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review

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List of abbreviations

AI - Artificial Intelligence

AJG - Academic Journal Guide

CPY – Citation Per Year

CRM - Customer Relationship Management)

DLT – Distributed Ledger Technology

ERP - Enterprise Resource Planning

ESG – Environmental Social and Governance

FinTech - Financial Technology

ID – Identification

RPA - Robotic process automation

SLR – Structured Literature Review

VHB - Verband der Hochschullehrer für Betriebswirtschaft

Abstract

Ziel – Das Ziel dieser Arbeit liegt in der Identifikation von aktuellen Trends der Blockchain Technologie im Bereich Rechnungswesen, als auch von zukünftigen Fragestellungen und Herausforderungen. Hierzu werden Forschungsschwerpunkte und -lücken der Fachliteratur identifiziert und analysiert.

Methode – Inspiriert von Massaro et al. (2016), wurde eine strukturierte Literaturrecherche durchgeführt. Die finale Stichprobe umfasst 87 Artikel aus hoch bewerteten Fachzeitschriften. Anschließend wurden die ausgewählten Artikel mit der NVivo Software kodiert und dessen Ergebnisse mit Hinblick auf die Forschungsfragen analysiert.

Ergebnisse – Die strukturierte Literaturrecherche zeigt, dass die Blockchain Technologie das Potential birgt, existierende Prozesse im Rechnungswesen langfristig und nachhaltig zu verändern. Der Fokus auf die Digitalisierung und Automatisierung der Prozesse durch die Implementierung der Blockchain Technologie, würde das Arbeitsbild der Wirtschaftsprüfer nachhaltig prägen und neue Kenntnisse erfordern. Jedoch ist die Reifephase der Blockchain Technologie noch nicht erreicht. Daher muss das Thema weiter entwickelt und untersucht werden.

Mehrwert - Die Studie bietet einen Überblick über die relevanten wissenschaftlichen Arbeiten, die den aktuellen Zeitraum widerspiegeln. Zudem werden künftige Forschungsrichtung aufgezeigt.

Abstract

Purpose – The study aims to identify current trends in the blockchain technology in accounting literature and formulate the future research proposals. The purpose is to identify main research focuses and research gaps in existing literature and analyze them.

Methodology – The study carries out a structured literature review followed by Massaro et al. (2016). The final sample comprised 87 papers from the top ranked journals. The papers were further coded with the NVivo software. The results of coding were analyzed to answer the research questions and to fulfil the purpose of the study.

Findings – Blockchain technology has the potential to change accounting processes, but the technology is still in its infancy and requires further investigations. The accounting professionals work would shift towards digitalization and automation, but will never completely disappear. Therefore, the accountants and auditors would need to transform and adapt their skills.

Originality/value – The study provides the review of the relevant academic papers and considers the most actual information. It identifies the research direction for the future investigations.

1. Introduction

Blockchain technology or distributed ledger technology stands in forefront of emerging technologies. It has a potential to reshape current accounting and auditing systems and transform the existing accounting practices (Schmitz and Leoni, 2019; Wang and Kogan, 2018). After appearance of blockchain technology many industries and companies got interested in this technology. Therefore, the distributed ledger technology is experiencing high level of investments from the companies in order to develop and adopt it (Alles and Gray, 2020). The highest amounts of investments are at the moment directed to supply chain and finance, but over the last decades the accounting firms and industry also started actively investing in the blockchain technology (Alles and Gray, 2020). The companies such as KPMG, EY, PWC and Deloitte also known as Big 4 companies are actively working on development and research on the blockchain in order to guide the clients with the implementation and help digitalize their current work (Alles and Gray, 2020). The blockchain technology could bring a lot of benefits and positively improve the current work and practices in accounting (Dai and Vasarhelyi, 2017). However, the adoption and implementation of it is very challenging and has a lot of issues (Dai and Vasarhelyi, 2017). The same situation can be applied to the future of accountants and auditors role. There would be expected a major transformation of the work, which implies both positive and negative shifts of the accountants and auditors role (Parmoodeh, Ndiweni and Barghathi, 2023).

Blockchain technology first appeared in 2009 as a foundational methodology for the record of cryptocurrency transactions (Dai and Vasarhelyi, 2017). This highlights that technology is relatively new to the world and it will take many years till the maturity phase is reached (Stratopoulos, Wang and Ye, 2022). Although the blockchain technology has made their first steps into influencing and changing different industries, the research area and the technology are both still in its infancy. Therefore, research on blockchain technology in accounting has a lot of gaps and there is a need in more studies related to this topic (Han et al., 2023). During the analysis of existing literature related to the blockchain technology in accounting field, there was a lack of published papers covering the current needs in the research.

Purpose of this study is to examine current state of the research in blockchain technology in accounting area and analyze the trends to suggest the direction of the future research. To conduct this analysis the study is following the structured literature review (SLR) method. This paper focuses on three timelines the past, current trends and adoption and future of it in accounting research area. This study also highlights the main focus topics and areas that do not receive enough attention at the moment.

Currently, many journals and practitioners call for more studies that investigate this topic (Tyma et al., 2022). Therefore, this work is motivated to cover the literature gap and provide a literature review that considers most recently published works in the top ranked journals. The study aims to give an overview over current problems and challenges, benefits and positive effects, analysis by region and research method of the existing literature and focus and trends of the blockchain in accounting. To fulfil the purpose and motivation of this study three research questions are proposed and described in the section three of the study.

The study is structured as follows: the second section of the study is motivated to give an overview of blockchain technology, its features and how would it influence accounting. The next section explains in details how the study is conducted and what method steps are taken into consideration. The fourth section focuses on deriving the results of the study and answering the first two research questions. Thereafter, the fifth section answers the third research question and discusses the future research path of this topic by relying on the outcomes of previous part. The last section concludes and summarizes this study and describes the limitations.

2. Blockchain technology in accounting

This section provides a comprehensive overview of blockchain technology. The main motivation is to delineate the definition of the blockchain technology, its characteristics including benefits and problems of distributed ledger technology, qualities of it (e.g.

permissioned and permissionless) and features enabled by the technology (e.g. smart contracts, triple-entry accounting).

2.1 What is blockchain?

Blockchain is a distributed ledger technology that takes its roots from the paper written by Nakamoto in 2008 (Nakamoto, 2008). Distributed ledger saves and records all transactions across different locations and users, which means that every change in the records will be automatically displayed to all network users (Schmitz and Leoni, 2019).

Blockchain technology is designed without being affected by any central authority (Gietzmann and Grossetti, 2021). An important characteristic of blockchain technology is the consensus: The agreement of all authorized network users (Secinaro et al., 2021). These users are permissioned to view and use the ledger, in order to validate the information (Secinaro et al., 2021).

The technology offers two controversial effects of its use. On one hand, it enables high level of transparency, where all users share information with each other and have access to it. On the other hand, the more information is shared the higher is the difficulty to keep the information confidential (Wang and Kogan, 2018).

Blockchain is organized according to the following components: records or transactions, nodes, blocks, ledgers and hashes (Centobelli et al., 2022). The data in blockchain is organized in blocks connected to each other (Tan and Low, 2019). Each block consists of hashes, which serves as definition of length fixation in a form of text or numbers abbreviations. The whole chain of blocks can be represented as a node and the ledger is the book where all transactions are maintained together (Centobelli et al., 2022).

Nowadays blockchain technology is usually directly associated with cryptocurrencies, especially Bitcoin, but in reality blockchain technology does not only focuses on implementation for currencies (Zachariadis, Hileman and Scott, 2019). Blockchain technology is implemented in various fields and sectors such as supply chain, data management, health

care sector, government sector and many other industries and directions (Parmoodeh, Ndiweni and Barghathi, 2023).

Current state of the blockchain in accounting shows that it is yet in its infancy, but it has a great potential by serving more automatized processes (Parmoodeh, Ndiweni and Barghathi, 2023). The problem is that there is no ready-to-use accounting information systems based on the blockchain technology (Tan and Low, 2019). However, the blockchain technology has a potential to change accounting world and solve some of its issues by reducing the human-labor intensive tasks, that are mostly done manually (Roszkowska, 2021).

2.2 Blockchain characteristics

Blockchain technology is a foundation of possible transformation in accounting world. The technology enables real-time accounting, continuous auditing and automation of the processes (Lardo et al., 2022). Blockchain technology can be described as decentralized and synchronized network (Han et al., 2023). The main benefit of such network is the high level of security (Pimentel and Boulianne, 2020). In the decentralized blockchain system, whenever new transaction occurs, the whole system is updated including every ledger and node, which has its own copy of the ledger (Pimentel and Boulianne, 2020). In the case of a cyberattack, hacking or technical issues in the node, the other ledgers and entire network are not affected (Pimentel and Boulianne, 2020). The transactions of each node are using hashing function to grant anonymity inside the system by showing only cryptographed Identifications (IDs) (Pimentel and Boulianne, 2020).

The current development of the technology can be divided into 4 generations (Han et al., 2023):

- Blockchain 1.0 is focused on cryptocurrency
- Blockchain 2.0 enables smart contracts by Ethereum
- Blockchain 3.0 is focused on the use-cases in supply chain, finance and health care
- Blockchain 4.0 represents the collaboration with artificial intelligence (AI)

Blockchain technology can benefit current accounting systems and work by delivering transparency, operational cost reduction, time efficiency, digitalization, faster workflow of processes, reduction of human errors by automation of their work and security (Han et al., 2023). Auditors could spend less time on verification of transaction and therefore work more effectively, which means that auditability would be also increased (Schmitz and Leoni, 2019). Fraud detection process for the auditors would be simplified with the implementation of distributed ledger, because blockchain technology can detect the inconsistencies in transactions and will draw the auditors' attention to potential fraud occurrences (Schmitz and Leoni, 2019).

