethamraju (2021)	The paper describes a study that looked into the influence of customer use of blockchain technology on Australian accounting companies.	Australian accounting companies have either acquired or explored engagements with clients who operate Bitcoin businesses or use blockchain platforms. Blockchain technology presents unique risks and opportunities for applying and growing audit knowledge in a new field of auditing.
Dyball and Seethamraju (2022)	This study addresses the risks associated with auditing blockchain-based financial statements and cryptocurrencies.	Inherent and control risks are increased, and blockchain clients are thought to be riskier than traditional clients. Two possible audit approaches include increasing indirect and entity-level evidence or combining direct, indirect, account-level, and entity-level evidence.
Ferri et al. (2021)	Examine the auditing profession's readiness to adopt "disruptive" technologies based on empirical data from Italian Big Four employees.	Performance expectations and social influence are primary determinants of auditors' readiness to use blockchain.
Fortin and Pimentel (2024)	Examine Bitcoin as an accounting regime and its implications.	Bitcoin constitutes a new technology built on social practices and accounting language; human interactions underpin the system's power.
Fülöp et al. (2022)	Examine the status quo and development tendencies of digitization in accounting.	User trust and perceived usefulness influence the adoption of digital services; risk factors did not affect perceived use.
Gauthier and Brender (2021)	The study examines the methods auditors are using to determine whether the present auditing standards are still relevant, given the growing usage of blockchain technology.	There is a rising need for IT auditing standards, and regulators are slow in updating or releasing new standards, contrary to the evolving IT environment.
Gietzmann and Grossetti (2021)	The paper questions the taxonomy of distributed ledgers and raises concerns about the consensus system and the ability to write to the ledger.	Transitioning from centralized to decentralized ledger systems keeps accounting knowledge relevant. Distributed ledger systems can create value without cryptocurrency.
Gomaa et al. (2023)	Develop a conceptual framework leveraging blockchain to streamline and enhance transaction reconciliation efficiency.	The proposed framework involves recording transactions on the blockchain before updating ERP systems, improving transparency and consistency. Demonstrates technical feasibility with examples.
Hampl and Gyönyörová (2021)	The study examines whether fiat-backed stablecoins can be classified as cash or cash equivalents under IFR Standards.	Fiat-backed stablecoins may be reported as cash equivalents if kept to meet short-term obligations. Companies must evaluate whether the material requirements of the coins have been met before reporting them as cash equivalents.

Table A1. *Cont.*

Citation	Key Research Focus	Key Research Findings
Hubbard (2023)	Examine potential financial accounting treatments for cryptocurrencies.	Proposes an intangible asset revaluation model; aims to inform standard setters and financial statement preparers.
Juma'h and Li (2023)	Examine factors influencing auditors' intention to use blockchain.	Auditors' knowledge is positively associated with use intention; perceived adequacy of accounting standards negatively affects intention.
Karajovic et al. (2019)	Assess how blockchain technology will affect the accounting industry and specific procedures.	Blockchain can help accounting businesses provide better customer service and manage transactions, records, and performance. New governance models must be created for moral decision-making and efficient crisis management.
Kend and Nguyen (2022)	Analyze whether blockchain technology will significantly alter Australian assurance and audit services.	The impact of BDA, robotics, and AI on auditing is considered favorable, but participants are doubtful of blockchain's applicability in auditing practice.
Kokina et al. (2017)	Provide a summary of blockchain-related procedures followed by big accounting firms and identify key turning points in the technology's development.	Big accounting firms have a positive outlook on blockchain adoption, with advantages outweighing disadvantages.
Lee et al. (2024)	Examine the impact of blockchain technology on taxpayer compliance among US taxpayers.	Integrating blockchain can address noncooperative behavior and reduce the tax gap; key factors include IRS efficiency and increased punishment.
Li and Juma'h (2022)	Examine how blockchain features must align with auditors' task needs to enhance acceptance of blockchain-based solutions.	The auditors' task needs to fully mediate the effect of blockchain features on acceptance. Different blockchain features hold varying importance. Strengthening auditors' knowledge and awareness of blockchain is essential.
Liu et al. (2022)	Examine the potential impact of blockchain technology on accounting and auditing processes through the lens of transaction cost theory.	Blockchain offers significant advantages for accounting and auditing by enabling recording, tracking, and managing transactions and assets, potentially lowering transaction costs.
Liu et al. (2019)	Investigate potential blockchain effects on auditing and accounting procedures and offer ideas for auditors.	Analysis of advantages and disadvantages of permissioned vs. permissionless blockchains. Auditors should become knowledgeable about blockchain governance and technology, focusing on risk management.
Casciello et al. (2021)	Investigate the potential advantages and disadvantages of integrating blockchain technology into accounting and auditing procedures.	Emphasizes the value of accountants' and auditors' expertise and professional conscience in contrast to blockchain's impersonal and standardized AI operating system.
Marei et al. (2023)	Investigate the understanding of cryptocurrencies among newly certified public accountants and accounting graduate students.	Recent graduates and CPAs have limited awareness of cryptocurrencies, likely due to a lack of exposure during education.
McAliney and Ang (2019)	Review two current technologies for network-based data storage and sharing—relational databases and Google Sheets—and their use in accounting organizations.	Framework to choose between blockchain and traditional databases. Organizations relying on traditional databases' security features will face new data governance challenges.

