The Future of Accounting: Triple-Entry Accounting Enabled by Blockchain

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Abstract. The present accounting and auditing practices are characterised by high costs, extensive labour requirements, and significant time commitments. The field of accounting, auditing, and reporting is undergoing a transformation due to the emergence of new technology and digital innovations. Blockchain is a promising emerging technology that has the potential to elevate traditional double-entry accounting into novel triple-entry accounting, resulting in enhanced system efficiency. The purpose of this research is to provide insight into the academic state-of-the-art of research on triple-entry accounting and its effect on future accounting practices. This article uses a systematic literature review to provide numerous bibliographic analysis and synthesis from scopus indexed articles. The results show that the number of papers and citations indicates a growing interest in scientific research on this particular topic but still in its early stages, reflected by the existing research on blockchain and triple-entry accounting that primarily adopts a qualitative approach. Keyword co-occurrence analysis shows that study on triple-entry accounting's challenges is least explored. In the future, blockchain is predicted to have the capability to enhance accounting processes through the implementation of triple-entries and smart contracts. The implementation of blockchain technology is also anticipated to have significant implications for the creation of employment opportunities in the long run.

Keywords: Accounting, Triple-Entry Accounting, Blockchain.

1. Introduction

According to a thorough empirical examination utilising a substantial sample size over the past fifty years, researchers Lev and Gu (2016) have observed a consistent and significant decrease in the value and applicability of financial information. The present accounting and auditing practices are characterised by high costs, extensive labour requirements, and significant time commitments. Nevertheless, it might be argued that these measures are still inadequate in effectively mitigating fraudulent activities (Cai, 2021). Various initiatives have been undertaken to enhance the level of transparency in accounting information. The primary objective of the International Financial Reporting Standards (IFRS) is to enhance transparency within financial

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markets, thereby fostering trust, facilitating growth, and ensuring financial stability in the global economy. However, it is imperative to develop a novel accounting approach that effectively addresses the inherent trust deficit between internal stakeholders and external parties of a company. Without such an innovative method, the enhancement of information transparency can only yield incremental improvements (Cai, 2021).

The field of accounting, auditing, and reporting is undergoing a transformation due to the emergence of new technology and digital innovations (Bonsón & Bednárová, 2019; Lombardi & Secundo, 2020; Mancini et al., 2021; Marrone & Hazelton, 2019). In the last two decades, numerous scholarly investigations have concentrated on examining the consequences of emerging technological frameworks, including automation, big data, cloud computing, social media, and artificial intelligence, in the field of accountancy (Arnaboldi et al., 2017; Choudhary & Vithayathil, 2013; Cockcroft & Russell, 2018; Issa et al., 2016; Kokina & Davenport, 2017; Manetti & Bellucci, 2016; Mosteanu & Faccia, 2020). Blockchain is a promising emerging technology that has the potential to significantly transform company models and subsequently impact the fundamental procedures associated with management control, accounting, auditing, and reporting (Schmitz & Leoni, 2019; Liu et al., 2021).

The feasibility of a novel accounting approach was dubious until the emergence of Bitcoin and its underlying blockchain technology in 2009. The primary breakthrough of Bitcoin lies in its ability to showcase the feasibility of conducting remote value transfers without the presence of a reliable intermediary capable of verifying the transaction. Bitcoin represents an innovative means of transferring value that employs a decentralised payment transaction system, incorporating blockchain technology and a duplicated and shared ledger (Cai, 2021). The term "blockchain" pertains to a transparent system of information and record-keeping that enables the verification and management of financial transactions. Notably, it operates in a decentralised manner, hence preventing the replication or digital proliferation of currencies (Abad-Segura et al., 2021). Numerous scholarly works have posited the potential disruptive impact of blockchain technology on the accounting and auditing profession. There is a debate about the potential impact of blockchain technology on the traditional accounting and auditing profession. One perspective suggests that blockchain might potentially lead to the decline of these professions, while another perspective argues that it presents an unexplored opportunity that accountants should take use of (Desai, 2023).

In the year 2005, a researcher named Ian Grigg made a significant contribution to the field of accounting by developing what is widely regarded as the initial implementation of blockchain technology (Griggs et al., 2014). The implementation of blockchain technology has the potential to bring about a significant transformation in the domain of accounting, specifically by facilitating a transition towards triple-entry bookkeeping (Cai, 2021; Carlin, 2019). A triple-entry accounting system is a system that utilises distributed ledger technology (DLT) (Perdana et al., 2021). This system combines value units, also known as tokens, in a third information entry which have the capacity to symbolise various accounting elements, including but not limited to facts, assets, equities, and liabilities. The implementation of blockchain technology in accounting can result in an expanded scope of information, enhanced accessibility,

heightened security, and eliminates the need for control and reconciliation processes between companies. Furthermore, the removal of intermediaries leads to a reduction in both time and costs, resulting in enhanced system efficiency (Abad-Segura et al., 2021).

According to recent reports conducted by the Big Four audit firms, blockchain innovations are expected to have a substantial impact on accountants, auditors, and regulators. These impacts primarily pertain to the various stages involved in transaction management, including initiation, processing, recording, reconciliation, auditing, and reporting (Coyne & Mcmickle, 2017; Schmitz & Leoni, 2019). The implementation of blockchain technology holds the potential to enhance operational efficiencies in accounting practices, hence posing significant implications for the traditional roles and skill sets of accountants (Dyball & Seethamraju, 2022; Schmitz & Leoni, 2019).

The current discourse around the use of blockchain technology in the corporate sector has prompted increased attention. However, it is important to note that the ramifications of blockchain technology and its various applications remain an area of study that is still in its early stages, particularly within the realms of accounting, auditing, and reporting. The triple-entry accounting paradigm in accounting exhibits significant potential. This still under-researched topic warrants further investigation (Bellucci et al., 2022; Cai, 2021) especially because there exists a widespread deficiency in comprehending the nature of blockchain technology, along with misconceptions regarding its capabilities (Alles & Grey, 2023).

The limited progress in blockchain implementation within the accounting field can be attributed to the existing disparity in knowledge between professionals specialising in blockchain development and those with expertise in accounting (Alles & Grey, 2023). One of the key challenges faced by accounting professionals and academic researchers is the insufficient training they receive on blockchain concepts and infrastructures. As a result, they often lack the necessary knowledge and abilities to effectively engage with this technology. However, in order for blockchain to revolutionise corporate operations, including accounting, it is imperative that blockchain professionals have enhanced support from the accounting profession and academics in terms of specialised business and accounting expertise (Cai, 2021).

The level of involvement of scholars and professionals in exploring the possibilities of blockchain and technical breakthroughs is increasing, but with certain constraints (Bellucci et al., 2022; Schmitz & Leoni, 2019). In the current pivotal stage of blockchain technology's spread and development, numerous prominent enterprises, institutions, and big audit firms have embraced its use. In light of this, our study aims to offer an updated and complete systematic literature review (SLR) of research products that are indexed on Scopus. This paper makes a valuable contribution to the existing body of accounting literature by engaging in a comprehensive analysis of the state-of-art research pertaining to the utilisation of blockchain technology and the triple-entry accounting as well as future prospective areas of investigation pertaining to blockchain technology in the field of accounting. This study serves as a valuable resource for current and future scholars who seek to explore the significant associations between accounting and disruptive applications utilising blockchain technology.

The subsequent sections of this work are organised in the following manner. The following section 2 provides a comprehensive literature review pertaining to blockchain, accounting and triple-entry accounting. This includes a precise description of the blockchain technology, history and a concise evaluation of the existing state of blockchain and triple-entry accounting. Subsequently, section 3 will elucidate our research methodology. Section 4, will present the findings of this paper and discussion of our investigation's findings. Section 5 provides conclusions and summary of our contribution to the current body of knowledge and suggests some potential directions for further research.

2. Literature Review

2.1 Accounting

Accounting is regarded as a profound intellectual discipline. The perspective presented by Sunder (2018) offers a unique and original analysis of the behavioural and economic processes within the field of accounting. The establishment of accounting as the language of business can be attributed to Luca Pacioli in the year 1494. The accounting process involves the systematic collection, identification, classification, summarization, and documentation of financial transactions within an organisation's accounting records, with the ultimate objective of generating financial statements (Fikri et al., 2022). The field of accountancy holds the distinction of being one of the most ancient professions, as evidenced by the existence of early commercial records dating back to approximately 3500 B.C in Mesopotamia. Nevertheless, over its extensive historical timeline, ancient accounting failed to advance beyond the utilisation of a single-entry accounting system.

The single-entry accounting system is characterised by the use of a unilateral accounting entry for every transaction. Assets are logged and marked when they undergo movement within and outside the organisation, resulting in corresponding entries in the accounting ledger. The monetary value associated with each transaction is recorded only once. The system's weaknesses are significant due to its reliance on a single record and absence of cross checking. This configuration hinders error detection and traceability, hence creating favourable conditions for fraudulent activities (Cai, 2021).

During the Renaissance period, specifically in the late 1400s, merchants in Venice used a novel approach known as double-entry accounting to effectively monitor and record their economic transactions. Within this particular recording system, it is imperative that every financial transaction necessitates a minimum of two accounting entries, specifically a debit and a credit. A notable characteristic of double-entry accounting is its ability to maintain a verifiable audit trail. This is achieved by recording dollar values twice for every transaction, ensuring that the sum of debits is equal to the sum of credits. In the event that the accounting entries are recorded without any discrepancies, it can be observed that the total sum of debit balances across all accounts will be equivalent to the total sum of credit balances across all accounts. In the event of an error, it is possible to trace each debit and credit back to its original entry and transaction source document. The implementation of this dual-recording system serves as a protective barrier for the organisation, effectively safeguarding it against both inadvertent and deliberate errors (Cai, 2021).

The accounting industry is dominated by four major firms, commonly referred to as the Big Four, namely Deloitte, PricewaterhouseCoopers (PwC), Ernst & Young (EY), and KPMG (Karajovic et al., 2019). The prevailing presence in industry literature is primarily publications originating from the prominent Big Four accountancy firms and esteemed professional bodies (Jayasuriya & Sims, 2023).

An Accounting Information System (AIS) is a framework employed by organisations to effectively gather, store, administer, analyse, and retrieve financial data pertaining to the entity. According to Sarwar et al. (2021), the data input for an AIS consists of information pertaining to company activities, while the output is in the form of financial reports. Accounting information systems are considered open systems that are both influenced by and have an impact on the surrounding environment. Consequently, it is imperative for accounting information systems to operate continuously and adapt to leverage all advancements occurring in fields related to their overall function and the business environment specifically (ALSaqa et al., 2019). According to Alles and Grey (2023), AIS researchers perceive blockchain as the most recent addition to a series of emerging technologies that have generated "inflated expectations." This pattern of heightened anticipation, as described in the Gartner Hype cycle, has been observed in relation to various technologies such as audit analytics, big data, XBRL, drones, expert systems, and cloud computing, among others.