The current research underlines many advantages of blockchain technology application in accounting and the way how it could positively impact the work of auditors. The problem is that the technology is still in its early stage of development and implementation (Parmoodeh, Ndiweni and Barghathi, 2023). The awareness level about blockchain in accounting remains low and the research area is understudied (Parmoodeh, Ndiweni and Barghathi, 2023). Therefore, there are a lot of challenges and problems that need to be considered. For instance, current version of blockchain has issues with the scalability, because it can process only limited amount of transaction per second and cannot deal with the high amount of real-time transactions, which is a standard case of every business (Dyball and Seethamraju, 2022). Further problems are related to the high level of computational resources consumption and consequently it requires more energy to process and continue the work (Gauthier and Brender, 2021; Dyball and Seethamraju, 2022). The problem results in a negative environmental footprint. In general, the implementation will generate quite high amount of costs required for adoption of blockchain in already existing ecosystem of the firm and its development and implementation in it (Roszkowska, 2021). On one hand blockchain can reduce the human labor and operational costs of the firms, and on the other hand create a lot of costs itself. Another barrier for adoption is the regulatory issue. At the moment there are no standards and regulations in order to audit blockchain (Gauthier and Brender, 2021). The same problem exists for regulation of cryptocurrencies (Dyball and Seethamraju, 2022).

2.3 Continuous auditing and real-time accounting

Current corporate and business world is rapidly changing due to appearance of new technologies, digitalization and automation of the processes. Consequently, accounting systems and methods need to adopt accordingly to the changing world and advance their traditional methods together with the new emerging technologies (Han et al., 2023).

Continuous auditing is focused on finding solution for these topics and analyze how the technologies such as AI and blockchain can be implemented in order to optimize and automatize the current auditing (Han et al., 2023).

There is a controversial opinion about the future of blockchain technology in accounting. Some researchers assume that blockchain technology can possibly substitute current Enterprise resource planning (ERP) systems used in the firms (Vincent, Skjellum, and Medury, 2020). On the other side, there is a low probability that the firms would be willing to bear such high costs of replacing the functioning and existing ERP systems with the blockchain and invest into adoption of the complicated new technology (Vincent, Skjellum, and Medury, 2020). Based on that, the existing systems will not be completely replaced by blockchain technology, but there will be search for the solution on how to combine the existing systems with the new emerging technologies (Vincent, Skjellum, and Medury, 2020).

The Big 4 companies are actively investigating and improving current auditing and accounting solutions with the trending technologies (Han et al., 2023). The main focus of AI adoption is to increase effectiveness and reduce the time costly processes such as preparation of paperwork or analytics tasks using machine learning (Han et al., 2023). Adoption of AI will make the implementation of blockchain in accounting and auditing ecosystems easier and unimpeded (Han et al., 2023). Continuous auditing based on blockchain technology offers a real-time auditing.

Blockchain technology updates the information about transactions in real-time and for all network parties (Pimentel et al., 2021). This positive characteristic would potentially support accounting and auditing work by creating real-time accounting (Pimentel et al., 2021; Han et

al., 2023). The real-time solutions can be beneficial for the analysis of data, scanning of transactions and comparison of data (Roszkowska, 2021). Real-time auditing is more efficient in detecting anomalies in transactions and consequently preventing fraud by real-time detection of it (Roszkowska, 2021). Unlike the current centralized ERP systems, that do not offer the validation of transactions by all parties in the real-time, blockchain technology and its real-time accounting allows the records to be displayed to all parties including the financial information, income statements and balance sheets of the company (Han et al., 2023). This feature could be used to build more transparent communication to the managers, business partners and investors as they can be also part of the blockchain network and verify the transaction and records (Han et al., 2023).

2.4 Permissioned and permissionless blockchain

Blockchain as a distributed ledger technology can follow different protocols and rules (Schmitz and Leoni, 2019). The allowed permissions and to what user are they allowed can differ from company to company (Han et al., 2023). For instance, access permissions, transaction validation permissions and rights to update the records (Han et al., 2023).

Blockchain technology has two type of ledgers (Schmitz and Leoni, 2019):

- Permissionless and public
- Permissioned and private

Therefore, each company can decide on its own, which type of blockchain is more suitable for their business (Han et al., 2023).

Permissioned blockchain are accessible only for the users that have permission to view the content there (Schmitz and Leoni, 2019). This kind of blockchain usually does not have as much nodes as public blockchain, because only selected number of users can participate there (Han et al., 2023).

Permissionless and public blockchain grants access to all users that want to view it (Schmitz and Leoni, 2019). A good example of public blockchain is Bitcoin where everyone is allowed to participate in the ledger and validate the transactions (Han et al., 2023). Therefore, usually

the public blockchains have a high number of participating nodes, which makes it more costly to process the information and follow the protocols (Han et al., 2023). Unlike private and permissioned blockchains, that have fewer participants, it is more difficult to build trust, because the ID of the users is unknown or hard to track (Han et al., 2023).

Private and permissioned blockchain has an administrator or the user with the higher authority. This user is able to define which users are getting access to the private ledger and what role do they need to fulfil in the system (Gietzmann and Grossetti, 2021). This type of DLT grants higher security level for the company (Gietzmann and Grossetti, 2021). On one hand, this could be seen as legal advantage of such structure, that the private blockchain contains of only reliable parties, that are controlled by a central authority and all of them are identifiable (Gietzmann and Grossetti, 2021). On the other hand, the centralized or single point of authority in a private blockchain can be seen as a disadvantage caused by the risks of manipulation and cyber-attacks (Wang and Kogan, 2018). In general, such system contradicts the decentralized nature of blockchain technology (Wang and Kogan, 2018).

Current research focusses on the discussion and explanation of two main blockchain types: permissioned and permissionless. However, Pimentel and Boulianne (2020) introduce in their work an emerging type of blockchain – federated blockchain. This type of blockchain is similar to the private blockchain. The difference is that federated blockchain does not have the node with higher authority, but it has decentralized pre-selected nodes, that can verify the records (Pimentel and Boulianne, 2020). This could be a solution of the problem discussed above. The decentralized nature of blockchain will be considered in federated blockchain.

2.5 Role of accountants and auditors

In the previous sections this study highlights the potential positive and negative transformations of accounting processes based on implementation of blockchain technology. Therefore, the role and work of accountants and auditors awaits the transformation as well. Adoption of blockchain technology can shift the work focus on other activities, that cannot be yet automated or digitalized (Han et al., 2023). For example, auditors and accountants would

have to focus more on strategy or complex analysis (Han et al., 2023). Some papers raised a concern, that the profession of accountants and auditors could even be fully replaced by the blockchain technology (Desplebin, Lux and Petit, 2021). This scenario is unlikely to happen, because the profession is highly complex and demands different type of specialization. Thus, it cannot be replaced completely, but it can become more automated (Desplebin, Lux and Petit, 2021).

The role of accountants and auditors would require better expertise from technical background. Smart contracts enabled by blockchain technology would be also a part of their standard work. As implementation of blockchain will approach toward real-life adoption use-cases, there will be higher demand and interest in regulating the smart contracts (Desplebin, Lux and Petit, 2021). Therefore, accountants would need to understand the processes and content of smart contracts and be able to evaluate their adoption (Desplebin, Lux and Petit, 2021).

In the future perhaps some work forces in accounting and auditing that were doing only operational tasks such as transaction validations and simple data analysis will be reduced (Karajovic, Kim and Laskowski, 2019). However, the new job opportunities will be opened and new work places will be created (Karajovic, Kim and Laskowski, 2019). The new professions would require a transformed profile of accountant or auditor with the shift towards technology, IT risk and other roles in this direction (Karajovic, Kim and Laskowski, 2019). The auditor would need to understand the main code of the blockchain (Dyball and Seethamraju, 2021). Furthermore, the new role would require to test the effectiveness and information posted by users in the blockchain (Dyball and Seethamraju, 2021).

To be prepared for the future transformation of accountants and auditors role, the new generation of professionals need to start gaining expertise in emerging technologies. Stern and Reinstein (2021) discuss this topic in their work by focusing on analysis of existing courses related to blockchain technology. The university course is prepared for the accounting and finance students (Stern and Reinstein, 2021). Stern and Reinstein (2021) also suggest to offer

the course that covers a general study of emerging technologies in accounting including blockchain.

2.6 Smart contracts

Another extension of blockchain based technologies is the smart contracts. The first one who invented this technology was Ethereum (Moll and Yigitbasioglu, 2019). Initially smart contract was a computer based program, which contains rules, protocols and penalties for breaking the agreement between the users (Sheldon, 2021). After all parties has satisfied the agreed conditions, the smart contract is accomplished (Moll and Yigitbasioglu, 2019). One of the major characteristics of smart contracts is that it guarantees transparency for the all parties of the contract (Sheldon, 2021). Smart contracts can be deployed in different ways. For example, for classic commercial contracts or to track the supply chain records in order to verify the products (Pimentel and Boulianne, 2020). The automatic verification enabled by smart contracts reduces the possibility of human errors and increases effectiveness of work (Schmitz and Leoni, 2019). Therefore, it can be used for insurance contracts, credits and other art of financial products (Pimentel and Boulianne, 2020).

The implementation of smart contracts together with other emerging technologies such as AI or internet of things can significantly improve the automatization of audits (Roszkowska, 2021; Schmitz and Leoni, 2019). AI could make an impact on the estimation of the assets. Schmitz and Leoni (2019) suggest for example to measure the damage of goods during the shipment and report it automatically to the smart contracts. Internet of things could be used to tag those goods, install cameras on them or any other devices (Albizri and Appelbaum, 2021). Therefore, it is important to consider high level of adaptivity, meaning that the smart contracts can also automatically adjust and systematize according to the changes in the environment (Parmoodeh, Ndiweni and Barghathi, 2023).

Smart contracts can be also used together with the triple-entry bookkeeping enabled by blockchain technology (Cai, 2021). In this system the smart contract will act as the third

element of the ledger which implies the blockchain (Cai, 2021). Based on the protocols defined by the smart contract parties it can be automatically self-executed (Cai, 2021).

Oracle is an important part of the smart contracts (Sheldon, 2021). Under consideration that some actions of the smart contract can be done only in the real world within off-blockchain actions, there must be a way on how to control this process in order to avoid potential risks and fraud (Hsieh and Brennan, 2022; Sheldon, 2021). Therefore, there must be a trusted unbiased agent or in other words oracle (Sheldon, 2021). His main task is to operate in the off-chain world and collect the requested data or information to transfer it into smart contracts code (Sheldon, 2021). The oracle problem is that the agent is a human and thus can be biased (Albizri and Appelbaum, 2021). Oracle can gather inaccurate information and be fraudulent, so based on that there is a need of an audit of his actions or another solution is to replace the oracle with the machine (Hsieh and Brennan, 2022; Albizri and Appelbaum, 2021).

