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# A Bibliometric Analysis of Accounting in the Blockchain Era

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**Abstract:**

**Research aims:** This study aims to conduct a comprehensive accounting and blockchain analysis with a bibliometric study.

**Design/Methodology/Approach:** The sample consisted of 67 documents published in the 2017-2021 period using the Scopus database with keywords: accounting and blockchain. This study utilized VOSviewer software to provide graphical analysis of bibliometric data and visualization of research results.

**Research findings:** From the visualization, three main groups (colors) of nine clusters were generated. The red area consists of topics related to blockchain technology, ledger technology, and Bitcoin. The green cluster area includes keywords related to the application and the design science research methodology. Lastly, the blue area focuses on accountants and millennial accountants. From the network analysis results, it can be stated that accountants and millennial accountants accepted the presence of blockchain technology. They could integrate blockchain into the company's business model and make their work easier. From these findings, a research methodology emerged, especially in conducting blockchain research, namely the design science research approach.

**Theoretical contribution/Originality:** With the new and hyped topic of blockchain in the accounting sphere, the bibliometric analysis would be able to review multiple studies efficiently and offer a systematic, transparent, and replicable literature review. Also, it guides researchers to the most influential works and maps areas of research with less subjective bias. Besides, it enables analysis more objectively and reliably and improves the quality of the review.

**Keywords:** Accounting; Blockchain; Bibliometric; Scopus; VOSviewer

## Introduction

Blockchain is a technology underlying Bitcoin cryptocurrency transactions (Nakamoto, 2008). This technology is a transactional database that is cryptographically secured and governed by a consensus mechanism. Basically, this technology is an immutable digital recording of events. Blockchain is also a very secure and trusted platform for record-keeping between parties who may not be able to trust each other (Iansiti & Lakhani, 2017). Blockchain technology is believed to be used to prevent fraud, increase trust between parties conducting transactions and transparency, and save time and money by eliminating intermediaries (banks). Therefore, blockchain is one of the most talked-about technologies to date. However, the technology is not free from skepticism about its application in real cases. Blockchain technology has the potential

to be a technology that disrupts business ecosystems in the same way that the Internet disrupts offline commerce (Coyne & McMickle, 2017).

Finance and accounting are the areas predicted to be most disturbed by this technology (Kokina et al., 2017). Blockchain can reduce costs and risks in financial markets by activating smart contracts (Swan, 2011) and increasing transaction security and speed (Rechtman, 2017). This technology also has the potential to impact all record-keeping processes, including the way transactions are initiated, processed, authorized, recorded, and reported. Blockchain has implications for auditors who also need to understand this technology since it can be applied to their client's business processes (Psaila, 2016; Schmitz & Leoni, 2019). Then, the role and expertise of auditors may change as new blockchain-based techniques and procedures emerge. In addition, there is potential for greater standardization and transparency in reporting and accounting, which could enable more efficient data extraction and analysis. Substantially, blockchain is a new shared database, is transparent, keeps records of business transactions, and ensures data from deletion, tampering, and alteration (Dai & Vasarhelyi, 2017; Yermack, 2017). After the transaction has been executed, it is practically difficult to change (immutability). Besides, this technology supports procedures for sharing transactions and smart contracts between parties. Thus, blockchain can record transactions between parties efficiently, sustainably, and permanently (Iansiti & Lakhani, 2017).

In addition, blockchain technology has the possibility of impacting accounting and auditing functions. This technology is capable of recording and storing assets, liabilities, and transactions and serves as an approach to recording cash flows and reconciling accounts. It is not surprising for impacting the accounting ecosystem, which still relies on paper paths until now, and it is even cloud-based technology to perform accounting and auditing functions and transactions. Since blockchain provides an immutable and transparent record of all accounting-based data, this technology offers an opportunity for accountants and auditors to revolutionize their audit trail. It is an improvement over traditional accounting procedures, which can be fraught with errors and fraud (Plansky et al., 2016).