2.2 Blockchain

Blockchain is a digital ledger that facilitates the recording of transactions between several parties in real-time, operates as a decentralised database, wherein each participant maintains a publicly accessible distributed digital ledger that primarily records transactions and safeguards data integrity against unauthorised modifications (Alkafaji et al., 2023; Bonyuet, 2020; Fikri et al., 2022; Kirkland, 2016; Lemieux, 2016; Prux et al., 2021; Smith, 2018; Tapscott & Pflueger et al., 2022; Y. Wang & Kogan, 2018; Zhang et al., 2021). Blockchain functions as a transaction recording system, resembling a book, and enables entities lacking mutual trust to establish consensus regarding the existence, status, and progression of shared elements (Abad-Segura et al., 2021; Gietzmann & Grossetti, 2021). Moreover, the utilisation of peer-to-peer technology fosters trust among participants involved in transactions, obviating the necessity for intermediaries to facilitate the completion of said transactions (Al Shanti & Elessa, 2023). In contrast to a centralised system, the absence of a singular authoritative copy of the ledger and/or a designated entity accountable for its maintenance is seen (Pflueger et al., 2022). Blockchain technology has been identified as a value transfer protocol that exhibits applicability across several fields associated with value (Zhang & Zhu, 2022) such as fuel and energy sectors (Ivanchenkova et al., 2023), supply chain management, finance, and accounting (Kostić & Sedej, 2022).

The initial and primary application of blockchain technology emerged inside the realm of digital currencies. The emergence of blockchain technology coincided with the introduction of bitcoins in 2009, wherein it was developed as an open-source programme that incorporated the novel protocol (Sinha, 2020). Some research points out that the initiation of the Blockchain framework can be traced back to 1999, when a technical resolution was introduced to tackle the temporal predicament associated

with malleable digital assets, including audio files, images, and text documents (ALSaqa et al., 2019). The initial practical application of Blockchain technology was pioneered by Satoshi Nakamoto in 2009. Nakamoto established Bitcoin, an electronic cash system that relies on Blockchain as a foundational mechanism for overseeing and verifying digital currency transactions. The study of cryptocurrencies extends beyond their use as digital currencies and has been explored for various purposes in different domains. These applications include decentralised document registration, management of medical records, registration of property ownership, monitoring of production processes, customs control, implementation of voting systems, and establishment of digital identity (Abad-Segura et al., 2021; Alexander et al., 2019; Bourlakis et al., 2019; Tso et al., 2019; P. Wang & Qiao, 2020).

The operational concept of blockchain is inherently evident: it consists of a collection or sequence of blocks of transaction records in a sequential manner based on timestamps interconnected by cryptographic hash strings (Fikri et al., 2022). Each block contains data, as well as hash values for both the block itself and the previous block. These blocks are ordered in chronological order by the presence of foundational code that establishes the network's regulations and logic (Mark, 2018) to comprehensively document all transaction activities that take place inside a given process (Wu et al., 2019). The data contained within each block of a blockchain represents the various activities involving the exchange of value that took place between the creation of the previous block and the formation of the current block. These blocks collectively form a set of records. The recorded data encompasses a range of transactions, such as asset exchanges, asset issuances, clearing activities, smart contract operations, and even records related to Internet of Things (IoT) data (Wu et al., 2019). Each block added to the blockchain is linked to the preceding block, commonly referred to as the parent block and the entire sequence of blocks can be traced back to the initial block, known as the genesis block (McCallig et al., 2019). Consequently, users are able to trace the origin and history of the data, enabling transparency and accountability (Cai, 2021).

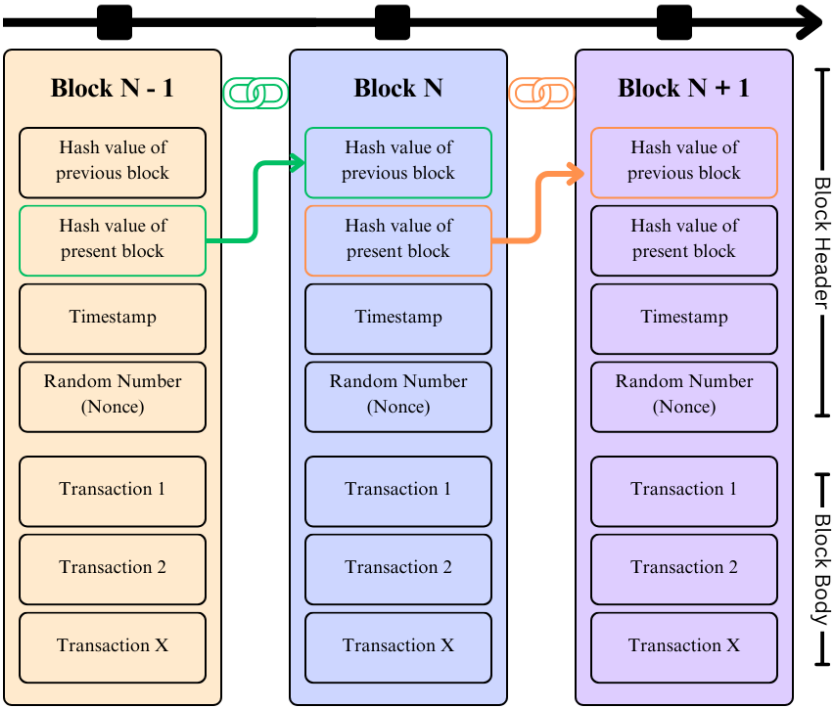

Fig. 1. Typical Blockchain Structure (Source: Author's image)

A conventional blockchain is distributed among a decentralised network of individual computers referred to as nodes. This network can be categorised as either permissioned, wherein access is limited to authorised users, or permissionless, allowing unrestricted participation (Prux et al., 2021). Alternatively, a hybrid model may be employed, combining elements of both permissioned and permissionless networks. Each node maintains an updated version of the transaction ledger, and when a new block is appended to the chain, the nodes collaborate to establish consensus (Sinha, 2020). The consensus mechanism is employed to ensure a unified record across the network's ledgers. These mechanisms encompass predefined rules and economic incentives that are encoded within the platform's software. Notably, two commonly utilised consensus mechanisms are proof-of-work (POW) and proof-of-stake (POS). The prevailing blockchain technology predominantly employs the POW mechanism to facilitate the mining of new blocks. POW grants the privilege of constructing new blocks and certain incentives to the earliest user who successfully calculates the nonce (Yu et al., 2018). Some existing technologies, such as hashing, EDI, ERP, the Internet of Things, data warehouses, and controls, have been proposed as fundamental components of blockchain applications for transaction processing in various contexts, including real-time and autonomous systems. Various platforms, such as Bitcoin, Ethereum, Hyperledger, R3, Ripple, Obyte, SapHana, and EOS, have been identified in the literature (Sharma et al., 2022).

In the conventional practice, a bilateral transaction is recorded by each party in their individual ledgers, utilising an invoice or purchase order as a basis. Subsequently, a request is submitted to their respective banks for the transfer of funds. Additionally, both financial institutions document the transaction in their separate ledgers and notify the relevant party. Therefore, all four parties are responsible for maintaining records. In the event of any disputes, if they arise, resolution shall be sought through the involvement of a neutral third party. The utilisation of blockchain technology involves the transmission of encrypted messages by a sender, containing information pertaining to the transaction as well as the network address of the recipient, to the entire network of participants. Once the message has been validated, the transaction is conducted, and a freshly generated block is added to the chain. In contrast to conventional systems, the absence of an intermediary is a distinguishing feature of blockchain technology. This is due to the capability of blockchain to enable real-time transaction recording and reconciliation, which are characterised by immutability and transparency (Dyball & Seethamraju, 2022).

2.3 Triple-Entry Accounting

Blockchain advantages in the field of accounting are particularly noteworthy due to the potential of blockchain technology to establish a triple-entry accounting system (Bonyuet, 2020; Jayasuriya & Sims, 2023). Researchers employ the phrase 'triple-entry accounting' to elucidate a novel accounting approach that represents an advancement above the conventional double-entry system (Alsalmi et al., 2023). Triple-entry accounting offers capabilities for registering ownership, maintaining invoices, processing payments, storing records, facilitating contracting, and documenting transactions (Cai, 2021; Fikri et al., 2022). According to Alsalmi et al. (2023) and Dai & Vasarhelyi (2017), the triple-entry blockchain system necessitates the recording of transactions in three distinct ledgers by all involved parties, including a shared ledger. Additionally, accounting entries are accompanied by timestamps. This system ensures that all transactions are unalterable, accompanied by timestamps, recorded in real-time, and encrypted.

The term 'triple-entry' was initially introduced by Yuji Ijiri, a scholar in the field of accounting, in 1986. Ijiri proposed the inclusion of a third layer of entries, known as trebit, in addition to the traditional debit and credit entries. These trebit entries would be associated with a new set of accounts aimed at explaining changes in income. The concept of a 'triple-entry bookkeeping' system aims to provide organisations with more comprehensive financial information. Ijiri (1986) states that accounting systems could be extended to triple-entry bookkeeping, which differs from double-entry bookkeeping by utilising three fundamental financial statements: the momentum, force, and wealth statements (Cai, 2021).