Table A1. *Cont.*

Citation	Key Research Focus	Key Research Findings
McCallig et al. (2019)	Provide stakeholders with reliable information about the entity separate from the auditor and improve audit evidence to support their opinion.	Representational accuracy of financial reporting information can be demonstrated using multiple security techniques.
McGuigan and Ghio (2019)	Critically examine how continuing technological revolutions can expand accounting's potential into other areas.	New technologies can expand accounting into areas like visualization, curation, performance, and disruption.
O'Leary (2017)	Define suggested applications of blockchain technology for transactions, such as those in supply chain or accountancy.	Companies will mainly use private and cloud-based blockchain configurations. Hybrid systems combining current and blockchain technologies may be created.
O'Leary (2018)	Examine how corporate blockchain systems for transaction processing are affected by transactions involving open information.	Incentives are needed for companies to abandon control of information disclosure via blockchains, such as mandates from governmental bodies or significant penalties.
O'Leary (2019)	Portray that conventional private blockchains are created to satisfy consortium requirements and may not be adopted by all parties involved in business.	Suggests creating a design before moving to a blockchain application, using a database combining blockchain and database features.
Parmoodeh et al. (2023)	Explore the impact of blockchain technology on audit practice.	Blockchain can enhance audit procedures, reduce audit budget time, and facilitate analytical procedures.
Pimentel et al. (2021)	Focus on why auditors are hesitant to work with clients that own cryptocurrencies.	Ownership and price of cryptocurrencies are major obstacles to offering an audit opinion. Suggests lowering audit risk by carefully screening clients and management groups and working closely with blockchain experts.
Qasim and Kharbat (2020)	Demonstrate ways to include blockchain technology, AI, and data analytics in accounting syllabi to increase graduates' employability.	The accounting curriculum requires significant changes to align with new developments.
Qasim et al. (2022)	Determine the extent to which the current accounting curriculum reflects the ongoing digital transformation in the UAE, focusing on AI, blockchain technology, and data analytics.	Highlights recent initiatives in the UAE to test and adopt AI, blockchain technology, and data analytics, raising concerns about the adequacy of current accounting curricula.
Ram et al. (2016)	Choose a theoretical strategy for accounting for Bitcoin based on stewardship and neoliberalism theories.	Models based on neoliberalism and stewardship emphasize the fair value and cost of Bitcoin.
Roszkowska (2020)	Investigate the causes of financial scandals connected to audits and offer recommendations on how developing technologies can address these issues.	Blockchain, IoT, smart contracts, and AI can address financial reporting and audit-related issues, improving data accuracy in financial statements.
Rozario and Thomas (2019)	Provide a solution to the expectation gap challenge using an external audit blockchain backed by smart audit processes and smart contracts.	Smart audit techniques and blockchain could drastically alter auditing, but audit judgment will still play a big role. Future research prospects are presented.
Sheldon (2018)	Suggest a blockchain-based solution for compiling and disseminating cases of practitioner misconduct nationwide.	Proposes impartial access granting and creation of the blockchain by an impartial organization to avoid bias.
Sheldon (2019)	Examine threats to permissioned and private blockchains using IT general controls (ITGCs) as a framework for internal control over financial reporting audits.	Blockchain must obtain robust ITGCs to benefit from various systems. Several areas of consideration are named when changing a blockchain.

Table A1. *Cont.*

Citation	Key Research Focus	Key Research Findings
Smith (2020)	Provide practical insights into business information related to blockchain technology and its effects on risk assessment procedures.	The integrity of the verification and audit process may be preserved with decentralized and distributed systems.
Stein Smith (2018)	Study and evaluate the adaptations blockchain technology has created for the accounting industry.	Recognizing factors to consider and asking the right questions are clear first measures.
Stein Smith and Castonguay (2020)	Investigate how blockchain technology affects financial reporting and assurance and address financial data integrity and reporting challenges.	Organizations using blockchain must modify internal controls and counterparty risk assessment policies. External auditors should evaluate blockchain technology as a financial reporting risk.
Stern and Reinstein (2021)	Discuss how business professors teaching accounting may incorporate blockchain into their present courses or create new ones.	Results in sample course syllabi, recommended reading lists, resources for group and individual work, and student feedback. Expands students' knowledge by focusing on business applications of blockchain.
Tan and Low (2017)	Study the caveats pertaining to accounting for cryptocurrencies like Bitcoin.	It is not necessary to establish a new accounting standard for Bitcoin, but it is necessary to establish whether Bitcoin is a currency or a commodity.
Tan and Low (2019)	Investigate how blockchain technology would change the accounting industry.	Accountants will likely continue to oversee financial reports but not be the primary oversight of blockchain technology AIS. Audits will still be required in blockchain-based AIS.
Tang and Tang (2019)	Offer a structure for a distributed carbon ledger (DCL) system for managing climate change.	Implementation of the DCL complements current market-based emissions trading schemes (ETSs).
Tiberius and Hirth (2019)	Investigate changes in auditing practices that German auditing professionals expect within the next five to ten years.	The existing annual auditing method will give way to a continuous audit strategy. New technology will play a supporting function.
Vincent and Barkhi (2021)	Address the dangers of joining a blockchain consortium, concerns about internal controls, and whether COSO frameworks address a collaborative supply chain ecosystem.	Explains the inherent risks of participating in a blockchain consortium and provides an overview of smart contracts. Lists possible internal control-related queries for launching a smart contract or participating in a consortium.
Vincent et al. (2020)	Create a blockchain architecture for businesses to allow auditors to use blockchain technology for audit and assurance services.	The proposed design solves the problems.
Wang and Kogan (2018)	Determine how to use blockchain in accounting and auditing while balancing information transparency and confidentiality.	Provides design frameworks for processing systems to ensure confidentiality, monitoring, and enhanced performance.
Weigand et al. (2020)	Formally introduce a shared system based on decentralized ledger technology (DLT) that complies with Financial Reporting Standards.	Smart contracts can develop a simple representation pattern for business exchange transactions, improving auditability and interoperability.

Table A2. Theories and Frameworks Used by Reviewed Studies.