Likewise, Psaila (2016) anticipates that blockchain technology will increase collaboration between companies and individuals as well as transparency of business processes and data. Exploration of blockchain applications by auditors can improve audit efficiency and effectiveness, as well as accounting convergence. Therefore, blockchain technology shows great promise not only for the big four but also for public accounting firms with smaller company sizes. Also, blockchain is a technology that can reduce excessive manual effort, increase transaction completion speed, and avoid fraudulent financial reporting (Psaila, 2016; Ernst & Young, 2016; KPMG, 2002; PWC, 2018).

On the other hand, today, scientific articles are collected in large databases, such as Scopus, Web of Science, ScienceDirect, and many other reputable databases. It allows the evaluation of various aspects of the scientific article, such as the number of authors, keywords, subject, citation number, and institutional collaboration. By utilizing these sources, an organization can obtain valuable information about impacts on individuals

and aggregates. Then, these sources can facilitate new researchers from a cognate discipline to understand the consequences of the subject, as well as emerging scientific trends. In this respect, it is very different from the traditional literature survey. This kind of indexing service is an important input in the evaluation process in academia.

Moreover, bibliometric analysis is assumed to have been introduced by Price (1965), who identified relationships between articles based on citation numbers. Bibliometrics is a quantitative technique used to estimate, analyze, and visualize the construction of scientific fields (Singleton, 2010). Bibliometrics are also employed to describe the expansion of the desired field in a particular area of knowledge (Holden et al., 2013). Furthermore, bibliometrics produces an evaluation of publications, such as impact factors, citations, publishers, and countries of origin of publications (Lewison, 2005).

In the social sciences, methodologies such as bibliometric analysis (quantitative) and content-analysis (qualitative) have begun to be widely used as data analysis tools among academics. Although these methods are still underutilized in business research, the fields of economics and finance are the most likely to identify trends in economic and financial research in the future (Helbing, 2019). Furthermore, Costa et al. (2018) have revealed economic behavior and financial behavior in the economic field by utilizing the bibliometric method. However, bibliometric research with accounting and blockchain subjects is still very minimal. Therefore, this research used the bibliometric method to obtain an evaluation of publications that can be utilized by academics, especially the relationship between accounting and blockchain. Thus, bibliometric data provides knowledge about all key components at the macro research level, such as author names, journal data, and descriptive characteristics and citation analysis, which can be accessed by the communication process (Holden et al., 2013). With the new and widely discussed issue of blockchain in the accounting profession, the bibliometric analysis would be able to rapidly examine various research and provide a systematic, transparent, and repeatable literature review. It also leads scholars to the most significant works and maps study topics with less subjective bias. Additionally, it evaluates more objectively and consistently, improving the review's quality.

## **Literature Review**

Blockchain first appeared in 2008 when the cryptocurrency Bitcoin was launched by Nakamoto (2008). Bitcoin is a digital currency that is “mined” using blockchain technology to solve mathematical puzzles. It is vital to understand that blockchain and Bitcoin are not the same. Blockchain is considered an operating system, much like Windows, while Bitcoin is just one of the many applications running with that operating system. With the main characteristic of blockchain being immutable, this technology can prevent fraud, increase trust and transparency, and save time and money by eliminating intermediaries. Thus, this technology is the answer to making business transactions more effective in terms of cost efficiency and a high level of security. Moreover, the blockchain architecture is designed to be a decentralized database. In this system, each party in the network has the right to read, verify, and update transactions into the chain.

However, in many modern applications, this kind of openness can be undesirable. In many cases, the use of blockchain in a business or group of companies regarding the read and write permission features should be restricted to certain entities. For that, such systems, known as private blockchains, involve a small number of participants (Viriyasitavat & Hoonsoon, 2019). The advantage of this type of blockchain is that the information stored in the chain can only be accessed by specified entities. This design can protect the privacy and confidentiality of business data. Another type of blockchain is the Permissioned Blockchain (Appelbaum & Smith, 2018). In this type of blockchain, trusted parties are selected first by a central authority and then authorized to verify transactions. The benefit of a Permissioned Blockchain is that the transaction verification role is retained from irrelevant parties, simplifying the verification process and avoiding unwanted manipulation. Since only a few parties can verify transactions, consensus on validated transactions can be reached more quickly.