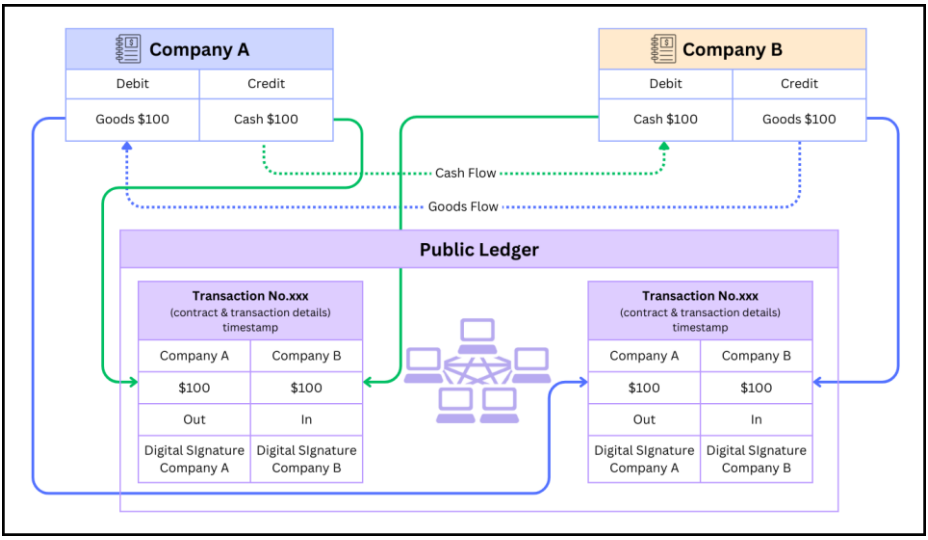

Fig. 2. A purchase transaction from company A to company B is recorded in triple-entry accounting (Source: Author's image)

In 2005, Ian Grigg, a financial cryptographer, published a working paper on his website entitled "Triple-entry Accounting," which introduced a novel interpretation of the term that diverged from Yuji Ijiri (1986) definition of momentum accounting. Grigg proposed a fresh concept, referred to as "the receipt is the transaction," wherein a digitally signed receipt, supported by financial cryptography, serves as a means for two parties to engage in a transaction. This receipt can be accessed by a shared third party, thereby mitigating the risk of transaction fraud and minimising redundancies in internal record-keeping (Grigg, 2005). However, during its inception, there was uncertainty regarding the identification of a trusted and impartial third party to oversee the shared ledger. Subsequently, the emergence of Bitcoin and its underlying Blockchain protocol three years later demonstrated that a trusted and impartial third party is not always necessary for the implementation of the third public ledger proposed by Grigg (2005). Instead, blockchain technology enables decentralisation, immutability, security, and automation of the ledger. In this decentralised system, untrusting users directly share all records, ensuring that each participant possesses a secure copy of all records and their subsequent modifications.

Triple-entry bookkeeping is a method that employs a distinct digital signature that cannot be transferred for every user. This digital signature ensures that transactions are observable by relevant parties and protected against interference from external entities through cryptographic measures. The conclusive transaction receipts encompass the digital signatures of all stakeholders involved (Cai, 2021; Jayasuriya & Sims, 2023; Kuruppu et al., 2022).

2.4 Smart Contracts

A smart contract refers to a digital contract encoded into a blockchain in which the terms are mutually agreed upon by two parties and encompasses a set of

predetermined states and transition rules, activated by specific scenarios that initiate contract execution, such as the occurrence of a particular event (Brown, 2015; Fikri et al., 2022; Subramanian, 2020; Wu et al., 2019). These contracts are formulated as if-this-then-that (ITTT) statements that are programmed and executed through code. Smart contracts serve the dual purpose of defining and enforcing the rights and responsibilities within the platform. As previously discussed, the consensus mechanisms encompass a collection of smart contracts that regulate and reliably execute diverse functions, such as distributing payments to miners or releasing staked capital upon the fulfilment of predetermined conditions. Once deployed within a network of computers, these contracts operate autonomously (Pflueger et al., 2022).

The inclusion of the smart contract is a significant enhancement to triple-entry accounting, surpassing the conventional double-entry approach. Each transaction generates a record that is stored in a separate blockchain ledger, alongside entries that are recorded in the conventional double-entry system. The records in this blockchain ledger consist of token transfers between debit and credit accounts. The inclusion of smart contracts within the third ledger constructed on blockchain surpasses the conventional notion of a mere ledger that records information. This advanced ledger possesses the capability to autonomously execute and enforce agreements entered into by two parties. Moreover, it exhibits responsiveness by disseminating information. This ledger has the potential to function akin to a conventional financial institution, as it can safeguard customers' assets and facilitate transactions using tokenized money instead of fiat currency (Cai, 2021).

The phrase 'smart contract' was first introduced by Nick Szabo (Cai, 2021). While the notion of a smart contract was initially conceived in 1997, it is only via the advent of blockchain technology that its vast potential has been acknowledged. The notion of a smart contract is a specific use case of blockchain technology and aims to tackle the challenge of documenting contractual occurrences. The utilisation of a blockchain ensures that terms in smart contract cannot be altered or tampered with by either party, owing to the immutable nature of the blockchain.

One drawback of the original 'smart contract' proposed by Szabo (1997) is that the agreements or instructions code within such a contract are solely readable by machines, rendering the contract legally non-binding. In the event of any mishap, establishing the presence of malicious intent from a legal standpoint in a court of law becomes challenging (Cai, 2021). In 2004, Ian Grigg further developed this concept and introduced the concept of a digital rendition of the smart contract, known as the Ricardian contract (Grigg, 2004). A Ricardian contract is a digital contract that encompasses all essential terms and clauses, comprehensible to both individuals and computer programmes. In the event of necessity, computer programmes can subsequently execute this contract. Cai (2021) proposes a solution that involves transforming a human-readable legal contract involving multiple parties into machine-readable software code, thereby enabling the execution of all smart contract features. The utilisation of digital signatures is important for the legal validity of this contract (Cai, 2021).

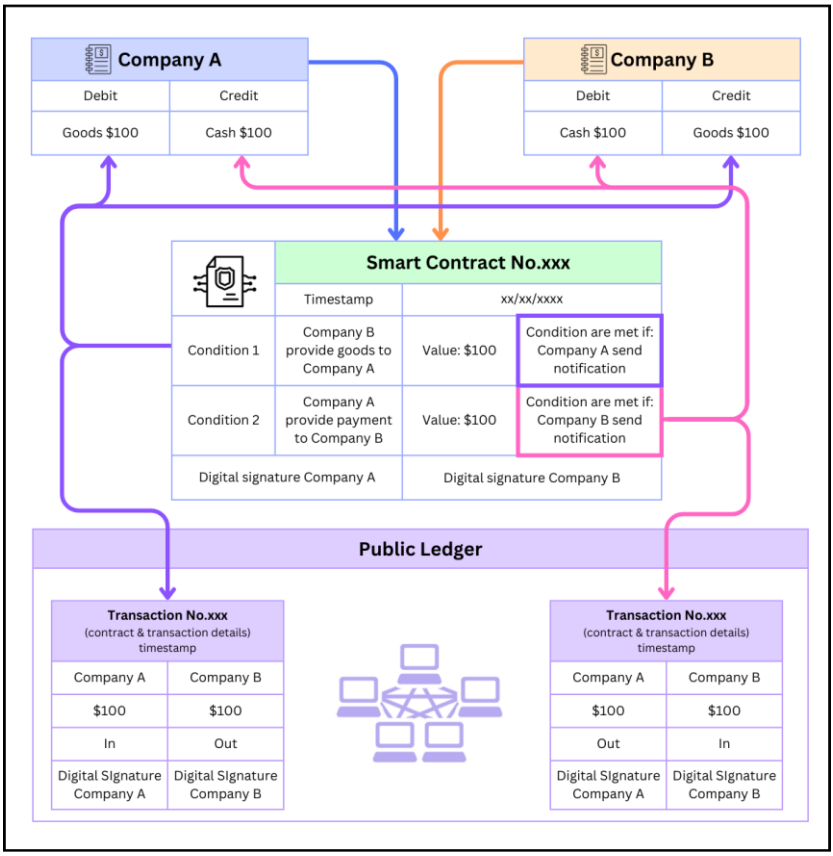

Fig. 3. An illustration of smart contract in triple-entry accounting (Source: Author's image)

Research Method

This study employed the systematic literature review (SLR) approach of qualitative research. A systematic literature review is "a systematic and transparent method of gathering, synthesising, and evaluating the findings of studies on a particular topic or question," according to Sweet & Moynihan, (2007). The SLR method involves a series of steps for collecting, evaluating, and synthesising relevant information from various literature sources related to the topic or issue under discussion. The research methodology used in this study adheres to guidelines outlined by Denyer and Tranfield (2009) to conduct SLR process, which consists of five stages or phases.

3.1 Phase 1 : Pilot Research and Formulating Research Question

The first step in this research is conducting a pilot search to conduct initial searches, identifying relevant literature and information sources related to the research topic. The pilot search is performed to gain a better understanding of triple-entry accounting enabled by blockchain, as well as its potential for accounting based

on existing literature. Next, the author determines relevant keywords related to the research topic, such as "Blockchain", "Accounting" and “Triple-Entry Accounting” to compile literature from electronic databases, primarily scopus database.

The Research Question represents the main question in the research that is to be answered through the research process. This question should be clear, specific, and relevant to the predetermined research topic. The Research Question serves as a guiding principle that directs the research and forms the basis for formulating hypotheses or research objectives to be tested and examined. In this study, the focus is on the academic state-of-the-art of research on Triple-Entry Accounting enabled by blockchain and its effect on future accounting practices.

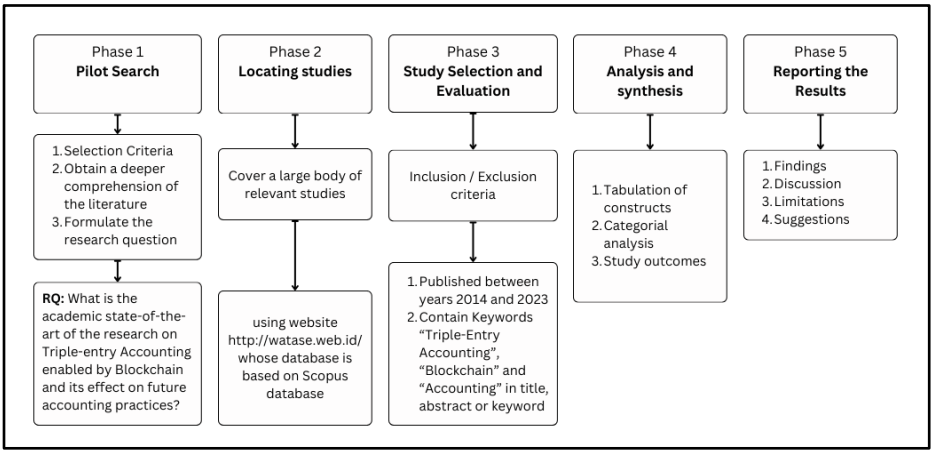

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Fig. 4. Systematic Literature Review Research Process

3.2 Phase 2: Locating studies

To find relevant studies, a selection process is conducted from various available data sources. For this research, a database that provided broad access to various literature related to the research question, namely Watase Uake was chosen. Watase Uake focuses on the Scopus database and includes various other databases such as Elsevier, Emerald, Taylor, and others. The keywords used in the search string included "Blockchain", "Accounting" and “Triple-Entry Accounting”. A specific search protocol then applied when exploring the Watase Uake database, with a focus on relevant research variables.