Publication Details Citation	Theories/Frameworks Applied
Abu Afifa et al. (2022)	Unified theory of acceptance and use of technology (UTAUT)
Abu Afifa et al. (2022)	Extended unified theory of acceptance and use of technology (UTAUT) model
Akter et al. (2024)	Technology–Organization–Environment (TOE) framework
Al Shanti and Elessa (2023)	Agency theory
Al-Htaybat et al. (2019)	Global brain concept, evolutionary cybernetics concept
Appelbaum and Nehmer (2020)	Design science research (DSR)
Centobelli et al. (2021)	Design science research (DSR)
Dyball and Seethamraju (2021)	Gendron's (2002) typology, Greenwood and Suddaby's (2006) archetype
Dyball and Seethamraju (2022)	van Buuren et al. (2014) continuum of audit approaches
Ferri et al. (2021)	Integrated theoretical framework merging the third version of the technology acceptance model (TAM3) and the unified theory of acceptance and use of technology (UTAUT)
Fülöp et al. (2022)	Technology Acceptance Model (TAM) combined with trust and perceived risk
Hampl and Gyönyörová (2021)	IFRS framework
Kend and Nguyen (2022)	Diffusion of innovation theory
Li and Juma'h (2022)	Task–technology fit and fit-as-mediation perspectives
Liu et al. (2022)	Transaction cost theory (Coase 1937)
McCallig et al. (2019)	Network analysis
O'Leary (2018)	Arrow's impossibility theorem
O'Leary (2019)	Arrow's impossibility theorem; Business logic: Semantic model
Ram et al. (2016)	Stewardship, neoliberalism
Rozario and Thomas (2019)	Design science research (DSR)
Sheldon (2019)	Information technology general controls (ITGCs)
Vincent and Barkhi (2021)	Committee of Sponsoring Organizations (COSO) integrated and COSO's Enterprise Risk Management (ERM) frameworks
Weigand et al. (2020)	REA Accounting Model, Accounting Ontology

Table A3. Further research.

Citation	Avenues for Future Research
Abu Afifa et al. (2022)	Additional empirical research is required. Moreover, the authors suggest applying the model to SMEs, as they exhibit greater strength in accounting digitization.
Akter et al. (2024)	Gather data from actual users in the accounting domain to validate the use and anticipated adoption of blockchain in accounting and to understand the conditions under which blockchain adds value, such as specific types of blockchain and accounting areas. Additionally, future studies should employ quantitative techniques to validate the key drivers of blockchain accounting adoption identified at the organizational level and determine their relative significance. Moreover, research should explore blockchain accounting adoption across various industries, markets, and geographic regions to contextualize findings within different legal, political, and cultural jurisdictions.
Al-Htaybat et al. (2019)	Future research should further explore the concept of value creation and pinpoint specific indicators for various types of value, including financial, practical, societal, and environmental sustainability. This research will also concentrate on backing the 2030 UN Agenda and its goal of achieving enduring sustainable development and fulfilling the SDGs. Specifically, examining practical applications to ascertain how integrated thinking can promote sustainable value creation in support of sustainable development and the achievement of SDGs would be particularly intriguing.

Table A3. *Cont.*

Citation	Avenues for Future Research
Autore et al. (2024)	Extend the sample period and include more firms beyond early adopters, investigate motivating factors for blockchain adoption, such as real-time financial reporting and reduced accounting manipulation, measure the variation in blockchain usage among firms, develop methods to assess monitoring efforts by market participants, and explore the unintended consequences of blockchain adoption on financial reporting as the technology becomes more widely adopted.
Cai (2021)	The author recommends exploring the regulatory challenges, security threats, and uncertain ROI that impede the broader application of triple-entry accounting. Additionally, the author advocates for the use of empirical methodologies like experiments, interviews, surveys, and case studies to delve deeper into the theoretical framework and the concept of triple-entry accounting, thereby fostering more robust foundational support. Lastly, future research could undertake interdisciplinary studies encompassing technology, economics, and psychology.
Carlin (2019)	The author contends that it is vital for scholars to shift their focus toward the numerous unresolved issues associated with this transformation. In doing so, they can seize a critical opportunity to wield influence, interact with pertinent stakeholders, and generate significant impact. Moreover, this will allow them to kick-start the creation of educational frameworks that will guarantee the sustainability of the accounting and auditing sectors beyond the double-entry era.
Centobelli et al. (2021)	The research suggests broadening the research methods to include empirical experiments, interviews, surveys, and case studies. Furthermore, the research could be expanded to encompass larger sample sizes. It is crucial to strengthen the conceptual and theoretical underpinnings and to include a wider range of empirical contexts in the sample. The study also calls for interdisciplinary research involving the fields of technology, economics, and psychology. It's necessary to contrast various industrial contexts to identify both common and unique trends and to further explore the impact of blockchain on accounting from both ecosystem and sociological viewpoints.
Dai et al. (2019)	The study suggests a potential direction for future research could be to delve into the uses of different types of blockchain (such as public, private, and permissioned) within the context of Audit 4.0. Additionally, researchers could seek methods to improve the precision of crowdsourced data while ensuring data privacy is maintained. The development of effective smart audit and reporting contracts is another significant aspect to explore. Even though IoT, blockchain, and smart contracts can effectively gather and store real data and conduct automated analyses, auditors are still required to apply their professional expertise to pinpoint process risks, assess system effectiveness, and filter and gather pertinent data. Lastly, it is crucial to investigate whether the adoption of emerging technologies and any novel audit methodologies linked with them could potentially jeopardize auditor independence.
Dyball and Seethamraju (2022)	The authors recommend modifying the continuum of audit methods proposed by van Buuren et al. (2014) to incorporate evidence at both the account and entity levels. This adjustment should reflect the viewpoints of audit practitioners, standard-setting entities, and regulatory bodies, which have been collected through interviews.
Ferri et al. (2021)	The authors propose (1) to adopt a longitudinal approach to study audit professionals' perceptions before the implementation and after the implementation of blockchain technologies in auditing activities, (2) to employ other theoretical models, e.g., the Technology–Organization–Environment (TOE) framework to increase explanatory power, and (3) to assess the existence of any disparities between voluntary settings and mandatory settings, and across different countries in terms of technology acceptance.
Fortin and Pimentel (2024)	Examine the evolution of Bitcoin under the leadership of recent Bitcoin Core Developers and its mainstream adoption, exploring potential ideological fragmentation within the Bitcoin community. Additionally, research could investigate how firms reconcile clashes between traditional accounting regimes and the Bitcoin regime, particularly for firms operating within both spheres, such as Bitcoin exchange-traded funds and crypto exchanges overseen by financial regulators. Analyzing how these companies navigate competing social practices to recognize economic value will be crucial as Bitcoin's usage and its impact on the accounting profession continue to evolve.
Fülöp et al. (2022)	Extend the data collection to a larger sample size. Additionally, increasing the number of variables involved could allow for more detailed research on the elements that affect the intention to apply new IT skills. This approach would provide a more refined, detailed, and comprehensive perspective on the identified factors. Consequently, a new empirical study could analyze the model of adopting services offered by Industry 4.0 within the financial accounting field in greater detail.