Since its emergence, blockchain has evolved through three phases: blockchain 1.0, 2.0, and 3.0 (Swan, 2011). Blockchain 1.0 is purely focused on cryptocurrency trading. Then, blockchain 2.0 involves similar trading but with a much wider scope of financial applications. Such applications include derivatives and digital asset holdings (Swan, 2011). To expand trading from just digital currencies to a wide variety of products, a new type of application called smart contracts was introduced in the second generation of the blockchain (Swan, 2011; Szabo, 1997). Blockchain-based smart contracts are computer programs operating on the blockchain that independently verify, enforce, and enforce the terms of the contracts (Kiviat, 2015). These smart contracts autonomously carry out pre-determined tasks, or complete contracts, by examining changing conditions concerning the rules inherent in the contract. Meanwhile, blockchain 3.0 extends the blockchain's system further beyond financial and business applications. Cloud storage products, voting systems, attestation services, or even government administrations can be dramatically transformed into decentralized self-management and monitoring models (Swan, 2011).

## **Research Method**

This research was conducted with a quantitative approach using bibliometric analysis. The bibliometric data provide insight into all the key components at the macro research level, such as the author's name, the publication's data itself (the source of the journal), and its descriptive characteristics and citation analysis, which the communication process makes accessible (Holden et al., 2013). Bibliometrics is also an instrument for ensuring objective publication data, which is often used as mathematical and statistical performance data that is easy to understand (Ball, 2019). The bibliometric method is a literature review method that uses statistical and quantitative analysis of published research and focuses on the structure of articles included in a reference (Singleton, 2010). The bibliometric method's unit analysis includes sub-components, such as citations, authors, journal sources, scientific families, and countries. The number of mappings from this bibliometric analysis is extensive, and it requires software tools for analysis and visualization, namely VOSviewer (Van Eck & Waltman, 2017).

This study constructed the number of samples from the Scopus database. Launched in 2004, Scopus is the largest database of abstracts and citations of peer-reviewed publications that can be used to monitor, analyze, and visualize research and literature. Its purpose is to track scientific research effectively and efficiently. The Scopus database includes more than 24,500 active titles from more than 5000 publishers worldwide in the sciences, technology, medicine, and social sciences, as well as the arts and humanities.

The data collection technique in this study was obtained from the Scopus database by creating a data collection by searching for the word 'accounting and blockchain' in three dimensions: (a) article title, (b) abstract, and (c) keywords. The search results identified a total of 67 documents in the Scopus database during the 2017 to 2021 research period, with the cut-off in December 2021. The 67 documents met the sample collection criteria: scientific articles from Quartile 1 (Q1) to Quartile 4 (Q4). Thus, from these results, 67 documents were ready to be researched and became the subject of this research. Then, from the 67 documents, a bibliometric analysis of its sub-components was carried out, such as the number of publications, types of publication documents, sources of publications, and the number of publications most cited. The mapping from the bibliometric analysis results was then visualized with VOSviewer software that produced several clusters and was grouped into several main research themes.

## Result and Discussion

The number of publications by year is shown in Table 1. From these results, annual publications increased slowly in the first two years of the sample. However, in the third to third and fifth years, the growth rate showed an increasing trend after 2018. The significant increase in the number of publications could be due to the large number of global companies starting to implement blockchain technology, especially in the accounting area (Figure 1). Many companies were starting to realize that the advantages of blockchain can increase company value since financial transactions recorded in the blockchain ledger are transparent, immutable, and increase trust from external parties. Therefore, it is unlikely that research trends in the realm of accounting and blockchain in 2022 and the following year will continue to experience an increase in the number of publications.