2.7 Triple-entry bookkeeping

The concept of triple-entry bookkeeping was firstly introduced by an accounting researcher Yuji Ijiri in 1986 (Cai, 2021). At that time he suggested to improve the existing double-entry system with the third component “trebit” to analyze alterations of income (Cai, 2021).

Triple-entry bookkeeping provided by blockchain technology is focused on introducing a trusted third party into existing double-entry system (Schmitz and Leoni, 2019). The role of the third party is represented by the shared ledger technology, where all participants have the access to the transactions (Schmitz and Leoni, 2019). The aim of the third party in this system is to verify the transactions and guarantee transparency among the users (Schmitz and Leoni, 2019). The trust created by implementation of shared ledger shifts from external authorities to the users of the ledger (Schmitz and Leoni, 2019). Every change in the ledger is automatically visible for all participants of the network (Schmitz and Leoni, 2019). According to the protocols of the blockchain, the change in the ledger or transaction verification is only then possible, if the participants adhere to the consensus rules (Schmitz and Leoni, 2019).

As blockchain technology has a potential to disrupt the current accounting practices, it can be employed to improve the existing accounting services and systems (Karajovic, Kim and Laskowski, 2019). The most expected improvement is that blockchain offers triple-entry bookkeeping and consequently can guarantee better reliability (Karajovic, Kim and Laskowski, 2019).

The currently implemented double-entry system has an issue of creating an agency problem. On the other side, the system is relatively cost effective (Carlin, 2019). Double-entry has been used for a long time and does not bring so many uncertainties and issues as blockchain implementation (Carlin, 2019). Therefore the complete replaceability of the double-entry system by triple-entry accounting is still an open question.

2.8 Blockchain and sustainability

Sustainability became an important topic over the last decades. The companies are more interested in the sustainability reporting, corporate responsibilities and Environmental Social and Governance (ESG) (Bakarich, Castonguay and O'Brien, 2020). As the topics are new, the legal and standards system is still working on shaping detailed regulations for this topics. Therefore, there is a big threat of the greenwashing problem and general transparency issues in reporting of the ESG capital of the company (Bakarich, Castonguay and O'Brien, 2020).

At the moment there is a risk that companies could report unreliable and unverifiable information connected to sustainability of the company (Bakarich, Castonguay and O'Brien, 2020). The currently existing and actively used ERP systems are able to solve some of the issues mentioned before. However, the ERP systems do not consider the current globalization of the companies, meaning that they are not able to connect multiple organizations in one system and make the system transparent to the stakeholders and partners (Bakarich, Castonguay and O'Brien, 2020). Another problem with this solution is that ERP systems are based on the centralized system, which creates a range of risks (see section 2.4) (Bakarich, Castonguay and O'Brien, 2020). Nevertheless, it is not expected that ERP systems would be completely replaced by new technologies, but rather the companies will be looking for a way

on how to connect them in one ecosystem so that they complement each other (Bakarich, Castonguay and O'Brien, 2020).

In general, blockchain technology has a great potential on contributing the sustainability reporting and solving the current issues of sustainability reporting (Bakarich, Castonguay and O'Brien, 2020). For instance, the consensus system of blockchain can decrease the level of data manipulation and thus solve greenwashing and investors would be able to view the real-time analysis of sustainability data (Bakarich, Castonguay and O'Brien, 2020).

The issues of possible implementation of blockchain technology in sustainability reporting are based on lack of the established standards, techniques and general definitions in ESG topic (Bakarich, Castonguay and O'Brien, 2020). Another issue is that the implementation of blockchain would require high amount of costs: human labor, time and development of blockchain ecosystem (Bakarich, Castonguay and O'Brien, 2020).

3. Method

To investigate blockchain technology in the accounting research field, this paper's methodology follows the structured literature review based on Massaro et al. (2016). This research method has the purpose of examining the core academic literature for the specific topic. Therefore the aim is to generate new views, define the future research path, and also examine the current level of research development in this area (Massaro et al., 2016). On one hand, the SLR research method helps to look back at the past to examine the existing literature. On the other hand, the SLR investigates the present development and future path of the research area by scoping the issues and trends in the literature (Massaro et al., 2015).

The structured literature review methodology focuses on building a logical connection between the past literature and the future. This method is prevalent in current research, because it is based on the idea of delivering a high level of transparency and replicability.

The exact structure and rules are the main differentiating points of a structured literature review from traditional literature review and other methods. The main contribution of this research method is to deliver the development of this research field through time and define the focus and future perspectives of a certain research field (Massaro et al., 2016).

The literature review represents a qualitative approach where the information and analysis are interpreted by the researchers. Based on this fact it is crucial to guarantee the high level of reliability and validity of the research (Massaro et al., 2016).

The logical and understandable organization of the study is a high priority. It enables replicability and transparency for the readers and other scholars. In the role model paper for the SLR that this research is following, Massaro et al. (2016) described the ten steps to conduct the structured literature review:

- 1) Formulate and describe the protocol for the literature review
- 2) Research questions that the study is aiming to answer
- 3) Perform and deliver a comprehensive literature search
- 4) Analyze and measure the article's impact
- 5) Formulate and develop an analytical framework
- 6) Examine the literature review reliability
- 7) Perform and ensure validity test
- 8) Coding the gained data
- 9) Develop insights and critique
- 10) Propose and develop future research paths and future research questions

3.1 The literature review protocol

The research protocol aims to set boundaries and limits of the research (Massaro et al., 2016). It should describe the process of the research including the period of analysis, data gathering sources, and actions that are relevant to conduct the review. This information is important for the transparency and replicability of the study. As the research protocol is the first step of SLR, it should guide through the work and describe its logic (Massaro et al., 2016).

The foundation of this research originates from delivering high quality of analysis. Based on that, the study performs a careful selection of papers only from top-ranked and peer-reviewed accounting journals. A detailed description of the selection criteria is as follows:

1. Only high ranked journals are considered in this study. The selection considers AJG (Academic Journal Guide) and VHB-Jourqual 3 (Verband der Hochschullehrer für Betriebswirtschaft) ranking. AJG ranking metrics based on peer review and professionals' evaluations. Its main goal is to guide researchers in the selection of journals for their study. The AJG is published and provided by the Chartered Association of Business Schools. The second ranking that was used in this study - VHB-Jourqual 3 is provided by the German Academic Association for Business Research. These ranking metrics are based on the VHB professional's evaluations, where "A+" is considered as "excellent" and globally leading and "D" means recognized in the field. VHB ranking is highly used by academics to assist them in the selection of high-quality journals. In this paper, we consider only journals with AJG rankings of 4*, 4 and 3 and VHB-Jourqual 3 ranking of A+, A, B and C. The goal is to ensure the reliability of the examined papers in this study.
2. As blockchain technology in accounting is a new research direction, there is little evidence of literature, because it exists only since the last decade. Blockchain itself has existed since the appearance of cryptocurrency (Castonguay and Stein Smith, 2020). Considering this information, there is no time frame restriction in this research.
3. This study applies keyword-driven searches of the literature in selected journals. This is relevant for the literature sample and it helps to narrow the search by focusing on topic related literature. In this study, multiple combinations of keywords are used.

3.2 Research questions

A structured literature review, according to Massaro et al. (2016), must provide a critical evaluation of the literature and propose the future directions. To fulfil this criteria the study has to consider three pivotal research questions. The research questions have to focus on the following areas: provide insights about the current state of the art, the trends as well as

analysis of literature focus and definition of future research path in this research area (Massaro et al., 2016). The research questions for this study are formulated as follows:

RQ 1: How is research for inquiring blockchain technology in accounting developing?

RQ 2: What is the focus and critique of the literature linking blockchain technology and accounting?

RQ3: What is the future path for research in blockchain technology within the accounting field?

The first research question is motivated by providing insights and analysis of historical literature evidence. It measures the contribution of the past and current literature (Massaro et al., 2016). The second research question aims to develop a critical view of the existing literature and determine the current level of development, whether it is developing, emerging or already in the maturity phase. This could be done by developing and formulating the research framework (Massaro et al., 2016). The third research question is future-oriented. To answer the question the information from RQ1 and RQ2 needs to be summarized. The knowledge gaps or important suggestions for future research have to be delivered in this section (Lombardi and Secundo, 2021; Massaro et al., 2016). This section can be seen as a culmination of the study, where the gathered information needs to be implemented to describe the research area perspectives and recommendations (Massaro et al., 2016).

3.3 Comprehensive literature search

This section focuses on a description of the procedure for literature search and selection of articles. As described in the research protocol, this study focuses on papers from high-ranked journals. Therefore the motivation of this SLR step is to identify relevant literature and ensure at the same time the SLR quality (Garanina et al., 2021).

The comprehensive literature search for this study is conducted in three main steps:

1. Top journal selection
2. First screening including the sample collection
3. Second screening and scoping of the final sample

The comprehensive literature search can be completed when the final sample is defined and can be further analyzed in an analytical framework. In this study the three types of sources were used for the literature search: Google Scholar, Scopus, and official journals sites. The detailed information about SLR criteria for literature search is described in Table 1.

Table 1: Structured literature review: criteria and description

Criteria	Description
Source	Google Scholar, Scopus and official journal cites
Field	Accounting
Literature type	Research article
Literature language	English
Period	No restrictions
Keywords	Group of keywords
1st screening	Keywords
2nd screening	Title, abstract, main text

3.3.1 Journal selection

Journal selection is a first step of a comprehensive literature search. The motivation of it, is to select the literature and concentrate on quality of the literature to deliver a high level of research reliability (Massaro et al., 2015).

As stated in the research protocol, this study is based on the journals from AJG (Academic Journal Guide) ranking and VHB (The German Academic Association for Business Research) ranking. The selection consists only of journals, that fulfill following criteria:

1. Journals are peer-reviewed
2. Journals are evaluated based on experts judgements
3. Journals with AJG ranking of 4*,4 and 3 are considered in this study
4. Journals with VHB-Jourqual 3 ranking of A+, A, B and C are considered in this study

The information was gathered from official AJG and VHB sites. The total number of the journals that match the criteria is 70 journals. Table 2 summarizes the journal selection list.