Table A3. *Cont.*

Citation	Avenues for Future Research
Gauthier and Brender (2021)	The authors suggest that to enhance the reliability of the results, similar surveys could be carried out in different locations (local, national, or international), encompassing organizations that are involved in setting and enforcing standards. Furthermore, new IT auditing standards should be formulated to adapt to swiftly evolving technologies (such as blockchain) and their integration into auditing.
Gomaa et al. (2023)	Technical implementation and security issues.
Hampl and Gyönyörová (2021)	The sole objective of this paper was to determine if fiat-backed stablecoins could be classified as cash equivalents under IFRS. It did not delve into the different accounting standards (like IAS 2 Inventories, IAS 38 Intangible Assets, or IFRS 9 Financial Instruments) that could be used to report fiat-backed stablecoins by the holder or issuer. Additionally, it did not investigate other kinds of stablecoins (such as collateralized and algorithmic stable coins) or their market performance. Future research could focus on those topics.
Hubbard (2023)	Explore the implications of firms using cryptocurrency as an investment strategy compared to using it as a medium of exchange, and analyze the strategic implications of both methods.
Juma'h and Li (2023)	Explore how auditors' acceptance of permissioned and permissionless blockchains may differ across various auditing contexts.
Karajovic et al. (2019)	The authors propose that future research should also focus on establishing new governance models to guarantee ethical decision-making processes and effective crisis management.
Kend and Nguyen (2022)	There is a need for empirical tests for the technology's impact on the quality and/or the efficiency of the audit.
Liu et al. (2022)	Empirical testing as data becomes available within the proposed transaction cost theory is proposed.
Casciello et al. (2021)	Future research will explore strategies for adopting blockchain technology through the use of case studies. This could provide insights into how and to what degree blockchain technologies might influence accounting and auditing activities.
McCallig et al. (2019).	There is a need for additional research to advance these designs, construct more complex models, and develop a functioning system. This subsequent research could investigate the potential application of the proposed system to other areas that necessitate confirmation as part of an audit, e.g., accounts payable. The subsequent research objective might be to examine different implementation strategies for the design proposed in this paper, for instance, an Ethereum blockchain utilizing simulated data.
McGuigan and Ghio (2019)	The authors emphasize the necessity for accounting researchers and practitioners to question conventional accounting perspectives, thereby facilitating the development of more advanced accountability models.
O'Leary (2018)	The author contends that the utilization of wash accounts can potentially influence enterprise markets, making it essential to identify their presence. As such, it is valuable to investigate alternative approaches for detecting these accounts, like those suggested by Tsikerdekis and Zeadally (2014), or to prevent their formation entirely. Additionally, to monitor events of direct interest, it might be feasible to set up continuous surveillance systems that oversee blockchains and social media.
O'Leary (2019)	The study suggests a potential future direction could be to investigate the use of alternative distributed databases in place of BigchainDB and also to further refine the model and present a comprehensive case study of its deployment in a virtual organization. The creation of more sample transactions could help broaden the research scope. Given the time-intensive nature of blockchain and similar structures, alternative methods such as the 'tangle' proposed by Popov (2018) and Heilman et al. (2017) might be worth considering. While the tangle might not have broad applicability, strategies like the tangle or hash graph (Baird 2016) could be suitable consensus mechanisms for virtual organization systems due to their distinctive features.
Parmoodeh et al. (2023)	Examine the insights and challenges faced by early adopters to understand how these can be adapted to accounting and audit practices.
Rozario and Thomas (2019)	The paper underscored that the integration of various technologies encountered numerous issues and challenges, which could pave the way for future research opportunities. One such challenge is the ambiguity surrounding the process of updating or modifying audit standards, as demonstrated by the draft comments from IAASB and PCAOB on revising or introducing new standards that advocate for the use of advanced audit analytics. Automating the implementation of these analytics on the blockchain could present a new set of challenges for standard-setters and regulators. This calls for research to ascertain how to disrupt the oversight model of financial statement audits (including its impact on audit quality) and regulate smart audit procedures on the blockchain. Another challenge is the consolidation of diverse sources of endogenous and exogenous data, which will persist as a hurdle.

Table A3. *Cont.*

Citation	Avenues for Future Research
Stein Smith (2018)	It is crucial to stay informed of the changes that take place in the blockchain field and establish structures to effectively evaluate and interact with these technologies in the future.
Tan and Low (2019)	Future research will need to empirically validate predictions once blockchain-based AIS are accessible.
Tang and Tang (2019)	The study proposes that as new algorithms and methodologies are developed, there may be a need to revise and reevaluate ETS applications. Furthermore, future research should focus on specific areas such as carbon assurance, carbon financing, decarbonization, and issues related to climate change adaptation.
Tiberius and Hirth (2019)	The authors present the potential for future research focused on the implications of incorporating new technologies into the auditing process.
Vincent and Barkhi (2021)	As a further area of research, the authors posit the necessity of examining the potential implications of a multi-company blockchain and smart contract framework from a holistic perspective that accounts for the risk and control measures of individual companies. In addition, they argue whether the governance of blockchain technology should be considered separately from the governance of individual companies.
Wang and Kogan (2018)	The authors propose further development of the specifics of BB-CASs, which consist of a series of smart contracts. These contracts can continuously oversee transaction activities and automatically issue alerts when certain trigger conditions are fulfilled.
Weigand et al. (2020)	The paper further suggests studying the effects of distributed ledger technology (DLT)-based automated information systems (AIS) on auditing and the development of a declarative language for agreement-backed smart contracts through public reporting drawn from the blockchain.

Notes

[1] Nakamoto, Satoshi (24 May 2009). "Bitcoin: A Peer-to-Peer Electronic Cash System".

[2] Mellis' work was in turn based on Hugh Oldcastle's lost 1543 Profitable treatyce (Smyth 2010) that was probably a translation of Luca Paccioli's Summa de Arithmetica, Geometria, Proportioni et Proportionalita (1494).

[3] If a fully Blockchain-based Accounting system is achieved, then Auditing becomes automatic, and thus, one could argue, obsolete. Thus, whenever we speak of "Accounting on Blockchain", the implications for Auditing are automatic.