**Table 1** Number of Publications by Year

Year	Number of Publication Titles	Annual Growth Rate (%)	Percentage of Total Publications (%)
2017	3	0	4.48
2018	5	40	7.46
2019	15	200	2.39
2020	19	27	28.36
2021	25	32	37.13
Total	67	100	100.00

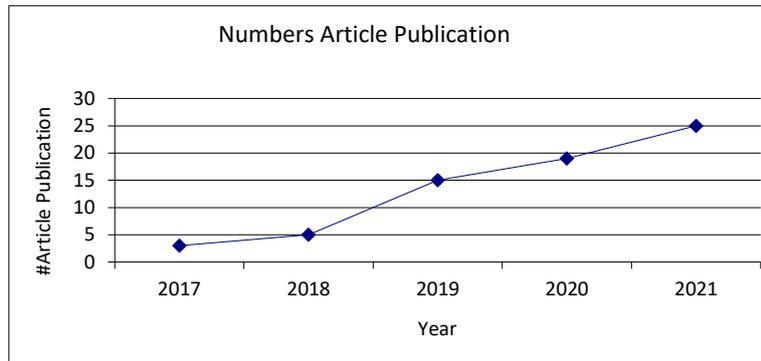


Figure 1 Number of Published Articles per Year

In this study, accounting and blockchain-related studies have been published in various types of documents. Table 2 depicts publications with the keywords accounting and blockchain by document type. Summary statistics showed that most documents were concentrated in two categories of document types. These types of documents were published as conference articles (proceedings) or articles with reviews. However, from these two types of documents, more than 50% of the number of publications came from the type of article documents with reviews.

Table 2 Publications with Keywords Accounting and Blockchain by Document Type

Document Type	Number of Publication	Percentage of Total Publications (%)
Conference Article (Proceedings)	8	11.94
Article with blind-review	59	88.06
Total	67	

Meanwhile, the number of publications with the type of articles written to be presented at the conference was very low. The possible reason behind the low number of publications in conferences refers to the impact of COVID-19, where many face-to-face meetings (conferences) have been canceled. Therefore, many researchers ended up diverting their scientific articles to be published on the journal platform.

Table 3 Top 5 (five) Publication Sources with Keyword Accounting and Blockchain

Source Title	Number of Article Publications	Publication Type
Journal of Emerging Technologies in Accounting	4	Article with blind-review
Australian Accounting Review	4	Article with blind-review
IEEE Access	3	Article with blind-review
Accounting, Auditing and Accountability Journal	3	Article with blind-review
Journal of Information Systems	2	Article with blind-review

Table 3 provides summary statistics for the 5 (five) main sources of publications on accounting and blockchain keywords. Among the sources, two stood out: the Journal of Emerging Technologies in Accounting and the Australian Accounting Review. The Journal

of Emerging Technologies in Accounting is one of the top-tier journals with an SJR 2020: 0.756. The journal is an important platform designed to encourage, support, and disseminate the production of high-quality research streams focused on emerging technologies and artificial intelligence that are applied or can be applied to a broad range of accounting-related issues. Meanwhile, the Australian Accounting Review (AAR) is published by Certified Public Accountant (CPA) Australia. AAR aims to stimulate and facilitate a dynamic and robust dialogue between academics, practitioners, and policymakers on issues of mutual interest. Scientific articles published on the AAR will benefit those involved in professional accounting, government, academic, or policymaking. From the two top publication sources mentioned, the keywords accounting and blockchain are still very broad research topics to be explored, and Scopus indexed publication sources (top-tier journals) provide this space.