3.3 Phase 3: Study Selection and Evaluation

The search resulted in 142 relevant articles. Each article was evaluated using inclusion and exclusion criteria, where the articles had to be published between years 2014 and 2023. The evaluation process involved three stages of elimination: removing duplicate articles (37 articles), excluding articles outside the publication year range (2 articles), excluding articles not ranked in Q1, Q2, Q3, and Q4 in the

Scopus database (11 articles) and articles without abstract or not written in english (1 article). Subsequently, in the screening stage, further elimination was conducted. The remaining 91 full-text articles were evaluated for inclusion in the qualitative synthesis after the initial screening. A decision is made based on eligibility requirements. Based on our research goals, inclusion or exclusion criteria were established in order to gain a better understanding of triple-entry accounting enabled by blockchain. As a result, 26 articles were found to be a secondary research or have the related keywords in their titles and abstracts but do not discuss topics relevant to this research. The second elimination was performed on articles that lacked available data, resulting in a total of 21 articles being excluded. Consequently, in the final analysis stage, 44 articles that met the criteria and passed the elimination stages were identified. These articles will be analysed and synthesised to obtain answers to the previously proposed research question. The elimination process will be presented in the figure 5 below.

3.4 Phase 4: Analysis and Synthesis

By analysing the 44 articles and extracting data, this research gained a better understanding of triple-entry accounting enabled by blockchain and its potential for future accounting practices. Various relationships between blockchain, accounting, smart contracts systems and triple-entry accounting theories from numerous countries are synthesised. Additionally, the researchers conducted a bibliometric analysis to evaluate the trends in this topic's development. Some aspects analysed in the bibliometric analysis included the number of articles published in the last 10 years and the distribution of articles based on countries.

3.5 Phase 5: Reporting the results

The results of the study are presented in the form of tables, and discussions that are consistent with the research conducted by Siddaway et al. (2018). The detailed information presented includes search strategies, inclusion and exclusion criteria, study selection process, quality assessment, data extraction, and data synthesis. The analysis of the findings is then conveyed through a report or scientific article that contains comprehensive and structured information about the triple-entry accounting enabled by blockchain and its potential for future accounting practices.

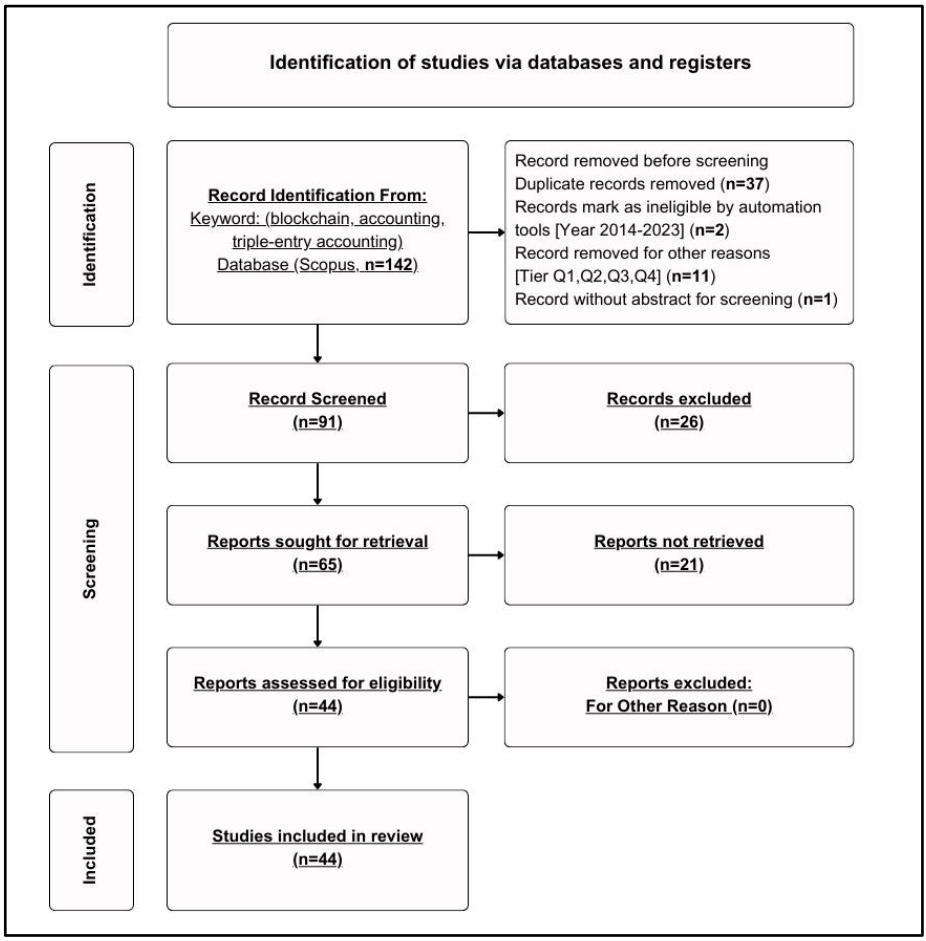

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Fig. 5. Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA)

The Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) suggested by Moher et al. (2009) were used in the current SLR investigation. PRISMA is a guide for transparently, objectively, and explicitly reporting systematic reviews. PRISMA was initially created for research in the healthcare industry, but it has since been widely used in business and marketing (Siddaway et al., 2018; ter Huurne et al., 2017).

Results and Discussion

This section undertakes a study of the raw bibliometric data collected and describes the analysis that was conducted. This section will address the research question, which is: "What is the current academic state-of-the-art of research on Triple-Entry

Accounting enabled by blockchain and its effect on future accounting practices?". The 44 articles referenced in the Systematic Literature Review are listed in appendix 1. The composition of articles by scopus quartile is as shown in figure 6 below.

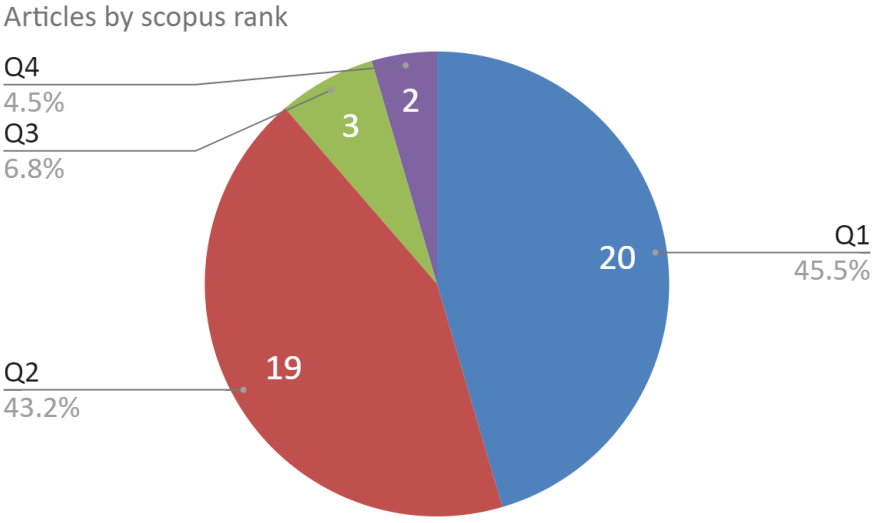

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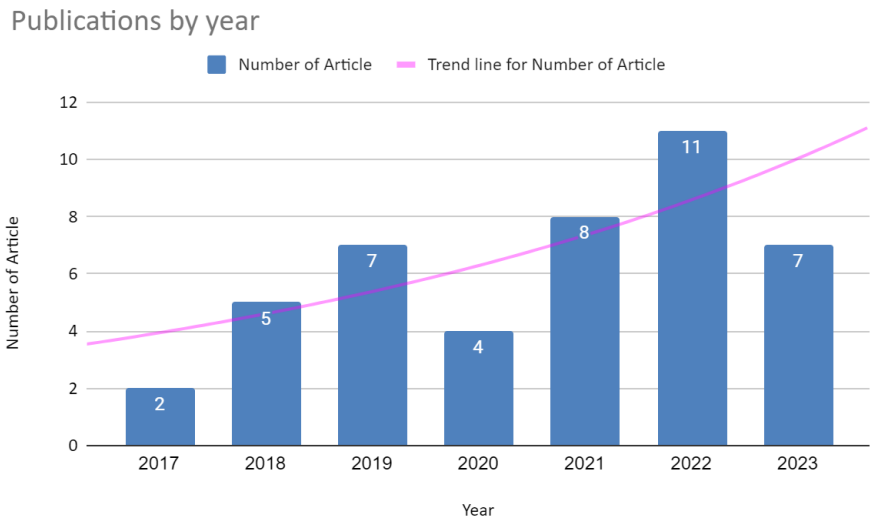
Fig. 6. Articles by scopus rank

4.1 Descriptive Bibliometric Analysis

The objective of the descriptive analysis is to present the key characteristics of our dataset, with a specific emphasis on five factors that are of interest to academics in the accounting profession regarding the blockchain and triple-entry accounting issue. This analysis intends to provide an accurate representation of the scientific research conducted on this topic. The following components encompass the analysis: (1) the trend of scholarly publications by year; (2) the papers with the highest citation counts and the corresponding citations each year; (3) the distribution of publishing activity across different countries; (4) the categorization articles by research method used; (5) the time period between articles being submitted and accepted.

Publications by year. The concept of blockchain and triple-entry accounting has emerged as a novel theme of interest among accounting researchers, particularly in the years after 2015. The frequency of scholarly articles pertaining to blockchain technology and triple-entry accounting in the fields of management and accounting has experienced a notable surge over the past five years, as depicted in Figure 7. The observed trend in the number of papers indicates a growing interest in scientific research on this particular topic.

The observed reduction in the trend depicted in Figure 7 for the year 2020 may be caused by extraordinary event affecting researchers, namely the covid-19 pandemic. Some researchers have reported decline in time spent on research during pandemic (Gao et al., 2021).



(Source: Author's image)

Fig. 7. Publications by year

The data exhibits an increasing exponential trendline, it suggests that the values in the series are growing at an accelerating rate over time. These findings are in line with many researchers before Exponential growth is characterised by a constant percentage increase in each period, leading to a curve that becomes steeper and steeper. This reflects a growing interest and recognition of the significance of these technologies in the academic and research communities. The surge in research papers in the field of blockchain and triple-entry accounting signifies a deepening understanding of these technologies and a commitment to exploring their potential impact across various industries and disciplines. Researchers are actively contributing to the evolving landscape, addressing challenges, and uncovering new opportunities for innovation and improvement in accounting practices as shown in figure 8 below. These result is inline with many previous research (Bellucci et al., 2022; Lardo et al., 2022; Schmitz & Leoni, 2019; Secinaro et al., 2021).