[4] As to the job platform Indeed, PwC was the leading Big Four recruiter in the Blockchain space in March 2019, with 40 job openings. With 17 openings, EY came in second, while Deloitte was next with 10 job offers.

[5] The list only focuses on behavioral, business-oriented Information Systems research. See: https://aisnet.org/page/SeniorScholarBasket?andhhsearchterms=%22basket%22 (accessed on 23 June 2024).

[6] Formerly known as the "ABS list".

[7] It was observed that at least for our sample, the journals included in the AIS list were also part of the 2021 Academic Journal Guide.

References

Abdennadher, Sonia, Rihab Grassa, Hareb Abdulla, and Abdulla Alfalasi. 2021. The effects of blockchain technology on the accounting and assurance profession in the UAE: An exploratory study. *Journal of Financial Reporting and Accounting* 20: 53–71. [CrossRef]

Abu Afifa, Malik Muneer, Hien Vo Van, and Trang Le Hoang Van. 2022. Blockchain adoption in accounting by an extended UTAUT model: Empirical evidence from an emerging economy. *Journal of Financial Reporting and Accounting* 21: 5–44. [CrossRef]

Akter, Mohsina, Tyge-F. Kummer, and Ogan Yigitbasioglu. 2024. Looking beyond the hype: The challenges of blockchain adoption in accounting. *International Journal of Accounting Information Systems* 53: 100681. [CrossRef]

Al Shanti, Ayman Mohammad, and Mohammad Salim Elessa. 2023. The impact of digital transformation towards blockchain technology application in banks to improve accounting information quality and corporate governance effectiveness. *Cogent Economics & Finance* 11: 2161773.

Al-Htaybat, Khaldoon, Khaled Hutaibat, and Larissa von Alberti-Alhtaybat. 2019. Global brain-reflective accounting practices. *Journal of Intellectual Capital* 20: 733–62. [CrossRef]

Alles, Michael, and Glen L. Gray. 2020. "The first mile problem": Deriving an endogenous demand for auditing in blockchain-based business processes. *International Journal of Accounting Information Systems* 38: 100465. [CrossRef]

Alsalmi, Noora, Subhan Ullah, and Muhammad Rafique. 2023. Accounting for digital currencies. *Research in International Business and Finance* 64: 101897. [CrossRef]

American Information Systems (AIS). n.d. Senior Scholars' Basket of Journals. Last Retrieved on 20 June 2024. Available online: https://aisnet.org/page/SeniorScholarBasket?andhhsearchterms=%22basket%22 (accessed on 23 June 2024).

Appelbaum, Deniz, and Robert A. Nehmer. 2020. Auditing cloud-based blockchain accounting systems. *Journal of Information Systems* 34: 5–21. [CrossRef]

Appelbaum, Deniz, Eric Cohen, Ethan Kinory, and Sean Stein Smith. 2022. Impediments to blockchain adoption. *Journal of Emerging Technologies in Accounting* 19: 199–210. [CrossRef]

Autore, Donald, Huimin Amy Chen, Nicholas Clarke, and Jingrong Lin. 2024. Blockchain and earnings management: Evidence from the supply chain. *The British Accounting Review* 56: 101357. [CrossRef]

Baird, Leemon. 2016. The Swirlds Hashgraph Consensus Algorithm: Fair, Fast, Byzantine Fault Tolerance. *Swirlds Tech Reports SWIRLDS-TR-2016-01*. Available online: http://www.swirlds.com/downloads/SWIRLDS-TR-2016-01.pdf (accessed on 23 June 2024).

Beigman, Eyal, Gerard Brennan, Sheng-Feng Hsieh, and Alexander J. Sannella. 2023. Dynamic principal market determination: Fair value measurement of cryptocurrency. *Journal of Accounting, Auditing & Finance* 38: 731–48.

Berg, Chris, Sinclair Davidson, and Jason Potts. 2018. Ledgers. Available online: https://ssrn.com/abstract=3157421 (accessed on 23 June 2024).

Bonsón, Enrique, and Michaela Bednárová. 2019. Blockchain and its implications for accounting and auditing. *Meditari Accountancy Research* 27: 725–40. [CrossRef]

Brandon, Duane, Travis Holt, Jefferson Jones, James H. Long, and Jonathan Stanley. 2024. The case of bitcoins: Examining the financial accounting and reporting issues surrounding cryptocurrencies. *Journal of Accounting Education* 67: 100902. [CrossRef]

Cai, Cynthia Weiyi. 2021. Triple—Entry accounting with blockchain: How far have we come? *Accounting and Finance* 61: 71–93. [CrossRef]

Campbell, Cory A., Sridhar Ramamoorti, and Thomas G. Calderon. 2023. Automation Bias and the "Goldilocks Effect" in Auditing Blockchain. *Journal of Emerging Technologies in Accounting* 20: 29–53. [CrossRef]

Carlin, Tyrone. 2019. Blockchain and the journey beyond double entry. *Australian Accounting Review* 29: 305–11. [CrossRef]

Casciello, Raffaela, Marco Maffei, and Fiorenza Meucci. 2021. The role of institutional shareholders in the relationship between unconditional conservatism and earnings management. *Corporate Ownership & Control* 19: 94–104.

Castka, Pavel, Cory Searcy, and Jakki Mohr. 2020. Technology-enhanced auditing: Improving veracity and timeliness in social and environmental audits of supply chains. *Journal of Cleaner Production* 258: 120773. [CrossRef]

Centobelli, Piera, Roberto Cerchione, Pasquale Del Vecchio, Eugenio Oropallo, and Giustina Secundo. 2021. Blockchain technology design in accounting: Game changer to tackle fraud or technological fairy tale? *Accounting, Auditing & Accountability Journal* 35: 1566–97.