**Table 4** The Sequence of the Most Cited Scientific Articles

Researcher and Year of Publication	Document Title	Number of Citation
Dai & Vasarhelyi (2017)	Toward blockchain-based accounting and assurance	186
O’Leary, D (2017)	Configuring blockchain architectures for transaction information in blockchain consortiums: the case of accounting and supply chain	89
Researcher and Year of Publication	Document Title	Number of Citation
Kokina et al. (2017)	Blockchain: emergent industry adoption and implications for accounting	86
Schmitz & Leoni (2019)	Accounting and auditing at the time of blockchain technology: a research agenda	56
Demirkan, S (2020)	Blockchain technology in the future of business cyber security and accounting	31
Bonson, E (2019)	Blockchain and its implications for accounting and auditing	26
Kwilinski, A (2019)	Implementation of blockchain technology in accounting sphere	25
Tan, B (2019)	Blockchain as the database engine in the accounting system	24
McCaling, J (2019)	Establishing the representational faithfulness of financial accounting information using multiparty security, network analysis and blockchain	22
Karajovic, M (2019)	Thinking outside the block: projected phases of blockchain integration in the accounting industry	18
Faccia, A (2019)	Integrated cloud financial accounting cycle: how artificial intelligence, blockchain, and xbrl will change the accounting, fiscal and auditing practices	14
Sheldon, M (2018)	Using blockchain to aggregate and share misconduct issues across the accounting profession	14
Casado-Vara, R (2019)	Distributed e-health wide-world accounting-ledger via blockchain	14

Table 4 displays a list of the most cited scientific articles in descending order (more than ten citations). The most frequently cited or top-cited articles were those that may have had an impactful outcome in the field under its scientific quality and excellence or because of articles published in the early years when accounting and blockchain were only starting to get talked about, or where research when accounting and blockchain was still confusion and the question mark in scientific circles. However, scientific articles published in 2019-2020 were starting to show significant citations. It can be interpreted that accounting and blockchain are starting to become topics of research discussion that describe various areas, such as accounting information systems, the accounting profession, and other developing technologies, such as artificial intelligence.

To provide a graphical analysis of bibliometric data and visualization of research results, VOSviewer software was utilized (Wong, 2018). VOSviewer is a scientific software that collects data and generates maps based on combining bibliographies, citations, and keyword repetitions, and it has its clustering technique (Van Eck & Waltman, 2017). This clustering technique was used to partition nine clusters into three main groups.

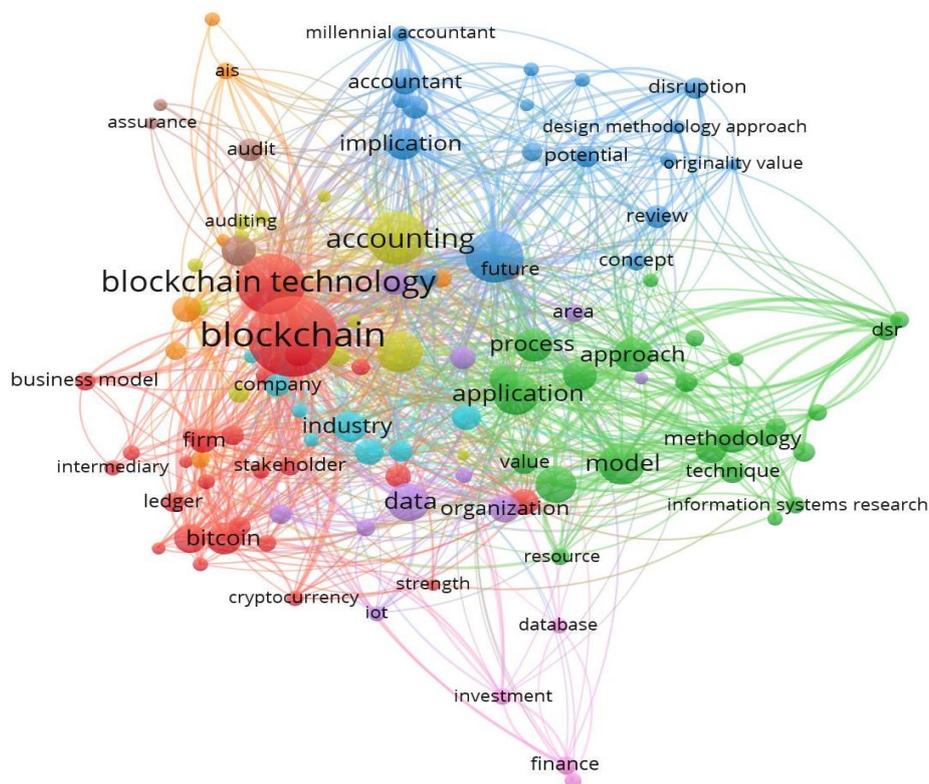


Figure 2 Network Analysis

Figure 2 represents a network analysis of keywords that appeared in scientific articles in the research sample. This cloud map shows the number of occurrences of the word in the