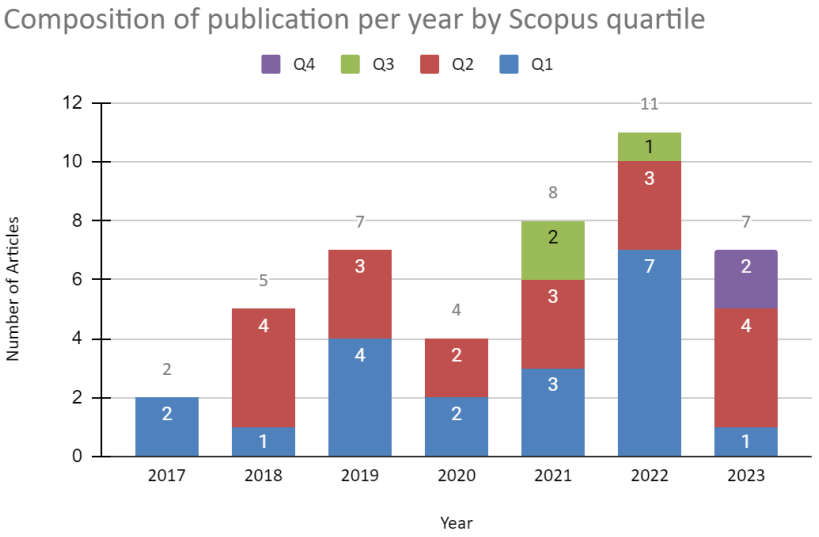


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Fig. 8. Composition of publication per year by scopus quartile

Citations by year and most cited documents. Through the process of analysing the quantity of citations, it is possible to obtain a comprehensive understanding of the significance of papers within a certain academic discipline (Baier-Fuentes et al., 2019). Figure 9 shows the maximum and the average number of total citations.

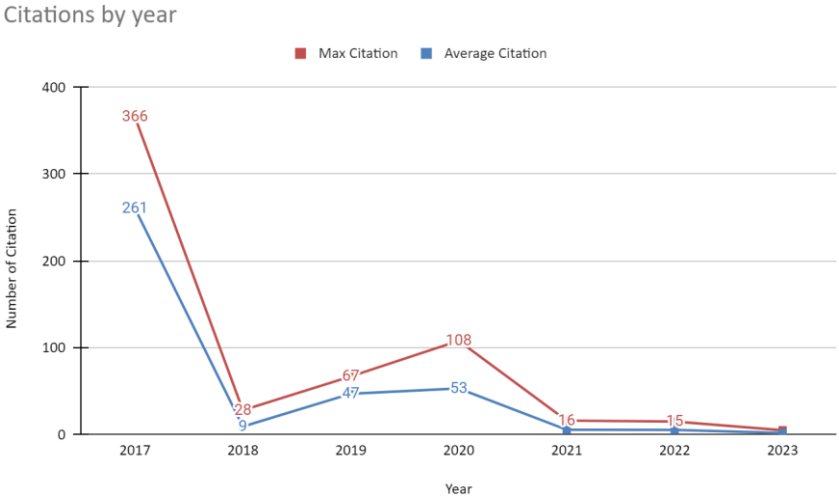

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Fig. 9. Citations by year

Figure 9 specifically emphasises the year in which the papers have a higher average number of citations and identifies the paper that receives the highest number of citations each year. This analysis provides insights into the representative nature of the average impact of papers in different years, based on the available citations in our dataset. It helps us discern the years when the average impact is distorted due to the inclusion of a single highly-cited paper, alongside other documents that have very few citations. The occurrence under discussion transpired throughout the years 2017 and 2015, wherein two papers garnered a much larger amount of citations compared to the average.

In Table 1 below are presented the top 10 cited papers. The first paper is Dai and Vasarhelyi (2017) can be considered as the seminal study in the application of blockchain technology to the domains of accounting and assurance. It remains a highly significant and influential reference point for all subsequent studies conducted in this particular subject. Dai and Vasarhelyi (2017) research underscores the impact of blockchain technology on the accounting system, resulting in enhanced real-time capabilities, verifiability, and transparency. Additionally, it has led to a significant transformation in auditing practices. The remaining publications with the highest number of citations, as presented in Table 1, have a count of citations ranging between 35 to 155.

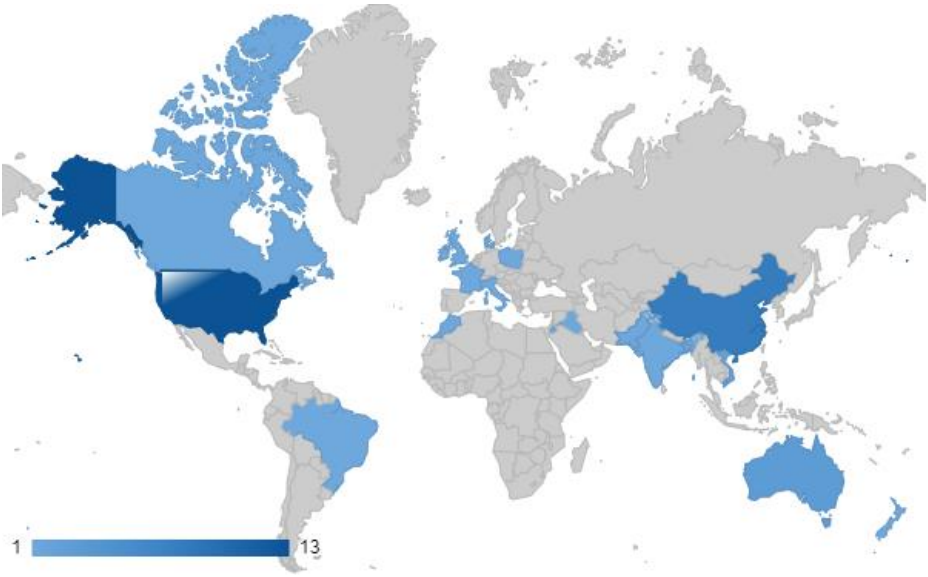
Table 1. Top 10 cited papers

No	Authors	Year	Quartile	Citation
1	Dai and Vasarhelyi	2017	Q1	366
2	O`Leary	2017	Q1	155
3	Demirkan et al.	2020	Q1	108
4	Yu et al.	2019	Q2	67
5	McCallig et al.	2019	Q1	62
6	Tan & Low	2019	Q2	59
7	Zhang et al.	2020	Q1	57
8	Karajovic et al.	2019	Q2	48
9	Cai	2019	Q1	46
10	Bonyuet	2020	Q2	35

(Source: Processed data, 2023)

Within this context, it is possible to discern three primary categories of interest. The first category focus revolves around diverse blockchain architectures in various domains, encompassing accounting, and assessing the capacity of blockchain technology to handle multiple forms of transactional data in different sectors (Shao et al., 2021). The second category of scholars views blockchain technology as a novel tool that presents potential advantages in the realm of finance, particularly in the context of digital financial technology such as triple-entry accounting (Cai, 2021). The third category centres on the capacity of blockchain to revolutionise the field of

accounting, influencing real-time accounting, continuous monitoring, and fraud prevention. These findings are in line with Lardo et al., (2022) that there is a dominant paper in 2017 that became the seminal paper in the field of blockchain technology and triple-entry accounting.



(Source: Author's image)

Fig. 10. Geochart of the number of articles by country

Publishing activity by country. The subject of blockchain technology and triple-entry accounting within the accounting domain appears to be a topic of global discourse. Based on the affiliation of the first author in our dataset, the research pertaining to this issue was carried out in a total of 21 countries. These countries exhibit variations in the quantity of published papers. Figure 10 exhibits the number of publications by the country. The United States of America is widely recognised as the most prolific nation, exhibiting a remarkable continuity that extends back to its earliest years. Lardo et al., (2022) also highlighted that in 2015, USA had two research which represent distinguished works on blockchain in the accounting field.

Categorization articles by research method used. According to Garanina et al. (2022), Mancini et al. (2021), Lombardi et al. (2022), and Secinaro et al. (2021), the existing research on blockchain in accounting primarily adopts a qualitative approach.

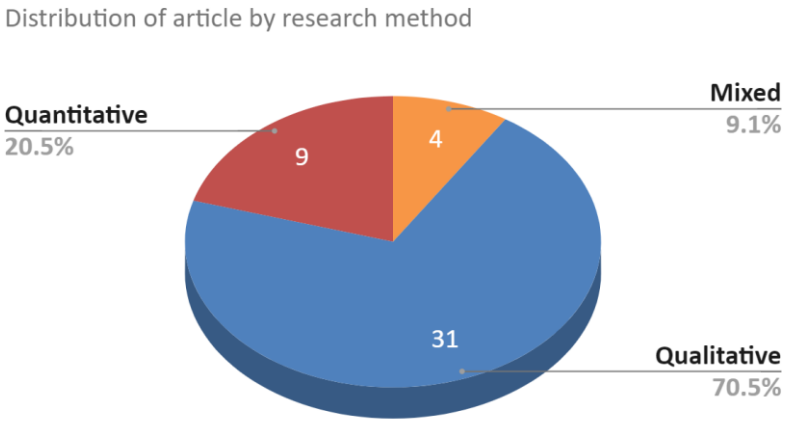


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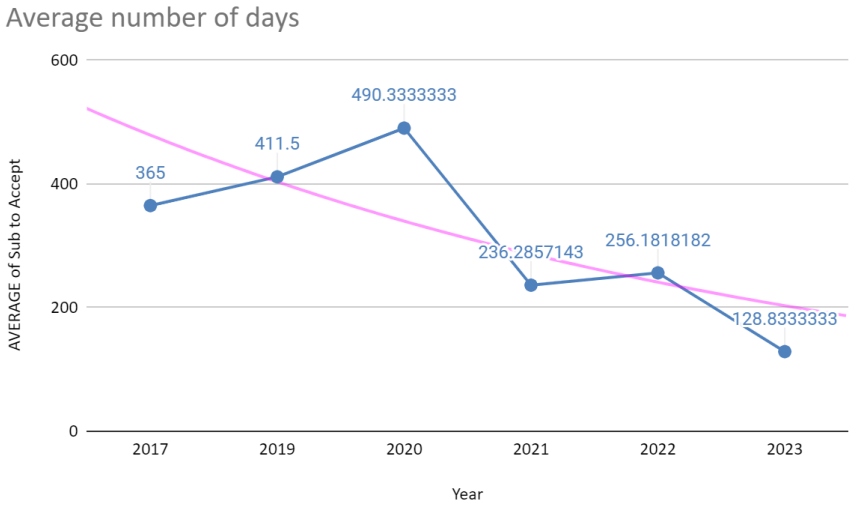
Fig. 11. Distribution of article by research method

This data further confirms that blockchain and triple-entry accounting is an area of study that is still in its early stages. This topic warrants further investigation, as highlighted by Bellucci et al. (2022).