Table 2: List of alphabetically sorted selected journals

Journals in alphabetical order		
Abacus	Business Ethics Quarterly	Journal of Applied Accounting Research
Accounting and Business Research	Business Ethics: A European Review	Journal of Business Ethics
Accounting and Finance	Contemporary Accounting Research	Journal of Business Finance and Accounting
Accounting and the Public Interest	Critical Perspectives on Accounting	Journal of Business Valuation and Economic Loss Analysis
Accounting Education: An International Journal	European Accounting Review	Journal of Contemporary Accounting and Economics
Accounting Forum	European Journal of Finance	Journal of Financial and Quantitative Analysis
Accounting Historians Journal	European Taxation	Journal of Information Systems
Accounting History Review	Financial Accountability and Management	Journal of International Accounting Research
Accounting Horizons	Foundations and Trends in Accounting	Journal of International Accounting, Auditing and Taxation
Accounting in Europe	Information and Organization	Journal of International Financial Management and Accounting
Accounting Perspectives	International Journal of Accounting	Journal of Management Accounting Research
Accounting Research Journal	International Journal of Accounting Information Systems	Journal of Risk
Accounting Review	International Journal of Accounting, Auditing and Performance Evaluation	Journal of Taxation
Accounting, Auditing and Accountability Journal	International Journal of Auditing	Journal of the American Taxation Association
Accounting, Economics and Law: A Convivium	International Journal of Economics and Accounting	Management Accounting Research
Accounting, Organizations and Society	International Journal of Managerial and Financial Accounting	Managerial and Decision Economics
Advances in Accounting	Issues in Accounting Education	Managerial Auditing Journal
Advances in Management Accounting	Journal of Accounting and Economics	Research in Accounting Regulation
Asia-Pacific Journal of Accounting and Economics	Journal of Accounting and Organizational Change	Review of Accounting and Finance
Auditing	Journal of Accounting and Public Policy	Review of Accounting Studies
Australian Accounting Review	Journal of Accounting Education	Review of Quantitative Finance and Accounting
Behavioral Research in Accounting	Journal of Accounting Literature	Social and Environmental Accountability Journal
British Accounting Review	Journal of Accounting Research	
British Tax Review	Journal of Accounting, Auditing and Finance	

3.3.2 First screening of literature

The first screening phase is focused on manual collecting of the papers from the journals, that are listed in the Table 2. The collecting of the papers followed individually for each journal by using the search engines in Google Scholar, Scopus and journals homepages (Garanina et al., 2021). As described in the protocol, the search in journals was conducted by implementing keyword-driven search in the journals. This approach aims to focus only on the paper that are relevant for this and helps to sort them effectively. During the search there were no limits set for the time period. That could be explained by the novelty and recency of this research area as it exists only over the last decade. The keywords combinations were created topic related terms:

1. “Accounting“ AND “Blockchain”
2. “Distributed ledger technology” AND “Accounting”
3. “Digital ledger” AND “Accounting”
4. “DLT” AND “Accounting”

After applying the keyword combinations in the search engine, the search resulted in 259 potential relevant papers for the study. For 70 journals the total result is quite low, this explains that this research area is in its infancy and still unexplored. Some journals have still no mentions of this topic in their articles, which indicates the need for further exploration of the research area for them.

The 259 articles were further collected in Zotero. This tool helps researchers to organize the study and enables the creation of research bibliography. The tool can automatically fill the characteristics of the paper in separate columns such as author, year of publication and store the pdf version of the articles.

Another tool to analyze the papers was the Excel. The sample of 259 papers was transported to an Excel spreadsheet for the further analysis in tables and in graphs.

3.3.3 Second screening of literature

The final phase of literature search is focused on manual screening of the sample to filter the papers for the relevance and applicability to the study purpose. To perform this step, the including and excluding criteria were formulated and applied for the final selection (Mengist Soromessa and Legese, 2020). The inclusion criteria for the study were:

1. The keywords combination must be found and must exist in the title, abstract, keywords of the article or in the main text.
2. The article reflects the topic related and relevant information connected to this study, in our case blockchain technology in accounting.
3. The article has to be written in English

The exclusion criteria of the papers were:

1. The article is written in other language, not in English
2. The article does not deliver insights that could be research relevant
3. The full text of the article is not accessible for the review or download

After completing these steps, the final sample of the articles was derived. The structured literature review relevant articles sample consisted of 87 papers. This sample will be further used for coding and to analyze the blockchain technology in accounting. The information will be used as a foundation to develop the critique, insights and future research paths (Massaro et al., 2016).

3.4 Define an analytical framework

SLR is a part of an empirical research method and therefore it analyzes the data to answer the certain research questions (Massaro et al., 2016).

In this section the final results of 87 papers from the comprehensive literature search were analyzed within an analytical framework. To ensure reliability of the research, the data was analyzed with the qualitative data analysis software NVivo 14. This software is used to code

the full texts and abstracts of the final sample articles (Garanina et al., 2021). NVivo 14 offers different metrics and tools for data evaluation to provide an overview of final sample papers and derive results for our study (Massaro et al., 2015). Following Massaro et al. (2016), this study adapts the analytical framework described in his work. However, only in customized variation of the original framework, with sections that are logically and thematically contribute the study. The adapted framework consists of following sections:

1. General information – Article: this sections describes the input data about the authors, journals, year of publication, overall number of citations
2. Region: information about geographical areas of the final literature selection
3. Research method: it describes the research approaches used in the papers
4. Research focus: it describes the topic focus of the study

The first section of analytical framework “General information - Article” aims to deliver a general overview of the sample results. The most relevant parameter there is the citation. This information is further used in the results section to analyze the connection between the articles and citation (Massaro et al., 2015). Metrics such as total citation and citation per year are applied there. The year of publication delivers useful insights as well. The researchers can observe the literature evaluation in this topic throughout the time period (Massaro et al., 2015).

Second category “Region” is generating insights about the topic awareness in different areas. It shows geographical regions where blockchain technology in accounting is actively investigated and regions that still do not pay enough attention to the emerging topic (Massaro et al., 2016). As a result the researchers can derive regions that are understudied and need more investigation on the topic (Massaro et al., 2016). In this study the location is divided into five geographical regions: USA-Canada, Europe, UK, Australasia and other.

“Research method” section in framework gives an overview of the method trends in this topic. It helps to understand which methods are over used and over investigated and which methods do not get attention of the researchers (Massaro et al., 2016). This section shows the results divided into following research methods: “case and field studies”, “interviews”, “commentary,

normative, policy”, “content analysis and historical analysis”, “literature review”, “survey and questionnaire” and “quantitative and other empirical”.

“Research focus” concentrates on the categorization of research themes, that were investigated on the selected literature sample. The information derived from this section delivers valuable results about the focus of the current literature and builds a foundation for formulating the future path for the literature (Massaro et al., 2015).

Next step was to apply this framework to the selected literature. To perform this, the papers stored in Zotero bibliography were imported to the NVivo 14 software. Thereafter each unique paper was manually coded into the framework.

The analyzed sections of analytical framework and the results are represented in Table 3.

3.5 Literature review reliability

The SLR method is based on approach where the information is being judged and evaluated by human beings (Hayes and Krippendorff, 2007). This can result in subjective evaluation of the inputs, that are resulting from coding action by researchers in NVivo software (Massaro et al., 2016). To reduce the bias, the researchers should apply different methods to guarantee the high level of research reliability. The most recommended method of reliability assurance is the calculation of Krippendorff’s α (Massaro et al., 2016). This method has a high compatibility with SLR. Krippendorff’s α is highly reliable, because it can deliver robust results independent from the number of other observers, sample sizes and missing data (Massaro et al., 2016).

Based on the information described above, this research applies Krippendorff’s α as the reliability indicator. According to the standards described from Krippendorff (2018), “the results of Krippendorff’s α above 0,800 are considered as reliable, results that are in the range from 0,667 to 0,800 are considered as suitable only for general conclusions”.

Table 3: Analytical framework

CATEGORY	ATTRIBUTES	RESULTS	KRIPPENDORF'S ALPHA
Article	Year	2017-2023	1
	Author	202 unique names	1
	Citations	2 to 887	1
	Journal	70 unique titles	1
	Titeles	87 unique titles	1
Region	USA-Canada	31	1
	Australasia	24	1
	Europe	23	1
	UK	8	1
	Other	1	1
	Total	87	
Research method			0,818
	Case/Field studies	7	
	Interviews	10	
	Commentary/Normative/Policy	2	
	Content analysis/Historical analysis	12	
	Literature review	36	
	Survey/Questionnaire	4	
	Quantitative/Other empirical	16	
	Total	87	
Research focus			0,916
	Blockchain and accounting/auditing	30	
	Accounting profession's transformation	10	
	Cryptocurrencies – ICO - Digital assets	16	
	Blockchain in business process or Inter-Organizational Relationships	3	
	Triple-entry bookkeeping	1	
	Sustainability accounting - ESG - Ethics	7	
	Smart contracts - Oracle Problem	3	
	FinTech – AIS - Transaction systems	11	
	Blockchain and law or standards	3	
	Blockchain-based assets	2	
	Blockchain architecture	1	
	Total	87	

The first step consists of coding the articles by the researcher and in the second step the second researcher, in our case another colleague, repeats the action with the same literature sample. In the third step the results of two researchers are documented in an excel file for the further comparison of outcomes. Researchers can calculate Krippendorff's α in statistical software, but nowadays the calculation process of the Krippendorff's can be simplified by using the online calculator for Krippendorff's α . For this action, the researchers should prepare the excel, where each researcher has its own results column, in our case there are two columns. The calculation was processed for each section of the analytical framework. The results are shown in Table 3 and indicate high level of reliability.

3.6 Validity test

The structured literature review has to build a logical connection between the assertions and observed data (Massaro et al., 2016). This step is important to fulfil the aim of answering the formulated research questions by analyzing the literature (Massaro et al., 2016). Therefore the conclusions should be based on the certain logic. This paper implements internal validity and external validity methods.