article and the relationship of the keywords. Each term in the network analysis is represented by a circle, and some terms are also represented by a label. VOSviewer aims to avoid overlapping labels, and therefore labels are only visible for some terms. While the size of the term reflected the number of publications in which the term was found, the distance between the two terms indicated the approximate relationship of the repetition of the word/term. The relatedness of terms was determined based on co-occurrences. In other words, the greater the number of publications in which two terms were found, the stronger the relationship between the terms. In addition, each color represents a group of terms that are relatively strongly related to each other. These groups were identified utilizing the VOSviewer clustering technique. In the visualization, the strongest relationships between terms are also shown using curved lines.

The findings can be divided into three parts. The red area consists of topics related to blockchain technology, ledger technology, and Bitcoin. On the other hand, the green cluster area includes keywords related to applications and design science research methodologies. Lastly, the blue area focuses on accountants and millennial accountants. Not surprisingly, blockchain technology is a new technology in the accounting area that millennial accountants and accountants can take advantage of, with its main advantage being ledger technology. Then, from the network analysis results, it can be stated that accountants and millennial accountants did not refuse the presence of blockchain technology. They could leverage blockchain as part of the company's business model and make their work easier. Besides, from these findings, a research methodology emerged, especially in conducting blockchain research, namely the design science research approach.

The above findings are related to the study conducted by Rahmawati et al. (2021) that blockchain is well accepted for accountants in Indonesia for the sake of the ease of working in accounting. Meanwhile, another study indicated that Indonesian millennial accountants are required to adapt blockchain technology as the requirement of the 4.0 revolution era (Haryanto & Sudaryati, 2020). On the other hand, there are promising use cases of this new technology; research and practice are still in their infancy about altering existing and creating new business models. Weking et al. (2019) propose to use design science research to discover further patterns fueled by blockchain technology and illustrate how firms can use blockchain technology to innovate their business models.

Since the bibliometric analysis is rarely carried out concerning the accounting sphere and blockchain technology, this current research can fill the gap that blockchain technology will transform accounting and the profession since transactions recorded on a blockchain can be aggregated into financial statements and confirmed to be true and accurate. In addition, this paper addresses the gap in the literature that misses the specific themes of blockchain technology that can influence the implementation of blockchain accounting with related implications for the accounting profession. Also, the themes of this study can be continued in the future by researching through a qualitative approach by testing the themes that have been generated through the network analysis above.

## Conclusion

From the perspective of accounting, blockchain represents a new technology paradigm that can be fully utilized. This study used a full bibliometric analysis of "accounting and blockchain" literature. Using the Scopus database, this research also examined a variety of emerging scientific literature on the issue of accounting and blockchain from 2017 to December 2021. Employing a total of 67 documents as a sample, this study yielded several aspects, such as changes in the number of publications over the research period, types of documents published, sources of publications, and extensively referenced research. According to the results, the number of publications on accounting and blockchain topics has risen dramatically, particularly in the third year (2019) through 2021. Moreover, based on the findings of VOSviewer's research, three primary groupings were formed from nine clusters.

According to the network research findings, accountants and millennial accountants acknowledged the presence of blockchain technology. They could use blockchain as part of the company's business strategy to simplify their work. As a result of these discoveries, a research methodology arose, specifically for doing blockchain study using a design science research strategy. However, blockchain study will not be restricted to specific areas in the future (accounting). Nevertheless, the research limitation of this study is that the data were generated from Scopus, not other databases (e.g., Web of Sciences), and the data were generated from 2017 to 2021. Meanwhile, the future study should include other objects like blockchain and the convergence to accounting standards and utilize various data sources, such as the Web of Science or SpringerLink. Also, the findings of this study can be expanded in the future by conducting qualitative research by analyzing the themes suggested by the network analysis described above.

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