Time period between articles being submitted and accepted. The process of publishing in scholarly peer-reviewed journals often involves significant delays between the submission and eventual publication of the research findings. This phenomenon can be attributed, in part, to the protracted duration of the peer review process. Additionally, it can be attributed to the prevailing practise of publishing articles in print issues, which was formerly imperative due to the limitations of paper-based publishing. Consequently, this practice has resulted in a backlog of manuscripts awaiting publication. The occurrence of delays in the dissemination of scholarly work can impede the timely distribution of academic knowledge and impose a substantial burden on the professional trajectories of writers (Björk & Solomon, 2013). Although this challenge is partly solved with the advent of online publishing due to early availability of articles, there is still a large gap between the time an article is submitted and it being accepted. This is a major issue in the technology field since the rapid and fast ever evolving nature of the field. A new technology at the start of this year, for example, can be considered obsolete by the end of the following year. Thus, it is very important to consider the time lag in scholarly peer-reviewed journals. Figure 12 below shows the average days between the date of article submission and the acceptance date. The decreasing number of days by year acknowledges the increasing interest of researchers (Bellucci et al., 2022; Cai, 2021; Dai & Vasarhelyi, 2017; Lardo et al., 2022; Secinaro et al., 2021).



Source: Author's image)

Fig. 12. Average number of days between article submitted and accepted by year of publication

The period of an article being under review in scholarly peer-reviewed journals is also affected by the requirements of the journal. Journals of higher quartile have higher standards and therefore generally have a longer period to accept a paper as shown in figure 13 below.

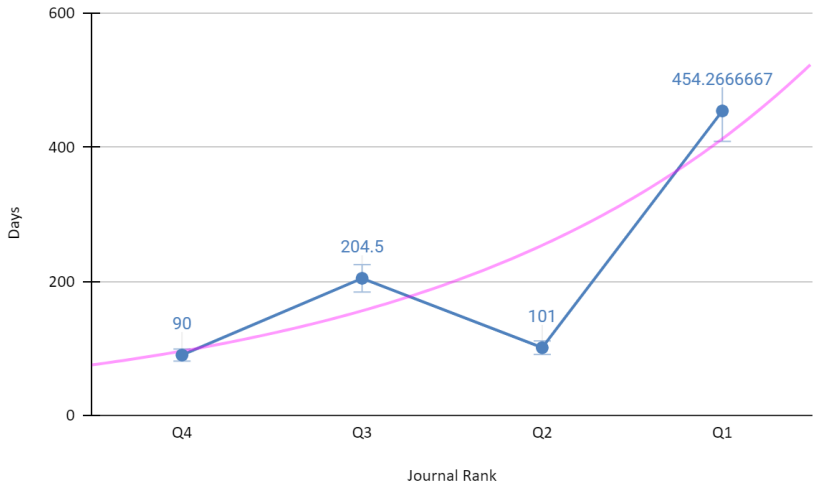


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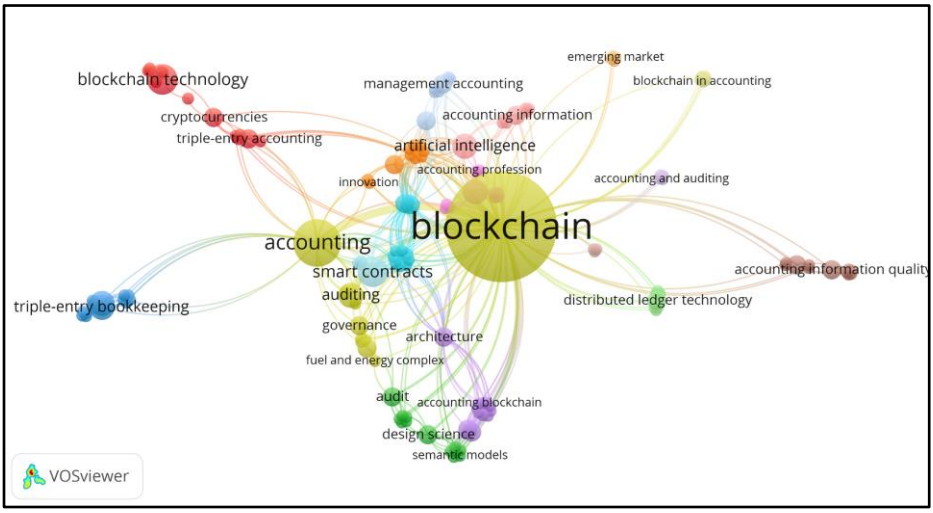
Fig. 13. Average number of days between article submitted and accepted by journal's scopus quartile

4.2 Bibliometric analyses of the main topics investigated in the data set

The objective of this part is to examine the most pertinent subjects that have been addressed inside our dataset. We conducted an analysis of the frequently occurring terms employed by authors. The study of keywords offers valuable information into the content and primary concerns around blockchain technology and triple-entry accounting.

The investigation of keyword co-occurrence uses the keywords provided by the author to examine the interrelationships between the primary themes within the analysed domain (Bellucci et al., 2022; Lardo et al., 2022). Figure 14 presents the data that reveals the fields associated with blockchain research within the accounting sector. The network's keyword co-occurrences are established.

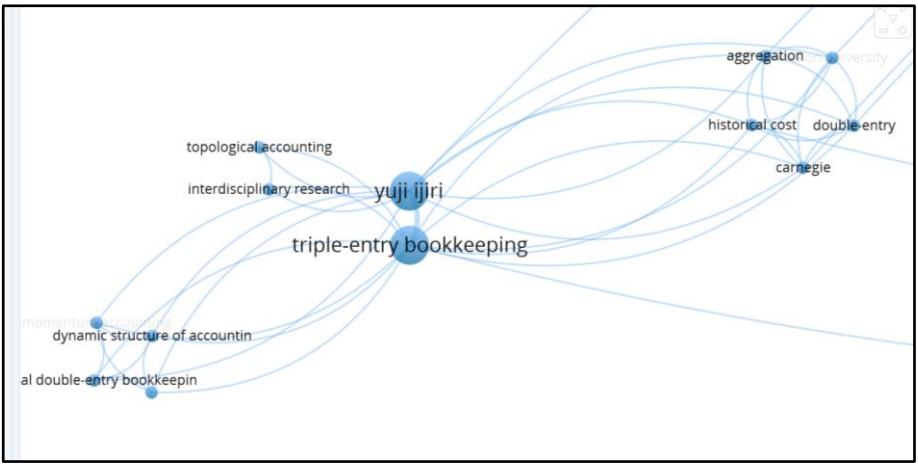


(Source: VOSviewer, 2023)

Fig. 14. Network visualisation of keywords co-occurrence

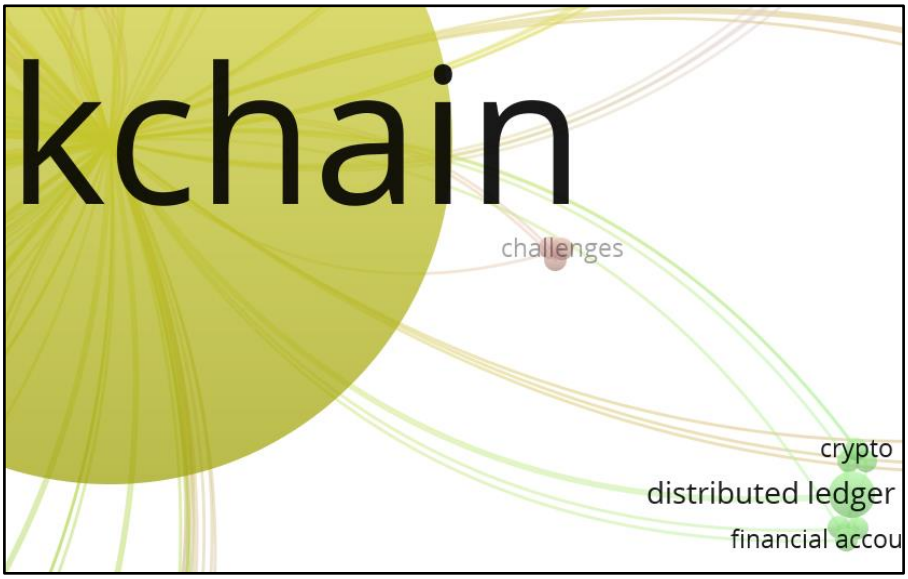
Based on the network map analysis, the term "blockchain" emerged as the most significant keyword, exhibiting robust connections with other keywords such as bitcoin, smart contracts, IoT, green computing, and accounting. The keyword that exhibited the highest degree of association was IoT, which displayed a particularly significant correlation with green computing. Furthermore, the triad of blockchain, IoT, and green computing emerged as the set of keywords with the most robust interconnections. The term "smart contracts" is closely associated with the fields of accounting and the Internet of Things (IoT). The network visualisation reveals that several noteworthy terms encompass blockchain, smart contracts, bitcoin, and accountancy.

Triple-entry accounting also has a strong connection to keyword accounting and blockchain. From figure 14 above, there are two clusters regarding triple-entry: triple-entry accounting and triple-entry bookkeeping. In most cases, these two keywords are interchangeable aside from the fact that some of the articles which discuss Ijiri's work commonly use the term triple entry-bookkeeping (Hsieh, 2018; Lin, 2018; Sunder, 2018) as shown in the light blue cluster (figure 15).



(Source: VOSviewer, 2023)

Fig. 15. Triple-entry bookkeeping cluster



(Source: VOSviewer, 2023)

Fig. 16. Least explored keyword

Among the many clusters of keywords, the cluster, ‘challenge’ is deemed as one of the least explored themes, as shown in figure 16. This cluster has minimal co-occurrences and no connection yet to other keyword especially to triple-entry accounting The aforementioned statement acknowledges the existing interest of accountants in blockchain research; however, it emphasises the need for further advancements in the establishment of regulations and benchmarks for blockchain and triple-entry accounting, necessitating the involvement of prominent accounting firms to contribute their expertise to broaden the opportunities and challenges in this field of topic (ALSaqa et al., 2019; Cai, 2021; Prux et al., 2021), particularly at the policy level (Gusc et al., 2022). It is also necessary to recognise the challenges associated with utilising blockchain technologies with other systems such as IoT, ERP, Big Data and others to enhance the quality of accounting information (Wu et al., 2019; Yang & Yin, 2023).