Internal validity aims to build a causal effect on the conclusions and results. This study refers to a time series analysis. The analysis enables the formulation of the results based on analyzing the evolution of the papers about blockchain in accounting through the time (Massaro et al., 2016). It is also important to consider the time frame of the analysis. In our case the time frame is from year 2017 to year 2023, as the literature growth started from this point of time. To estimate the evolution of literature, the citation analysis is applied (Massaro et al., 2016). The outcomes are presented in the results section of the paper.

External validity aims to assure that the data can be generalized (Massaro et al., 2016). In this study the theory explanation method is used to prove external validity. Theory explanation aims to employ the information from previous studies and theories to explain the results and build connection and foundation for the outcomes (Massaro et al., 2016).

3.7 Coding the data

Structured literature review is a coding based research method (Massaro et al., 2016). The results from the literature search must be analyzed in a predefined structure and logic. Coding can be performed either manually or with the help of software (Massaro et al., 2016). Since nowadays technologies are offering better solutions for the manually work, the study applies qualitative data analysis software NVivo 14. As other supportive tools for the data preparation the study uses Excel and Zotero library. The final selection of 87 papers was coded and analyzed in NVivo 14.

4. Research results

This section represents the outcomes of the second section of the research, where the ten SLR steps were performed to analyze the data. The aim is to apply the results and codes from NVivo 14 to answer three research questions of the study.

The “Research results” section is divided into five main subsections to provide the detailed answers to the research questions. Subsection 3.1 and 3.2 focus on answering the RQ 1 with the support of charts and diagrams.

RQ 1: How is research for inquiring blockchain technology in accounting developing?

The further analysis of the data continues in subsections 3.3, 3.4 and 3.5. This chapters present the answers on RQ2.

RQ 2: What is the focus and critique of the literature linking blockchain technology and accounting?

4.2 Articles over time

The motivation of the analysis for the year of publication is to spot the trends in the development of blockchain technology in accounting literature. Figure 1 demonstrates the evolution of the literature in blockchain technology within accounting research field. As stated in research protocol, initially there was no time period limit set for the literature search. The observation from Figure 1 demonstrates, that the researchers started gaining the interest on this topic in 2017. This publication from the year 2017 is mostly cited and builds a foundation for the research in upcoming years on the time span. Dai and Vasarhelyi (2017) focused in their work on describing possible benefits and problems of blockchain technology implementation and adoption for practitioners and scholars. The paper was the first, that has built insights about blockchain in accounting. It describes how the technology could pass into the current accounting eco-system and incorporate with other technologies (Dai and Vasarhelyi, 2017). The paper gives direction for the future research and topics, that are relevant to investigate in the approaching years to give an impulse of blockchain adoption. The authors describe the potential research direction divided into following categories: technological context with focus

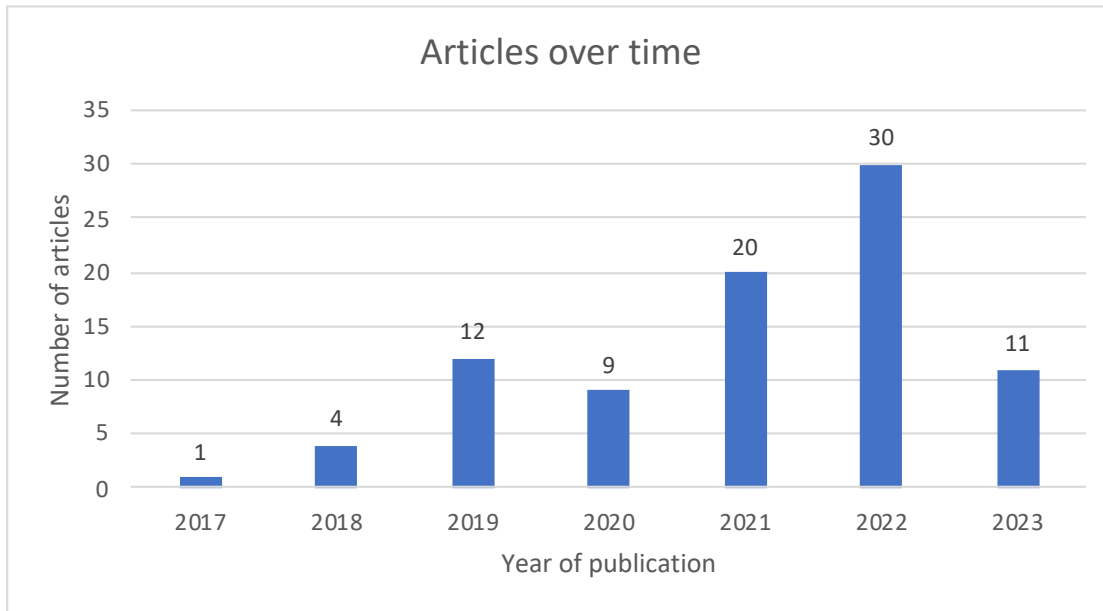


Figure 1: Number of articles over time

on accounting data, systems and adoption possibilities by SMEs, organizational context with the focus on cooperation with existing accounting models and systems, environmental context describing the potential need in standards and regulations (Dai and Vasarhelyi, 2017).

Figure 1 shows that on average the number of publications focused on investigation of blockchain topic in accounting is between 12 and 15 over the last decade. The graph shows that from 2017 till 2020 the literature was slowly gaining the relevance. The noticeable increase in 2021 and 2022 reflects that blockchain technology is now an emerging technology and is relevant to investigate. The literature increase was due to rapid development of technologies and general need of scholars reaction and investigation of possible adoption in accounting field.

The papers in 2021 and 2022 mostly focus on the topics, that were described as relevant in the work of Dai and Vasarhelyi (2017). For instance Cai (2021) describes in the paper, that the blockchain technology is now actively implemented in financial services, but there is still a lack of blockchain adoption in accounting field. This problem could be addressed to the knowledge gap between accounting practitioners and blockchain experts (Cai, 2021).

However, one of the main focuses of the paper is triple-entry bookkeeping enabled by blockchain technology and investigation on current state of the art of its adoption (Cai, 2021). The paper shows based on case studies that there is a little evidence of fully live triple-entry bookkeeping blockchain products (Cai, 2021). The main problem of lacking regulations, solutions for practical issues and fraud remains unresolved (Cai, 2021). In general the increase over last years indicates the relevance of the topic for accounting research field and accounting professionals.

On one hand, many papers have already discussed the challenges of the adoption. On the other hand, they state that there is a great potential in this topic. Based on this conclusions it is expected that the number of published articles will further increase in the future years.

The literature search was conducted at the beginning of 2023. This can explain the decrease of publications number in 2023. Therefore data for the year 2023 is incomplete and does not reflect the results for the whole calendar year.

4.2 Citation analysis: measure the article's impact

SLR takes into account the citation analysis to recognize the impact of given articles in order to estimate how the academic influence varies. Massaro et al. (2016) states that higher number of article's citation represents the article's quality. Therefore it is easier to prioritize the articles by making sure, that the papers with lower citation to zero citation number will not be considered equally as the articles with high citation impact. This approach allows to concentrate on deeper analysis of literature that contributes the academic discussion (Massaro et al., 2016).

As this research follows the SLR approach described by Massaro et al. (2016), the selected source of the citation data is Google Scholar. It is a broadly used and reliable database with valuable insights and metrics, that is a part of many literature reviews in accounting field (Massaro et al., 2016).

The approach of article's impact measurement consists of two views. At first, it is important to analyze articles by considering the total number of citations, which results in finding out the most influential articles on this topic over the whole time period (Massaro et al., 2016).

Secondly, the articles are analyzed on the basis of citation per year (CPY) metrics , which indicates the continued impact of articles (Massaro et al., 2016).

Table 4 displays the information summary about the overall citations of articles considered in this study. The observation shows relatively high number of citations in period of 2017 till 2019 and decrease after year 2020. The decline could be explained as there was not enough time to gain citations (Garanina et al., 2021).

Table 4: Total citations over the years

Year of Publication	Number of articles	Total citations
2017	1	731
2018	4	765
2019	12	1573
2020	9	309
2021	20	458
2022	30	407
2023	11	39
Total	87	4282

The information also correlates with the Table 5, which represents the top ten articles with the highest citation score. The majority of the most cited papers was published in the time frame from 2017 till 2019. Therefore, it means that these papers are the most influential in the field of blockchain technology in accounting.

Furthermore, the analysis of the papers reveals that papers are focused on the topics such as accounting profession's transformation through adoption of blockchain technology, triple-entry bookkeeping enabled by blockchain, blockchain governance and database. Some of the papers are motivated by building foundation of general understanding of blockchain in accounting. They describe what can be understood under the technology, characteristics of

blockchain, positive and negative impact of the technology on accounting and the possible implementation. The top ten papers are mostly based on literature review research method. The other methods applied by the papers are survey and empirical research. All papers are spread around different research regions: USA-Canada, Australasia, Continental Europe and United Kingdom. This indicates, that there is no dominance of a one certain region to be observed.

Table 6 demonstrates the citation analysis based on CPY metrics. CPY can be easily calculated by dividing the total number of citations by difference between current year and year of publication (Massaro et al., 2016). Therefore, the papers that were published recently and do not have as high number of citations as papers that were published longer time ago, can be equally evaluated. Higher CPY indicates increasing relevance of the paper and shows more reliable evaluation of article impact.

In comparison with Table 5, the table with CPY results considers papers that were published in 2022 and 2023. Eight articles from total citation analysis are also to be found in the top ten CPY analysis articles. The other two papers focus on literature review research method, which shows the trend in the current research as the most cited papers are also considering this research method. The top journals in total citation analysis and CPY analysis are mostly identical, except that in CPY metrics the Accounting, auditing and accountability journal finds its place in the list, but is not represented in the Table 5.