Coase, Ronald H. 1937. The nature of the firm. *Economica* 4: 386–405. [CrossRef]

Coyne, Joshua G., and Peter L. McMickle. 2017. Can blockchains serve an accounting purpose? *Journal of Emerging Technologies in Accounting* 14: 101–11. [CrossRef]

Dada, Olufunmilola. 2018. A model of entrepreneurial autonomy in franchised outlets: A systematic review of the empirical evidence. *International Journal of Management Reviews* 20: 206–26. [CrossRef]

Dai, Jun, and Miklos A. Vasarhelyi. 2017. Toward blockchain-based accounting and assurance. *Journal of Information Systems* 31: 5–21. [CrossRef]

Dai, Jun, Na He, and Haizong Yu. 2019. Utilizing Blockchain and Smart Contracts to Enable Audit 4.0: From the Perspective of Accountability Audit of Air Pollution Control in China. *Journal of Emerging Technologies in Accounting* 16: 23–41. [CrossRef]

Davenport, Stephan A., and Spencer C. Usrey. 2023. Crypto Assets: Examining Possible Tax Classifications. *Journal of Emerging Technologies in Accounting* 20: 55–70. [CrossRef]

Denyer, David, and David Tranfield. 2009. Producing a systematic review. In *The Sage Handbook of Organizational Research Methods*. Edited by David A. Buchanan and Alan Bryman. London: Sage Publications Ltd., pp. 671–89. Available online: https://psycnet.apa.org/record/2010-00924-039 (accessed on 23 June 2024).

Dunn, Ryan T., J. Gregory Jenkins, and Mark D. Sheldon. 2021. Bitcoin and Blockchain: Audit Implications of the Killer Bs. *Issues in Accounting Education* 36: 43–56. [CrossRef]

Dupuis, Daniel, Debbie Smith, Kimberly Gleason, and Yezen Kannan. 2023. Bitcoin and Beyond: Crypto Asset Considerations for Auditors/Forensic Accountants. *Journal of Forensic and Investigative Accounting* 15: 489–510.

Dyball, Maria Cadiz, and Ravi Seethamraju. 2021. The impact of client use of blockchain technology on audit risk and audit approach—An exploratory study. *International Journal of Auditing* 25: 602–15. [CrossRef]

Dyball, Maria Cadiz, and Ravi Seethamraju. 2022. Client use of blockchain technology: Exploring its (potential) impact on financial statement audits of Australian accounting firms. *Accounting, Auditing & Accountability Journal* 35: 1656–84.

Ferri, Luca, Rosanna Spanò, Gianluca Ginesti, and Grigorios Theodosopoulos. 2021. Ascertaining auditors' intentions to use blockchain technology: Evidence from the Big 4 accountancy firms in Italy. *Meditari Accountancy Research* 29: 1063–87. [CrossRef]

Fortin, Mélissa, and Erica Pimentel. 2024. Bitcoin: An accounting regime. *Critical Perspectives on Accounting* 99: 102731. [CrossRef]

Fülöp, Melinda Timea, Dan Ioan Topor, Constantin Aurelian Ionescu, Sorinel Căpușneanu, Teodora Odett Breaz, and Sorina Geanina Stanescu. 2022. Fintech accounting and Industry 4.0: Future-proofing or threats to the accounting profession? *Journal of Business Economics and Management* 23: 997–1015. [CrossRef]

Gauthier, Marion Pauline, and Nathalie Brender. 2021. How do the current auditing standards fit the emergent use of blockchain? *Managerial Auditing Journal* 36: 365–85. [CrossRef]

Gendron, Yves. 2002. On the role of the organization in auditors' client-acceptance decisions. *Accounting, Organizations and Society* 27: 659–84. [CrossRef]

Gietzmann, Miles, and Francesco Grossetti. 2021. Blockchain and other distributed ledger technologies: Where is the accounting? *Journal of Accounting and Public Policy* 40: 106881. [CrossRef]

Gomaa, Ahmed A., Mohamed I. Gomaa, and Ashley Stampone. 2019. A transaction on the blockchain: An AIS perspective, intro case to explain transactions on the ERP and the role of the internal and external auditor. *Journal of Emerging Technologies in Accounting* 16: 47–64. [CrossRef]

Gomaa, Ahmed A., Mohamed I. Gomaa, Salem L. Boumediene, and Magdy S. Farag. 2023. The Creation of One Truth: Single-Ledger Entries for Multiple Stakeholders Using Blockchain Technology to Address the Reconciliation Problem. *Journal of Emerging Technologies in Accounting* 20: 59–75. [CrossRef]

Greenwood, Royston, and Roy Suddaby. 2006. Institutional entrepreneurship in mature fields: The big five accounting firms. *Academy of Management Journal* 49: 27–48. [CrossRef]

Hampl, Filip, and Lucie Gyönyörová. 2021. Can Fiat—Backed Stablecoins Be Considered Cash or Cash Equivalents Under International Financial Reporting Standards Rules? *Australian Accounting Review, CPA Australia* 31: 233–55. [CrossRef]

Heilman, Ethan, Neha Narula, Thaddeus Dryja, and Madars Virza. 2017. Iota Vulnerability Report: Cryptanalysis of the Curl Hash Function Enabling Practical Signature Forgery Attacks on the Iota Cryptocurrency. Available online: https://github.com/mit-dci/tangled-curl/blob/master/vuln-iota (accessed on 23 June 2024).

Hubbard, Benjamin. 2023. Decrypting crypto: Implications of potential financial accounting treatments of cryptocurrency. *Accounting Research Journal* 36: 369–83. [CrossRef]

Juma'h, Ahmad H., and Yuan Li. 2023. The effects of auditors' knowledge, professional skepticism, and perceived adequacy of accounting standards on their intention to use blockchain. *International Journal of Accounting Information Systems* 51: 100650. [CrossRef]

Kaden, Stacey R., Jeff W. Lingwall, and Trevor T. Shonhiwa. 2021. Teaching Blockchain Through Coding: Educating the Future Accounting Professional. *Issues in Accounting Education* 36: 281–90. [CrossRef]

Karajovic, Maria, Henry M. Kim, and Marek Laskowski. 2019. Thinking outside the block: Projected phases of blockchain integration in the accounting industry. *Australian Accounting Review* 29: 319–30. [CrossRef]

Kauppi, Katri, Asta Salmi, and Weimu You. 2018. Sourcing from Africa: A systematic review and a research agenda. *International Journal of Management Reviews* 20: 627–50. [CrossRef]