4. 3 Blockchain and triple-entry accounting effect on future accounting practices

The transformative potential of blockchain. technology in revolutionising the storage and interaction of business records has garnered significant recognition. Referred to as a 'Distributed Ledger,' this technology has been acknowledged by the Bank of England as having applications beyond payment systems such as Bitcoin (Liu et al., 2021; McCallig et al., 2019). Given the numerous benefits associated with the adoption of blockchain technology in business entities, it is anticipated to offer intelligent solutions for enhancing the efficacy and efficiency of corporate governance, particularly in the context of shareholder-establishment dynamics. Consequently, the implementation of blockchain technology facilitates an improved relationship between shareholders and the organisation (Al Shanti & Elessa, 2023; Kostić & Sedej, 2022; Sheldon, 2019; Wu et al., 2019).

In brief, the double-entry system has certain limitations in its ability to recognise internal transactions and provide comprehensive assurance for business accounting transactions (Zhang et al., 2021). To address these limitations, a triple-entry accounting system has been proposed, which involves integrating a company's existing Enterprise Resource Planning (ERP) system with a blockchain technology that utilises blockchain tokens (Dai & Vasarhelyi, 2017; Dechow & Mouritsen, 2005; Kuruppu et al., 2022). This integration allows organisations to maintain their traditional double-entry accounting while incorporating a set of interlocking blockchain accounts that enable continuous recording, verification, and auditing of transactions. The predominant method of storing accounting data in contemporary practice involves the utilisation of specialised software that is seamlessly integrated with the ERP system. The overarching architecture of the ERP system facilitates the provision of a comprehensive solution to address the information processing needs of the organisation. In the context of accounting, the implementation of an ERP system commonly entails the adoption of standardised accounting reports.

In their comprehensive analysis, Dai and Vasarhelyi (2017) delve into the distinctions between ERP systems and blockchain technology. They assert that while ERP systems often necessitate substantial human involvement, blockchain has the

potential to automate transaction recording with minimal human intervention (Jayasuriya & Sims, 2023).

The implementation of a blockchain-based Smart Ledger has the potential to serve as a viable alternative to the conventional accounting information recording system. In the realm of accounting, transactions have traditionally been recorded through three primary mechanisms: double-entry accounting, judgement-based accounting, and ERP systems. Nevertheless, it is important to acknowledge that each of these mechanisms possesses certain drawbacks and limitations (Demirkan et al., 2020; Mark, 2018; Zhang et al., 2021).

The adoption of blockchain technology is primarily influenced by aspects such as enhanced security and privacy, increased transparency and auditability, immutability of records, improved cost efficiency, real-time transaction capabilities, and flexibility. The findings suggest that the Quorum, SAP HANA, and Ethereum platforms are the most reliable and reputable platforms for blockchain technology. Additionally, the study concludes that these blockchain platforms are highly suited, secure, and robust (Sharma et al., 2022). Aside from that, it is possible to utilise it in conjunction with Relational Database Management Systems (RDBMS) to offer cost-effective and resilient solutions (Sarwar et al., 2021). Another variable that affects adoption is Emotional Intelligence (Huy & Phuc, 2021). The cultivation and training of Emotional Intelligence have been found to have a notable influence on the acquisition of technological knowledge .

In relation to legislation and policy, it is noteworthy that while there is currently no extant legislation specifically addressing this matter, the government and financial regulatory authorities have expressed a favourable assessment of the potential of blockchain technology. Consequently, there is ongoing deliberation on the applicability of this technology in the provision of government services (Al-Zaqeba et al., 2022; Zhang & Zhu, 2022).

Multiple studies, including those conducted by PwC (2016), Deloitte (2016), EY (2016), and KPMG (2017), have indicated that the adoption of Blockchain technology by auditing companies enhances the efficiency and efficacy of the audit process (Ferri et al., 2020; Y. Wang & Kogan, 2018). In the context of industrial applications, Ernst & Young (EY) has made an investment in a start-up called Libra that specialises in blockchain-distributed ledgers. Additionally, EY has developed the EY Ops Chain, a platform that facilitates the processing of inventory information, pricing, payments, and digital contracting. In 2017, Deloitte successfully conducted an audit of a permissioned blockchain, adhering to established norms. A collaborative effort between KPMG and Microsoft has resulted in the establishment of a digital ledger system based on blockchain technology. PricewaterhouseCoopers (PwC) has published a series of publications pertaining to the adoption of blockchain technology, including one specifically addressing the energy consumption associated with blockchain networks (Jayasuriya & Sims, 2023).

In addition, the Big Four accounting firms engaged in discussions regarding the potential establishment of a consortium focused on blockchain solutions alongside the American Institute of Certified Public Accountants (AICPA) in the year 2016. The main emphasis of these applications lies in the implementation of blockchain technology and the challenges it presents in the financial services, health care, and public sectors. Since the year 2018, there has been a noticeable transition in industry

literature, where the focus has shifted from analysing the adoption of blockchain technology from a top-down perspective to examining the many issues encountered in the realms of accounting and auditing (Jayasuriya & Sims, 2023).

Triple-Entry Accounting. Triple-entry accounting is a subject of interest in various industry applications. One notable example is Ledgerium, an Australian company that has created a triple-entry accounting system utilising blockchain technology and smart contracts. This innovative system goes beyond traditional debits and credits reconciliation by incorporating a third set of blockchain transactions and records (Carlin, 2019; Dai & Vasarhelyi, 2017; Hsieh, 2018; Jayasuriya & Sims, 2023; Sunder, 2018). In addition to facilitating the exchange of information among participants, the peer-to-peer (P2P) network also serves as a valuable tool in mitigating the risks of data tampering and misinformation (Huy & Phuc, 2021). According to Cai (2021), the effective implementation of triple-entry accounting with blockchain has the potential to bring about significant improvements in the field of accounting.

According to Kuruppu et al. (2022), the use of triple-entry accounting and Blockchain technology has the potential to enhance the accountability of non-governmental organisations (NGOs) through the augmentation of efficiency, accuracy, and the ability to conduct audits pertaining to record-keeping, performance assessment, and external reporting.

Triple-entry bookkeeping offers several benefits in the realm of financial accounting. Firstly, it enhances transparency by providing a more comprehensive and accurate representation of financial transactions. This increased transparency is achieved through the inclusion of a third entry, which serves to corroborate and validate the traditional double-entry system. Secondly, triple-entry bookkeeping reduces the time gap between the occurrence of a financial event and its subsequent reporting. By incorporating real-time accounting practices, this approach enables more timely and up-to-date financial information to be available for decision-making purposes. Furthermore, the implementation of triple-entry bookkeeping helps to mitigate the potential for manipulation or fraudulent activities. The inclusion of a third entry acts as an additional layer of verification, making it more difficult for individuals to manipulate financial records without detection. Lastly, triple-entry bookkeeping allows for comprehensive audits of entire recorded populations. This means that auditors can examine and verify the entirety of financial transactions, rather than relying on sampling methods (Cai, 2021; Carlin, T. (2019).

Future Challenges. There is a possibility that blockchain technology could experience failure, similar to other instances where accounting solutions have proven to be unreliable (Pflueger et al., 2022). A blockchain-based AIS alone does not guarantee the accuracy and fairness of financial reports (Tan & Low, 2019). One distinctive obstacle posed by blockchain technology is its limitation in extending its benefits to the realm beyond the digital domain. It raises the question of how to ensure the veracity of products that are promoted as possessing specific attributes. Additionally, the verification process for the accuracy of smart contracts integrated within a blockchain system remains uncertain (Chowdhury et al., 2023; Sinha, 2020).

Furthermore, certain significant concerns pertain to latency, scalability, and energy consumption (O'Leary, 2019).

One of the primary obstacles hindering the widespread adoption of blockchain technology within the business ecosystem pertains to the considerable expenses and complexities associated with onboarding multiple business entities onto a unified platform (Sinha, 2020). For instance, Walmart mandates the utilisation of a blockchain system by all its lettuce suppliers in the United States and pork suppliers in China. However, the scarcity of organisations possessing comparable influence poses a significant challenge in achieving such extensive implementation.

The risks associated with the utilisation of blockchain technology in the accounting and auditing processes of fuel and energy companies have been categorised and organised into distinct areas. These areas include the substantial energy consumption demands imposed by blockchain technology, inadequate proficiency and expertise among accountants in handling blockchain, as well as technical, accounting, and auditing challenges (Ivanchenkova et al., 2023). Another risk that auditors must be cognizant of pertains to the potential occurrence of a "51 percent" or "majority rule" attack. This type of attack involves the deliberate introduction of inaccurate data by a user into the blocks, resulting in the creation of a fraudulent transaction. Subsequently, this fraudulent transaction is accepted as valid by the majority of nodes in the blockchain network (Bonyuet, 2020). In the context of private blockchains, the provision of access to external auditors for conducting audits becomes necessary (O'Leary, 2017).

The advent of blockchain technology, which aims to establish trust without the need for intermediaries, has sparked concerns regarding the future role of auditors and their societal significance. However, current apprehensions regarding this matter are unfounded as certain aspects of the auditing process still necessitate professional judgement (Turker & Biçer, 2020). While certain audit procedures like sampling, confirmation letters, payroll examinations, invoice evaluations, and reconciliation may become less costly or obsolete (Turker & Biçer, 2020), others such as systemic evaluation, risk assessments, predictive audits, and fraud detection will garner newfound attention and importance (Bellucci et al., 2022).

There exists a divergence of opinions among cryptocurrency enthusiasts regarding the implementation of additional regulatory measures. A faction within this community contends that such regulations would impede innovation and jeopardise the fundamental principle of decentralisation that underlies cryptocurrency. Conversely, an opposing viewpoint posits that the absence of a legal framework actually impedes the progress of cryptocurrencies. This is due to the potential deterrent effect on prospective investors, who may be dissuaded from engaging in cryptocurrency investments in the absence of regulatory safeguards (Alsalmi et al., 2023).

Blockchain scalability is also a concern for many firms. It is necessary to reiterate that scalability is more of an issue for the public blockchain, rather than private and permissioned versions. With enterprise-grade distributed ledgers and private inter-organisational blockchains, fewer nodes are involved, thus reducing the computational intensity needed to validate transactions. Storage space is also of no concern especially for corporate use as it is more manageable. The current Bitcoin blockchain grows at about one megabyte per hour (Karajovic et al., 2019). However,

if a company the size of Visa were to start using blockchain to process its 2000 transactions per second, growth would increase to one gigabyte per hour. This is the equivalent of 8TB per year. Consider other large organisations moving to blockchain, and an obvious scalability issue emerges (Karajovic et al., 2019).