4.3 Region of research

This section focuses on investigation of different regions of literature origination related to blockchain technology and accounting topic. The papers normally list the authors names in the order according to the author's contribution (Garanina et al., 2021). Therefore, this study uses the region allocation based on the first author's university and further codes the information in NVivo (Garanina et al., 2021). The region codes are divided into five main region groups:

1. USA-Canada
2. Australasia: representing Australia, New Zealand and countries in Asia

Table 5: Top ten articles based on total citations

<i>Authors</i>	<i>Title</i>	<i>Citation</i>	<i>Journal</i>	<i>Year</i>
Dai, Jun; Vasarhelyi, Miklos A.	Toward Blockchain-Based Accounting and Assurance	887	Journal of Information Systems	2017
Moll, Jodie; Yigitbasiglu, Ogan	The role of internet-related technologies in shaping the work of accountants: New directions for accounting research	518	The British Accounting Review	2019
Schmitz, Jana; Leoni, Giulia	Accounting and Auditing at the Time of Blockchain Technology: A Research Agenda	375	Australian Accounting Review	2019
Cai, Cynthia Weiyi	Disruption of financial intermediation by FinTech: a review on crowdfunding and blockchain	324	Accounting & Finance	2018
Dierksmeier, Claus; Seele, Peter	Cryptocurrencies and Business Ethics	317	Journal of Business Ethics	2018
Zachariadis, Markos; Hileman, Garrick; Scott, Susan V.	Governance and control in distributed ledgers: Understanding the challenges facing blockchain technology in financial services	287	Information and Organization	2019
Wang, Yunsen; Kogan, Alexander	Designing confidentiality-preserving Blockchain-based transaction processing systems	286	International Journal of Accounting Information Systems	2018
Cai, Cynthia Weiyi	Triple-entry accounting with blockchain: How far have we come?	178	Accounting & Finance	2021
Tan, Boon Seng; Low, Kin Yew	Blockchain as the Database Engine in the Accounting System	172	Australian Accounting Review	2019
Tiberius, Victor; Hirth, Stefanie	Impacts of digitization on auditing: A Delphi study for Germany	170	Journal of International Accounting, Auditing and Taxation	2019

Table 6: Top ten articles based on CPY

<i>Authors</i>	<i>Title</i>	<i>CPY</i>	<i>Journal</i>	<i>Year</i>
Dai, Jun; Vasarhelyi, Miklos A.	Toward Blockchain-Based Accounting and Assurance	127	Journal of Information Systems	2017
Han, Hongdan; Shiwakoti, Radha K.; Jarvis, Robin; Mordi, Chima; Botchie, David	Accounting and auditing with blockchain technology and artificial Intelligence: A literature review	124	International Journal of Accounting Information Systems	2023
Moll, Jodie; Yigitbasioglu, Ogan	The role of internet-related technologies in shaping the work of accountants: New directions for accounting research	104	The British Accounting Review	2019
Schmitz, Jana; Leoni, Giulia	Accounting and Auditing at the Time of Blockchain Technology: A Research Agenda	75	Australian Accounting Review	2019
Cai, Cynthia Weiyl	Triple-entry accounting with blockchain: How far have we come?	59	Accounting & Finance	2021
Secinaro, Silvana; Dal Mas, Francesca; Brescia, Valerio; Calandra, Davide	Blockchain in the accounting, auditing and accountability fields: a bibliometric and coding analysis	58	Accounting, Auditing & Accountability Journal	2022
Zachariadis, Markos; Hileman, Garrick; Scott,	Governance and control in distributed ledgers: Understanding the challenges facing blockchain technology in financial services	57	Information and Organization	2019
Cai, Cynthia Weiyl	Disruption of financial intermediation by FinTech: a review on crowdfunding and blockchain	54	Accounting & Finance	2018
Dierksmeier, Claus; Seele, Peter	Cryptocurrencies and Business Ethics	53	Journal of Business Ethics	2018
Wang, Yunsen; Kogan, Alexander	Designing confidentiality-preserving Blockchain-based transaction processing systems	48	International Journal of Accounting Information Systems	2018

3. Continental Europe
4. UK- United Kingdom
5. Other: there is a small number of papers, that does not belong to any of the region groups described above. The main example for that is UAE (United Arab Emirates).

Figure 2 delivers the results of papers distribution across different research regions over the years. The observation shows that 36 percent or 31 articles of the selected papers originate from authors in USA-Canada region, which shows this region as leading. Australasian authors have published a slightly lower number of papers in the period of 2017 till 2023 at 24 articles which represent 28 percent of sample. Continental Europe has produced almost the same number of articles as Australasia at 23 papers or 26 percent. Researchers from United Kingdom wrote 8 papers which counts as 9 percent of the total sample. There was only one paper written by authors from UAE (United Arab Emirates) that was published in the top journals.

The distribution of 87 papers reveals that blockchain technology is broadly discussed in all regions. The results from USA-Canada, Australasia and Continental Europe are almost in the same range, which indicates active development of the topic in these regions.

4.4 Research methods

This section of the structured literature review aims to develop insights and critique about methods applied in the final literature selection by presenting the coding results.

Blockchain technology is relatively new and has a great potential, however in the accounting research world the topic remains understudied and is identified as emerging technology (Garanina et al., 2022; Centobelli et al., 2022). There are a lot of knowledge gaps not only from scholars and research perspective, but also from practitioners side (Centobelli et al., 2022). The situation may change when the adoption of the blockchain would be more widely spread (Garanina et al., 2022). To understand the current state of the blockchain literature and define the research gaps so that the blockchain technology and its research area could reach

the maturity phase, it is important to analyze the methods that are currently being implemented.

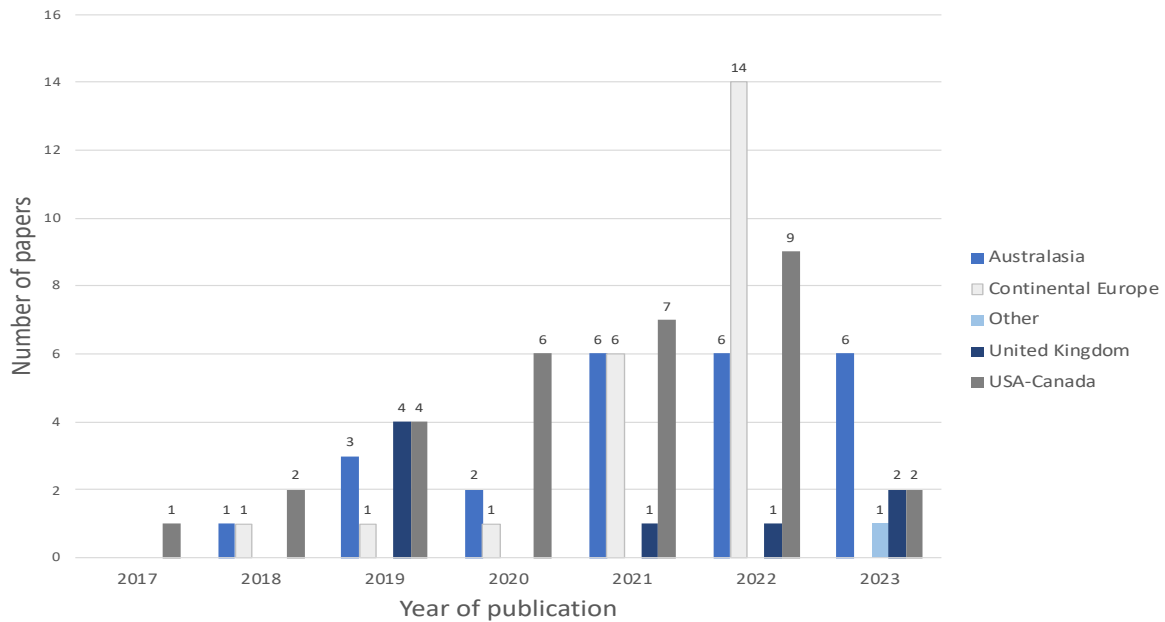


Figure 2: Research regions analysis over the year of publication

Table 7 describes the results of research method analysis. The dataset has been investigated and divided into six main research methods groups: case or field studies, commentary or normative or policy, content analysis or historical analysis, interviews method, literature review methods, quantitative or other empirical methods. The last category named “quantitative/other empirical” represents the articles that apply either quantitative method or other methods that could not be categorized to one of the five sections.

The data in the table shows that the most commonly used research method is literature review that represents 41% of papers in the sample. Other methods such as content analysis, interviews and other empirical methods are in the developing phase. Lombardi et al. (2021) comments on the matter, that the current state of accounting literature and blockchain technology is in the phase where the qualitative research methods are mostly used and predominate. At the same time there is a massive gap in the literature that applies quantitative methods and investigates the blockchain technology (Lombardi et al., 2021). The observations

from the sample show that the case and fields studies together with surveys are understudied, but they will play a massive role for future research.

Table 7: Analysis of research methods

Research Method	Number of papers (absolute)	Number of papers (relative)
Case/Field studies	7	8%
Commentary/normative/policy	2	2%
Content analysis/historical analysis	12	14%
Interviews	10	11%
Literature review	36	41%
Quantitative/Other empirical	16	18%
Survey/Questionnaire	4	5%
Total	87	100%

Figure 3 analyzes the literature by region and research methods applied. This investigation gives an overview of research methods trends in different regions including which methods are actively used and which methods are understudied so the researchers need to pay more attention to them in the future studies.

A closer look at the charts leads to a conclusion, that in all four regions the literature review dictates the trend and is mostly used. Interviews are getting popular in Australasia, whereas other regions are still not paying enough attention to this method. The papers with interviews research method are mostly focused on analyzing how blockchain technology will transform the profession of accountants. For example Kend and Nguyen (2020) provide the discussion regarding the situation that blockchain technology is presented as technology that has a potential to transform and improve current accounting and audit practice along with the audit quality. However it was unclear what the professionals and practitioners think about the technology and its future in accounting (Kend and Nguyen, 2020).