Kend, Michael, and Lan Anh Nguyen. 2022. Key audit risks and audit procedures during the initial year of the COVID-19 pandemic: An analysis of audit reports 2019–2020. *Managerial Auditing Journal* 37: 798–818. [CrossRef]

Kinory, Ethan, Sean Stein Smith, and Kimberly Swanson Church. 2020. Exploring the Playground: Blockchain Prototype Use Cases with Hyperledger Composer. *Journal of Emerging Technologies in Accounting* 17: 77–88. [CrossRef]

Kokina, Julia, Ruben Mancha, and Dessislava Pachamanova. 2017. Blockchain: Emergent industry adoption and implications for accounting. *Journal of Emerging Technologies in Accounting* 14: 91–100. [CrossRef]

Krystle, M. 2019. Want to Work in Blockchain? *Pwc Has Just Been Named Top Recruiter, Followed by Big 4 Auditing Firms.* Available online: https://bitcoinexchangeguide.com/want-to-work-in-blockchain-pwc-has-just-been-named-top-recruiter-followed-by-big-4-auditing-firms/ (accessed on 12 January 2021).

Kuhn, Daniel. 2019. Global Accounting Firm KPMG Partners with Microsoft, R3 on Telecoms Blockchain. Available online: https://www.coindesk.com/global-Accounting-firm-kpmg-partners-with-microsoft-r3-on-telecoms-Blockchain (accessed on 23 June 2024).

Lee, Eugene Y., Gordon C. Leeroy, and Wesley Leeroy. 2024. Impact of Blockchain on Improving Taxpayers' Compliance: Empirical Evidence from Panel Data Model and Agent-Based Simulation. *Journal of Emerging Technologies in Accounting* 21: 89–109. [CrossRef]

Li, Yuan, and Ahmad H. Juma'h. 2022. The Effect of Technological and Task Considerations on Auditors' Acceptance of Blockchain Technology. *Journal of Information Systems* 36: 129–51. [CrossRef]

Liu, Manlu, Ashok Robin, Kean Wu, and Jennifer Xu. 2022. Blockchain's Impact on Accounting and Auditing: A Use Case on Supply Chain Traceability. *Journal of Emerging Technologies in Accounting* 19: 105–19. [CrossRef]

Liu, Manlu, Kean Wu, and Jennifer Jie Xu. 2019. How Will Blockchain Technology Impact Auditing and Accounting: Permissionless versus Permissioned Blockchain. *Current Issues in Auditing* 13: A19–A29. [CrossRef]

Marei, Yahya, Adel Almasarwah, Mohammad Al Bahloul, and Malik Abu Afifa. 2023. Cryptocurrencies in accounting schools? *Higher Education, Skills and Work-Based Learning* 13: 1158–73. [CrossRef]

McAliney, Peter J., and Ban Ang. 2019. Blockchain: Business' next new "It" technology—A comparison of blockchain, relational databases, and Google Sheets. *International Journal of Disclosure and Governance* 16: 163–73. [CrossRef]

McCallig, John, Alastair Robb, and Fiona Rohde. 2019. Establishing the representational faithfulness of financial accounting information using multiparty security, network analysis and a blockchain. *International Journal of Accounting Information Systems* 33: 47–58. [CrossRef]

McGuigan, Nicholas, and Alessandro Ghio. 2019. Art, accounting and technology: Unravelling the paradoxical "in-between". *Meditari Accountancy Research* 27: 789–804. [CrossRef]

Mellis, John. 1980. A Brief Instruction, and manner, how to keep books of Accounts. In *Historic Accounting Literature*. London: Scholar Press, vol. 22. First published 1588.

Moll, Jodie, and Ogan Yigitbasioglu. 2019. The role of internet-related technologies in shaping the work of accountants: New directions for accounting research. *The British Accounting Review* 51: 100833. [CrossRef]

O'Leary, Daniel E. 2017. Configuring blockchain architectures for transaction information in blockchain consortiums: The case of accounting and supply chain systems. *Intelligent Systems in Accounting, Finance and Management* 24: 138–47. [CrossRef]

O'Leary, Daniel E. 2018. Open information enterprise transactions: Business intelligence and wash and spoof transactions in blockchain and social commerce. *Intelligent Systems in Accounting, Finance and Management* 25: 148–58. [CrossRef]

O'Leary, Daniel E. 2019. Some issues in blockchain for accounting and the supply chain, with an application of distributed databases to virtual organizations. *Intelligent Systems in Accounting, Finance and Management* 26: 137–49. [CrossRef]

O'Neal, Stephen. 2019. Big Four and Blockchain: Are Auditing Giants Adopting Yet? Available online: https://cointelegraph.com/news/big-four-and-Blockchain-are-Auditing-giants-adopting-yet (accessed on 23 June 2024).

Ovenden, James. 2017. Will Blockchain Render Accountants Irrelevant? Available online: https://channels.theinnovationenterprise.com/articles/will-blockchain-render-accountants-irrelevant (accessed on 23 June 2024).

Ozlanski, Michael E., Eric M. Negangard, and Rebecca G. Fay. 2020. Kabbage: A Fresh Approach to Understanding Fundamental Auditing Concepts and the Effects of Disruptive Technology. *Issues in Accounting Education* 35: 26–38. [CrossRef]

Parmoodeh, Abdollah Mohammad, Esinath Ndiweni, and Yasser Barghathi. 2023. An exploratory study of the perceptions of auditors on the impact on Blockchain technology in the United Arab Emirates. *International Journal of Auditing* 27: 24–44. [CrossRef]

Perez, Yessi Bello. 2015. How Deloitte's Rubix Is Approaching Blockchain Tech. Available online: https://www.coindesk.com/how-deloitte-rubix-Blockchain-tech (accessed on 23 June 2024).

Pimentel, Erica, Emilio Boulianne, Shayan Eskandari, and Jeremy Clark. 2021. Systemizing the challenges of auditing blockchain-based assets. *Journal of Information Systems* 35: 61–75. [CrossRef]

Popov, Serguei. 2018. The tangle. *White Paper* 1: 30.