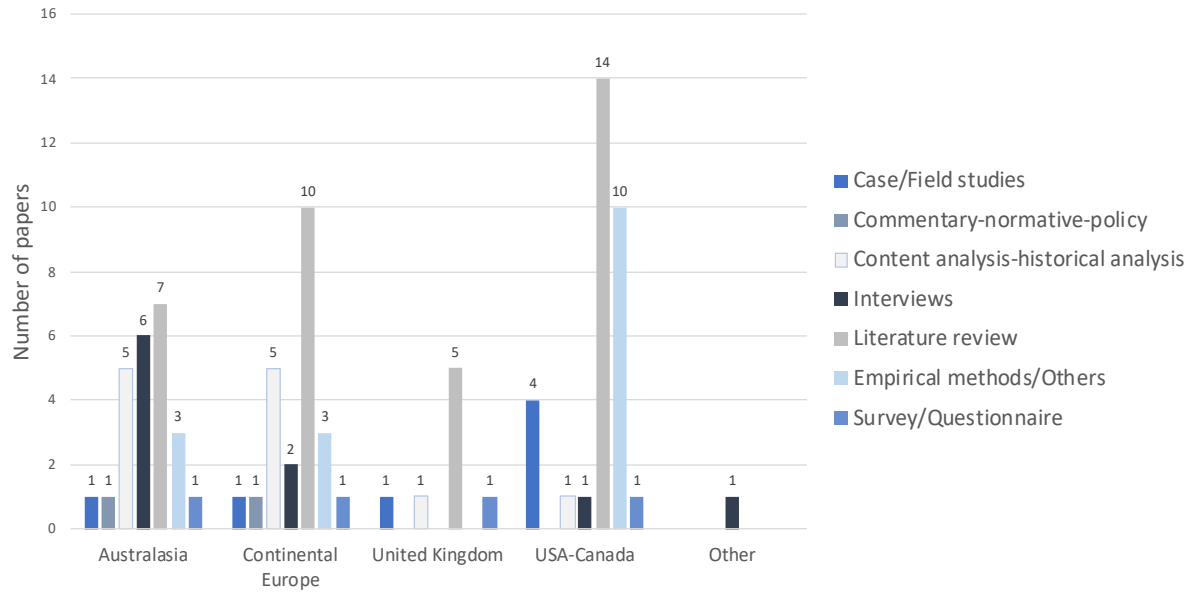


Figure 3: Analysis by region and research methods

The case studies is one of the understudied methods. However, this method could be crucial for shaping and improving the future research of blockchain technology. The problem at the moment is that the existing case studies are mostly oriented on proposed or potential solutions (Pimentel and Boulianne, 2020). Therefore, it is important to set a focus on practical real-world applications of the technology. This would help to understand the cases that work or fail in the implementation of blockchain technology (Pimentel and Boulianne, 2020). Pimentel and Boulianne also state in their work, that it will be also important to develop a case study for future research and address the educational topic. Stern and Reinstein (2021) response to this call and publish a paper focused on offering the suggestion of blockchain course for students. Their observations are based on the study of the first and only existing blockchain course prepared for students from accounting department (Stern and Reinstein, 2021).

Surveys and questionnaires are also underrepresented in the current research of blockchain technology in accounting. The reason for that is that there is still little to no practical implementations so it is difficult to conduct surveys.

One example of survey contributing to the literature in this topic is work of Li and Juma'h (2022), where they conduct survey across 112 auditors to question the awareness about

blockchain and potential task fit of their work and blockchain technology. The results reveal that blockchain has a great potential to become a mainstream technology for accountants, but to achieve this state it must overcome a lot of challenges and fill several knowledge gaps (Li and Juma'h, 2022).

4.5 Research focus

The articles from final sample were also separately coded in NVivo to analyze the focus or topic of every single article (Garanina et al., 2021). The papers were coded according to ten categories, that represent the main directions of current research in blockchain and accounting. This analysis contributes the understanding of up-to-date trends and research areas that are understudied. Table 8 represents the outcomes of coding and the papers distribution in percentage and total numbers.

Table 8: Analysis of research focus

Research focus/topic	Number of papers (absolute)	Number of papers (relative)
Blockchain and accounting/auditing	30	35%
Cryptocurrencies/ICO/Digital assets	16	18%
FinTech/AIS/Transaction systems	11	13%
Accounting profession's transformation	10	12%
Sustainability accounting /ESG/Ethics	7	9%
Blockchain in business process	3	3%
Blockchain and standards/regulations	3	3%
Smart contracts/Oracle Problem	3	3%
Blockchain-based assets	2	2%
Blockchain architecture	1	1%
Triple-entry bookkeeping	1	1%
Total	87	100%

The results show that more than a third of all articles describe concept of blockchain technology in accounting by giving the overview of the technology itself, characteristics, types of blockchain (e.g. permissioned and permissionless), problems and benefits of technology as well as its potential in accounting field.

Another research focuses are mostly also represented and discussed in the category “Blockchain and accounting/auditing”, but are not the main focus and rather used to build the whole picture around the blockchain in accounting.

The articles from this section are mostly the same articles that are from the table with highest citation rate, which means that the articles are highly cited and giving the foundation for the future research articles. For example, Dai and Vasarhelyi (2017) describe background of the technology by starting from the initial creation of the technology, which is described in the work of Nakamoto (2008). As the paper was published in 2017, when the technology and the research in accounting was in its early phase, Dai and Vasarhelyi (2017) build a strong foundation of a fundamental understanding, what would the implementation of the technology mean and how to distinguish it from the normal ERP systems. The main differences are, that ERP systems are mostly centralized which could be a potential risk for the failure at one single point. Contrasting ERP, the blockchain technology has a decentralized architecture and enables to lower the risks (Dai and Vasarhelyi, 2017). Additionally, blockchain technology is not dependent on the human labor like ERP systems (Dai and Vasarhelyi, 2017). The paper highlights the problem in the current state of accounting, that the adoption of emerging technologies in this area is very low and slow despite the fact, that the technologies are rapidly evolving and changing (Dai and Vasarhelyi, 2017). Therefore, the category “Blockchain and accounting/auditing” identifies the topic blockchain adoption in accounting and its possible implementation.

The further research focuses that examine the blockchain technology from the cryptocurrency view are also covering a high percentage of literature. The reason is that blockchain technology is a key and inseparable part of cryptocurrencies (Dierksmeier and Seele, 2018). The research focus on topics of accounting professions’ transformation and financial

technology (FinTech) compatibility with blockchain technology is also gaining interest in this research area. The predictions regarding the potential adoption and implementation of the distributed ledger technology in accounting state that it could disrupt and change the traditional work of accounting professions (Schmitz and Leoni, 2019). Other topics such as how the blockchain technology can be integrated in existing business processes, blockchain technology and its influence on sustainability topics and blockchain architecture are all understudied. Smart contracts and triple-entry bookkeeping are mostly considered as a part of general discussion about blockchain technology in accounting, thus there are little to no use cases of the real-world implementations (Cai, 2021). The same current state applies for the blockchain technology and regulations or standards.

This section of the paper identifies four main discussion topics:

1. Future of a technology: adoption and implementation
2. Accounting profession's transformation
3. Benefits and challenges of blockchain technology
4. Cryptocurrencies and blockchain: regulation and standards.

4.5.1 Future of technology: adoption and implementation

The integration of blockchain technology into accounting world has a potential to improve the audit quality (Fang et al., 2023). Blockchain technology is still in its early stages of adoptions, meaning that the possible outcome of the technology implementation is unknown (Kend and Nguyen, 2020). This also explains the doubts about the application of blockchain. To contribute the literature and close the knowledge gap Centobelli et al. (2022) describe in their work the possible ecosystem for the blockchain adoption in accounting. The architecture of the ecosystem consists of three levels: technological infrastructure, selection of permissions (e.g. permissioned or permissionless) and validation mode, customization of system design (Centobelli et al., 2022). The ecosystem should work together with the ground rules such as blockchains technology characteristics. This considers trust for avoidance of spreading incorrect data, transparency and truth for higher traceability (Centobelli et al., 2022). Adoption of such blockchain ecosystem has a disruptive character, but also brings high count of benefits and process automations (Centobelli et al., 2022).

The adoption of blockchain could have massive impact on accounting professionals and disrupt the classical understanding of their job and tasks. However, the awareness level by accounting practitioners is very low (Guo et al., 2021). Especially the professionals from small and medium size companies have a problem of general understanding of blockchain technology and therefore cannot estimate the potential impact on their profession (Kend and Nguyen, 2020). It could be also connected to that the adoption of blockchain technology on early stages would be only possible for large enterprises and tech companies. Guo et al. (2021) state in their analysis and observations, that the possible adoption of blockchain on early stages would be more likely achievable for the firms with high number of patents. This would help to gain competitive advantages and show high level of innovations adaptivity (Guo et al., 2021). At the moment, blockchain technology among other technologies such as AI (artificial intelligence), ERP systems (enterprise resource planning), CRM (customer relationship management) and RPA (robotic process automation) has a lower results of usage occurrence (Jackson and Allen, 2023). However, the discussion of adoption cannot be further developed without regulations and standards, which would be one of the main barriers (Dahabiyeh and Constantinides, 2022).

The major key players in developing and researching on blockchain's future in accounting world are the Big 4 companies (KPMG, EY, Deloitte and PwC). For example, PwC is actively working on blockchain for digital assets, introducing and integrating the blockchain technology in different areas of the world. They consult their clients with the possible implementation. To deliver high quality of work, they search and stuff more experts in this area (Karajovic, Kim and Laskowski, 2019). Other Big 4 companies also bring a high impact in exploring the technology in terms of different partnerships corresponding to KPMG and Microsoft and developing own blockchain system alike Deloitte (Karajovic, Kim and Laskowski, 2019;).

4.5.2 Accounting profession's transformation

Standard understanding of accounting profession's practices is that the work is very human labor intensive (Schmitz and Leoni, 2019). The auditors deliver high level of expertise and trustworthy of their work including the insurance of completeness and correctness of the transactions (Parmoodeh, Ndiweni and Barghathi, 2023; Schmitz and Leoni, 2019). The core and standard auditors activities are mostly to verify the transactions and information in financial statements, planning and conducting audit (Parmoodeh, Ndiweni and Barghathi, 2023). In total the whole process of their work is time intensive and could be less efficient without implementing the technologies (Schmitz and Leoni, 2019).

The difference between the work of auditors without blockchain implementation is that the auditors need the transactions approvals, whereas blockchain technology automatically approves and verifies the transactions (Schmitz and Leoni, 2019). In other words, blockchain technology grants the real-time auditing.

The current research on possible effect of blockchain technology on accounting also underlines some negative consequences of its application on the transformation of the work (Schmitz and Leoni, 2019). It has a disruptive character and the predicted automation of the daily accountants and auditors work can lead into loss or reduction of their jobs (Garanina, Ranta and Dumay, 2022). Conversely, the role of auditors and accountants will just improve and transform by shifting the tasks away that machines and technologies can do and focus on giving the assurance for the errors or fraud and correctness of automated work (Otia and Bracci, 2022). Additionally, the professionals need to develop and gain more IT-related skills especially related to the blockchain technology (Desplebin, Lux and Petit, 2021). For example, understanding and authentication of blockchain code and construction of blockchain (Desplebin, Lux and Petit, 2021). Another important point is that the possibility that the companies will store all of their transaction by using blockchain is very low, at least in the near future (Schmitz and Leoni, 2019).

In response to the evolution of technologies the accounting graduates and future accountants will need to gain more skills related to blockchain technologies, artificial intelligence and big data (Birt, Safari and de Castro, 2023).

4.5.3 Benefits and challenges of blockchain technology

The discussion about predicted consequences of blockchain adoption is still open. On one side, practitioners and scholars find a number of positive effects of adoption and on the other side, a lot of challenges and problems of the adoption and implementation of blockchain technology in accounting.

Major benefit of the blockchain use in accounting is the enabling of real-time auditing, which could cause higher efficiency and effectiveness of work. As outcome there could be the costs reduction and more effective working time distribution of the auditors (Schmitz and Leoni, 2019). Another benefit is the use of smart contracts and possibility of using individual firm control protocols to monitor the companies processes or accounting transactions (Dai and Vasarhelyi, 2017). Implementation of blockchain technology could make the work more transparent, verifiable and efficient (Dai and Vasarhelyi, 2017). Increased fraud detection is another argument towards benefits of blockchain technology, because fraud transactions can be detected in real-time (Han et al., 2023).

Blockchain technology enables triple-entry accounting, where the debit and credit transactions are automatically approved and verified (Karajovic, Kim and Laskowski, 2019). In this system blockchain technology acts as neutral intermediary (Dai and Vasarhelyi, 2017). Blockchain has a role of a trusted party by making possible for all participants of the distributed ledger network to have access to the same transactions and to view all the changes made followed by protocol (Schmitz and Leoni, 2019).

Although blockchain technology could bring a lot of advantages, there is still no ready to use product in the real use (Roszkowska, 2021). The reason for that is that the implementation of technology has high barriers to entry including costs of adoption and developing. Known fact

about blockchain is that it is very energy-consuming and has scalability problems (Roszkowska, 2021). The limited scalability means that blockchain technology can process only little of amount transactions in comparison with existing systems (Zachariadis, Hileman and Scott, 2019). Based on this challenges, the likelihood that small firms will adopt blockchain technology into their processes is very low (Garanina, Ranta and Dumay, 2022).

4.5.4 Cryptocurrencies and blockchain: regulation and standards

Blockchain technology and cryptocurrencies are strongly related to each other. Blockchain technology is the foundation for cryptocurrencies (Castonguay and Stein Smith, 2020). Therefore, the cryptocurrencies can not function without blockchain technology. However, blockchain is not dependent on cryptocurrencies (Castonguay and Stein Smith, 2020).

There are over 6000 cryptocurrencies in the world (Castonguay and Stein Smith, 2020). Their main characteristic is that they do not have physical matter, they are very volatile and the value creation of them is based only on the trust of other people in this currency (Hampl and Gyönyörová, 2021). With the growing attention and usage of cryptocurrencies more and more cases of misuse were detected, meaning that they could be used to support criminal activities (Amiram, Jørgensen and Rabetti, 2022).

The main problem of the cryptocurrencies from the accounting perspective is that there is no guidance on how to apply standards and evaluate them (Luo and Yu, 2022). Additionally, this topic is currently understudied and immature from both perspectives: in academical research and from practitioners side. In the work of Pimentel and Boulianne (2020) it is also underlined that there is a problem of lacking unified international standards for the taxation of cryptocurrencies.

Blockchain technology together with other emerging technologies are developing very rapidly. On the other side, regulations and development of new standards to adopt the new technologies response relatively slow and therefore building a gap between technologies and legislation (Pimentel and Boulianne, 2020).

5. Future research directions and findings

In this section of research the main focus is to analyze the results from previous sections and the codes in NVivo to formulate suggestions for future research directions and answer research question three:

RQ3: What is the future path for research in blockchain technology within the accounting field?

To be a full part of accounting systems, blockchain technology has to be prepared and endure a number of important stages such as development, technical readiness, standardization and regulatory and legal allowance (Han et al., 2023).

The current literature is mostly focuses on describing the characteristics, problems and benefits, potential implementation and consequences of adoption. However, there is little to no literature describing blockchain and its technological aspects with the real-world examples. For example, Schmitz and Leoni (2019) suggest to initiate the cooperation of academic and accounting experts and IT experts. The aim is to explore this topic jointly in order to advance in this research area. The reason for that is a knowledge gap between these two parties. Current necessity and problem is also mentioned in the results of the research method analysis where the observation shows, that currently there is a lack of quantitative studies and use-cases based on real-world examples.

Another important direction for the future research is to explore the blockchain technology features on practical use-cases. Especially to broadly explore smart contracts including the information about it suitability with business processes and the outcome of its implementations : will it make the work of auditors more efficient or not. The same approach is suggested for examining the triple-entry accounting. As the results of analysis of research focuses show, that the topic of triple-entry accounting is mostly described as a part of general discussion about blockchain technology in accounting and is rarely examined as a separate topic. The future research should investigate practical problems with the implementation and

regulations by applying different research methods, because the topic is understudied in all directions.

Garanina, Ranta and Dumay (2022) have underlined in their work, that the adoption of blockchain technology is more likely to be in a big firms or IT firms. Future research direction can take a course on investigating the blockchain technology adoption by small and medium sized companies including challenges and benefits of such adoption.

In a majority of the papers, the researchers state that blockchain technology will possibly transform the work of accountants (Schmitz and Leoni, 2019; Garanina, Ranta and Dumay, 2022). The future research focus for this problem can be focused on exploring what kind of new skills accountants need to develop in order to adjust to the future adoption of blockchain. It could be important to understand, what skillset related to evolving technologies do the accounting professionals have at the moment and what skills they need to develop. Another important perspective that needs to be explored, is how the companies can manage this challenges. For example, trainings or educational solutions. Results from the applied research method analysis shows that interviews are gaining interest in exploring blockchain technology in accounting and especially the effects of it on the accountants role transformation. Therefore, the suggestion for the future papers is to continue exploring this topic by applying interviews, questionnaires and survey methods.

If the adoption and implementation of blockchain technology in accounting would take a place in real world, then there is not only expected that the work of the auditors could change, but also auditing services. The future research could focus on investigation, how would the implementation of blockchain affect the audit fees and how are they going to be calculated (Moll and Yigitbasioglu, 2019). Another focus for the future agenda is to investigate how the audit and accounting services could change or adjust to the new technologies and will there be some new arts of the services created within the implementation of blockchain.

As mentioned above the skills of accounting professionals will possibly need to adjust to the rapidly changing technology world. Therefore, companies and firms would be searching for

the new generation of professionals that would already have a good level of technology understanding and the skillset needed to work as accountant or auditor with blockchain technology (Schmitz and Leoni, 2019). Based on this information, the future research needs to develop a path on how the educational system and universities could adapt to this issue and offer more lectures and courses connected to the blockchain technology.

Regulation and other legal issues related to the topic of cryptocurrencies are also understudied and do not get attention. The technology has a great potential for the firms, but the companies cannot use it fully because of the lack of harmonized and developed regulations (Garanina, Ranta and Dumay, 2022; Pimentel and Boulianne, 2020).

To better understand and define the future of blockchain technology, there should be investigations on blockchain ecosystems and how would blockchain cooperate and be integrated in the business processes (Centobelli et al., 2022). The problems of current blockchain implementation such as missing architectural designs, guarantee of security and solution of the fraud issues are still open and need to be investigated in the future (Centobelli et al., 2022). It is also important to examine in the future research how the blockchain technology could be used on the different management levels and how would they use the information.

The current state of literature in blockchain technology and accounting demonstrates a lack of researches that examine the effect of blockchain technology implementation on ethics, sustainability and ESG. These topics are very important in nowadays business world and environment. Blockchain technology can be implemented and used for sustainability reporting to create a sustainability assurance (Bakarich, Castonguay and O'Brien, 2020). The technology can be used for the solving such problems as child labor, tracking of the criminal activities and production with the high level of environmental destruction (Bakarich, Castonguay and O'Brien, 2020). However, without legal norms and standards the further development of this topic has no future.

6. Conclusion and limitations

Blockchain technology became a relevant topic in accounting research field. According to the results of the theme development over the years, the observation shows that the number of papers related to this topic is increasing. Therefore, this study contributes to the existing literature by giving direction and outlook for the future perspectives of the topic and the future focus.

Overall, the aim and motivation of the study was to give an overview of the literature from three perspectives: past, current and future research and identify the problems and advantages of blockchain technology in accounting including the effects on the profession, determine the focus themes of the current research and suggest the focus for the future research. To deliver the motivated analyses, the study follows and applies structured literature review method. As a result, this literature review identified 87 unique papers and further analyzed them by coding the papers with NVivo software. The outcomes of coding show that the relevant publications started to appear from 2017 and has a positive trend in their development, because the number of papers is growing. This indicates that the topic is getting more relevant to the scholars. The research on blockchain related topics originates from different geographical regions and it is evenly developed in the leading regions. Research focus highlights four leading topics in current literature: Future of a technology: adoption and implementation, accounting profession's transformation, benefits and challenges of blockchain technology, cryptocurrencies and blockchain: regulation and standards. Based on the summary of the results, the paper provides proposal for the future research topics. This includes the emerging topics and research directions that do not receive enough attention and are understudies. The study also suggests to pay attention to the other research methods in the future works, as the current situation highlights the lack of use cases and quantitative studies.

Another concern about the current state of blockchain technology in accounting research is underlined in the work of Garanina, Ranta and Dumay (2022), that even if the numbers of papers has a positive growing trend, there is still limited and low number of papers in the top ranked journals. The reason for that could be that the technologies are developing much faster

and need to reach the audience quicker, but the traditional journal route does not implicate such characteristic.

This research has particular limitations. The first limitation, is that the study gives a general overview of the trends and technology on its own. Secondly, this study applies only the coding software NVivo to analyze the data. Future studies could extend the work with more advanced analysis methods such as LDA or bibliometric analysis, which would positively contribute the study.

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