Qasim, Amer, and Faten F. Kharbat. 2020. Blockchain technology, business data analytics, and artificial intelligence: Use in the accounting profession and ideas for inclusion into the accounting curriculum. *Journal of Emerging Technologies in Accounting* 17: 107–17. [CrossRef]

Qasim, Amer, Ghaleb A. El Refae, and Shorouq Eletter. 2022. Embracing emerging technologies and artificial intelligence into the undergraduate accounting curriculum: Reflections from the UAE. *Journal of Emerging Technologies in Accounting* 19: 155–69. [CrossRef]

Ram, Asheer, Warren Maroun, and Robert Garnett. 2016. Accounting for the Bitcoin: Accountability, neoliberalism and a correspondence analysis. *Meditari Accountancy Research* 24: 2–35. [CrossRef]

Risius, Marten, and Kai Spohrer. 2017. A blockchain research framework: What we (don't) know, where we go from here, and how we will get there. *Business & Information Systems Engineering* 59: 385–409.

Roszkowska, Paulina. 2020. Fintech in financial reporting and audit for fraud prevention and safeguarding equity investments. *Journal of Accounting & Organizational Change* 17: 164–96.

Rozario, Andrea M., and Chanta Thomas. 2019. Reengineering the audit with blockchain and smart contracts. *Journal of Emerging Technologies in Accounting* 16: 21–35. [CrossRef]

Rückeshäuser, Nadine. 2017. Do We Really Want Blockchain-Based Accounting? *Decentralized Consensus as Enabler of Management Override of Internal Controls.* Available online: https://www.wi2017.ch/images/wi2017-0112.pdf (accessed on 23 June 2024).

Sheldon, Mark D. 2018. Using Blockchain to aggregate and share misconduct issues across the accounting profession. *Current Issues in Auditing* 12: A27–A35. [CrossRef]

Sheldon, Mark D. 2019. A Primer for Information Technology General Control Considerations on a Private and Permissioned Blockchain Audit. *Current Issues in Auditing* 13: A15–A29. [CrossRef]

Smith, Sean. 2018. Implications of Next Step Blockchain Applications for Accounting and Legal Practitioners: A Case Study. *Australasian Accounting, Business and Finance Journal* 12: 77–90. [CrossRef]

Smith, Sean Stein. 2020. Blockchains impact on risk assessment procedures. *Journal of Forensic and Investigative Accounting* 12: 55–65.

Smith, Sean Stein, and John Jack Castonguay. 2020. Blockchain and accounting governance: Emerging issues and considerations for accounting and assurance professionals. *Journal of Emerging Technologies in Accounting* 17: 119–31. [CrossRef]

Smyth, Adam. 2010. *Autobiography in Early Modern England.* Cambridge: Cambridge University Press.

Stern, Myles, and Alan Reinstein. 2021. A blockchain course for accounting and other business students. *Journal of Accounting Education* 56: 100742. [CrossRef]

Stratopoulos, Theophanis C. 2020. Teaching blockchain to accounting students. *Journal of Emerging Technologies in Accounting* 17: 63–74. [CrossRef]

Tan, Boon Seng, and Kin Yew Low. 2017. Bitcoin–Its economics for financial reporting. *Australian Accounting Review* 27: 220–27. [CrossRef]

Tan, Boon Seng, and Kin Yew Low. 2019. Blockchain as the database engine in the accounting system. *Australian Accounting Review* 29: 312–18. [CrossRef]

Tang, Qingliang, and Lie Ming Tang. 2019. Toward a Distributed Carbon Ledger for Carbon Emissions Trading and Accounting for Corporate Carbon Management. *Journal of Emerging Technologies in Accounting* 16: 37–46. [CrossRef]

Tiberius, Victor, and Stefanie Hirth. 2019. Impacts of digitization on auditing: A Delphi study for Germany. *Journal of International Accounting, Auditing and Taxation* 37: 100288. [CrossRef]

Tsikerdekis, Michail, and Sherali Zeadally. 2014. Multiple account identity deception detection in social media using nonverbal behavior. *IEEE Transactions on Information Forensics and Security* 9: 1311–21. [CrossRef]

van Buuren, Joost, Christopher Koch, Niels van Nieuw Amerongen, and Arnold M. Wright. 2014. The use of business risk audit perspectives by non-Big 4 audit firms. *Auditing: A Journal of Practice & Theory* 33: 105–28.

Vincent, Nishani Edirisinghe, and Reza Barkhi. 2021. Evaluating Blockchain Using COSO. *Current Issues in Auditing* 15: A57–A71. [CrossRef]

Vincent, Nishani Edirisinghe, Anthony Skjellum, and Sai Medury. 2020. Blockchain architecture: A design that helps CPA firms leverage the technology. *International Journal of Accounting Information Systems* 38: 100466. [CrossRef]

Vrontis, Demetris, and Michael Christofi. 2021. R&D internationalization and innovation: A systematic review, integrative framework and future research directions. *Journal of Business Research* 128: 812–23.

Wang, Catherine L., and Harveen Chugh. 2014. Entrepreneurial learning: Past research and future challenges. *International Journal of Management Reviews* 16: 24–61. [CrossRef]

Wang, Yunsen, and Alexander Kogan. 2018. Designing confidentiality-preserving Blockchain-based transaction processing systems. *International Journal of Accounting Information Systems* 30: 1–18. [CrossRef]

Weigand, Hans, Ivars Blums, and Joost de Kruijff. 2020. Shared Ledger Accounting—Implementing the Economic Exchange pattern. *Information Systems* 90: 101437. [CrossRef]

Wolfson, Rachel. 2020. The Big Four Are Gearing Up to Become Crypto and Blockchain Auditors. Available online: https://cointelegraph.com/news/the-big-four-are-gearing-up-to-become-crypto-and-Blockchain-auditors (accessed on 23 June 2024).

Yadav, Gaurav. 2018. How Blockchain Will Write a New Era for Accounting Industry. Available online: https://hackernoon.com/how-blockchain-will-write-a-new-era-for-accounting-industry-f8832bf24167 (accessed on 23 June 2024).

Young, Joseph. 2016. Ernst and Young Is Going Bitcoin While PwC, Deloitte and KPMG Push Permissioned Blockchains. Available online: https://cointelegraph.com/news/ernst-young-is-going-bitcoin-while-pwc-deloitte-and-kpmg-push-permissioned-blockchains (accessed on 23 June 2024).