Conclusion

In contrast to previous studies, our systematic literature review (SLR) was conducted at the conclusion 2023, ensuring the inclusion of the most recent literature on the subject. Moreover, while our evaluation of each research piece was performed manually and qualitatively, we adhered to the PRISMA protocol and utilised bibliometric software. These tools proved invaluable in facilitating the establishment of the SLR, generating bibliometric visualisations, and analysing and discussing each contribution.

High quality literature on blockchain and triple-entry accounting have increased over the years but the study is still in the early stages of development and has not yet reached a state of complete maturity. In relation to legislation and policy, it is noteworthy that while there is currently no extant legislation specifically addressing this matter, the government and financial regulatory authorities have expressed a favourable assessment of the potential of blockchain technology. The utilisation of blockchain technology can effectively address challenges related to aggregation and sharing by virtue of its capability to provide (near) real-time updates, maintain an immutable and searchable ledger, and implement a configuration that safeguards against any single entity gaining control over the ledger.

In the future, blockchain is predicted to have the capability to enhance accounting processes through the implementation of triple-entries and smart contracts, thereby enabling certified public accountants (CPAs) to focus on tasks that provide greater value. Certified Public Accountants (CPAs) who specialise in auditing and assurance services to expand their knowledge, enhance their skills, and effectively utilise their demonstrated capacity to respond to the evolving demands of a dynamic business environment. The implementation of blockchain technology is also anticipated to have significant implications for the creation of employment opportunities in the long run. While it is acknowledged that certain job positions may become redundant due to the adoption of this technology, there is a projected increase in demand for roles that necessitate human involvement, such as performance improvement, IT risk management, and advisory positions. Consequently, accounting professionals, including practitioners, educators, and students, are anticipated to enhance their technological expertise to facilitate more streamlined accounting practices. This observation aligns with the research conducted by Zhang et al. (2020).

In order to ensure widespread accessibility, it is imperative for blockchain solutions to possess the capacity for scalability, enabling efficient operation on a significant magnitude. In light of this consideration, the integration of blockchain solutions into Enterprise Resource Planning (ERP) systems, as well as their harmonisation with Radio Frequency Identification (RFID), Internet of Things (IoT), and Artificial Intelligence (AI) technologies, becomes crucial. This integration facilitates the establishment of expeditious, dependable, and replicable processes. By

consolidating information and procedures both within and across organisational boundaries, while aligning with emerging technologies, blockchains have the potential to streamline and expedite business operations, enhance cybersecurity measures, and potentially diminish or eliminate the need for intermediaries.

Ultimately, Blockchain is anticipated to serve as a pivotal strategy. However, its complete development, standardisation, and integration into the Web infrastructure and financial system are projected to require a significant amount of time, possibly spanning several decades. In order to adapt to this technology, organisations will need to enhance their speed and efficiency while simultaneously reducing operational costs. The advantages offered by blockchain will include the provision of reliable records and decreased need for adjustments. Moreover, accounting processes will become more effective due to heightened confidence in the available information and reduced time spent on routine procedures like compliance statements. Consequently, this will place greater emphasis on the fundamental objectives of accounting, namely the interpretation of economic value of transactions and the provision of information to facilitate improved decision-making. The use of blockchain technology holds promise for introducing substantial transformations in the domains of accounting and auditing. However, the broad implementation of blockchain faces some problems that necessitate resolution. The constraints encompassed in this context pertain to the absence of standardisation, issues related to scalability and privacy.

This study highlights certain constraints. For instance, it does not encompass the examination of technical, legal, or ethical concerns, such as data security, privacy, or the dependability of information recorded in the blockchain. From a methodological standpoint, the utilisation of the Scopus database restricts the analysis to a limited number of books, book chapters, and non-peer reviewed studies pertaining to the subject of blockchain and triple-entry in accounting.

Future studies on blockchain and triple-entry accounting should address the following aspects:

1. the examination of interfirm collaboration dynamics in the context of triple-entry accounting;
2. the formulation and implementation of formal legal framework on triple-entry accounting; and
3. the evaluation of opportunities, challenges and best practices in implementation of blockchain and triple-entry accounting.

In conclusion, this article has endeavoured to illuminate the transformative potential of the integration between blockchain technology and accounting practices, particularly through the lens of Triple-Entry Accounting. As the accounting landscape undergoes a paradigm shift towards greater transparency, accountability, and efficiency, the symbiotic relationship between blockchain and accounting emerges as a pivotal catalyst. The exploration of Triple-Entry Accounting, facilitated by blockchain's decentralised and tamper-resistant ledger, not only portends a redefinition of financial record-keeping but also promises to reshape auditing processes, enhance financial reporting accuracy, and mitigate fraud risks. While challenges persist, ranging from regulatory considerations to technological hurdles, the cumulative endeavours of scholars and practitioners contribute to a burgeoning discourse that envisions a future wherein the fusion of blockchain and accounting

establishes a novel standard for financial integrity and trust. This discourse is not merely speculative but, rather, grounded in the evolving realities of technological advancements, regulatory frameworks, and the dynamic needs of a globalised economy. As we stand at the cusp of this transformative juncture, the synthesis of Triple-Entry Accounting and blockchain technology beckons as a herald of a new era in the trajectory of accounting practices, resonating with the imperative of embracing innovation to propel the discipline into a more resilient and sophisticated future.

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Appendix

Articles used in Systematic Literature Review

No	Authors	Year	Title	Journal	Citation	Rank	Country
1	O`Leary	2017	Configuring blockchain architectures for transaction information in blockchain consortiums: The case of accounting and supply chain systems	Intelligent Systems in Accounting, Finance and Management	155	Q1	United States of America
2	O`Leary	2019	Some issues in blockchain for accounting and the supply chain, with an application of distributed databases to virtual organizations	Intelligent Systems in Accounting, Finance and Management	24	Q1	United States of America
3	Yu et al.	2019	Blockchain The Introduction and Its Application in Financial Accounting	Journal of Corporate Accounting & Finance	67	Q2	China
4	Sinha	2020	Blockchain--Opportunities and challenges for accounting professionals	Journal of Corporate Accounting & Finance	12	Q2	United States of America
5	Zhang et al.	2021	Smart ledger: The blockchain-based accounting information recording protocol	Journal of Corporate Accounting & Finance	2	Q2	China
6	McCallig et al.	2019	Establishing the representational faithfulness of financial accounting information using multiparty security, network analysis and a blockchain	International Journal of Accounting Information Systems	62	Q1	Ireland
7	Gietzmann and Grossetti	2021	Blockchain and other distributed ledger technologies Where is the accounting	Journal of Accounting and Public Policy	9	Q1	Italy
8	Alsalmi et al.	2023	Accounting for digital currencies	Research in International Business and Finance	4	Q1	United Kingdom
9	Pflueger et al.	2022	What is Blockchain Accounting? A Critical Examination in Relation to Organizing, Governance, and Trust	European Accounting Review	2	Q1	France

No	Authors	Year	Title	Journal	Citation	Rank	Country
10	Demirkan et al.	2020	Blockchain technology in the future of business cyber security and accounting	Journal of Management Analytics	108	Q1	United States of America
11	Al and Elessa	2022	The impact of digital transformation towards blockchain technology application in banks to improve accounting information quality and corporate governance effectiveness	Cogent Economics & Finance	2	Q2	Jordan
12	Dyball and Seethamraju	2021	Client use of blockchain technology: exploring its (potential) impact on financial statement audits of Australian accounting firms	Accounting, Auditing & Accountability Journal	7	Q1	Australia
13	Jayasuriya and Sims	2022	From the abacus to enterprise resource planning: is blockchain the next big accounting tool?	Accounting, Auditing & Accountability Journal	5	Q1	New Zealand
14	Kuruppu et al.	2022	How can NGO accountability practices be improved with technologies such as blockchain and triple-entry accounting	Accounting, Auditing & Accountability Journal	9	Q1	Australia
15	Abu et al.	2022	Blockchain adoption in accounting by an extended UTAUT model: empirical evidence from an emerging economy	Journal of Financial Reporting and Accounting	11	Q2	Vietnam
16	Wu et al.	2019	Application of Internet of Things and Blockchain Technologies to Improve Accounting Information Quality	IEEE Access	23	Q1	China
17	Zhang et al.	2020	The Impact of Artificial Intelligence and Blockchain on the Accounting Profession	IEEE Access	57	Q1	China
18	Sarwar et al.	2021	Data Vaults for Blockchain-Empowered Accounting Information Systems	IEEE Access	16	Q1	Pakistan
19	Fikri et al.	2022	A Blockchain Architecture for Trusted Sub-Ledger Operations and Financial Audit Using Decentralized Microservices	IEEE Access	0	Q1	Morocco

No	Authors	Year	Title	Journal	Citation	Rank	Country
20	Cai	2019	Triple-entry accounting with blockchain How far have we come	Accounting & Finance	46	Q1	Australia
21	Tan & Low	2019	Blockchain as the Database Engine in the Accounting System	Australian Accounting Review	59	Q2	Singapore
22	Karajovic et al.	2019	Thinking Outside the Block Projected Phases of Blockchain Integration in the Accounting Industry	Australian Accounting Review	48	Q2	Canada
23	Shao et al.	2021	Research on Accounting Information Security Management Based on Blockchain	Mobile Information Systems	3	Q2	China
24	Zhang and Zhu	2022	Environmental Accounting System Model Based on Artificial Intelligence Blockchain and Embedded Sensors	Computational Intelligence and Neuroscience	2	Q1	China
25	Sunder	2018	Yuji Ijiri Accounting for a Better Society	Accounting, Economics, and Law: A Convivium	1	Q2	United States of America
26	Lin	2018	An Interdisciplinary Journey with Professor Yuji Ijiri	Accounting, Economics, and Law: A Convivium	1	Q2	United States of America
27	Huy and Phuc	2021	Accounting Information Systems in Public Sector towards Blockchain Technology Application The Role of Accountants Emotional Intelligence in the Digital Age	Asian Journal of Law and Economics	4	Q3	Vietnam
28	Prux et al.	2021	Opportunities and Challenges of Using Blockchain Technology in Government Accounting in Brazil	BAR - Brazilian Administration Review	2	Q3	Brazil
29	Sheldon	2018	Using Blockchain to Aggregate and Share Misconduct Issues across the Accounting Profession	Current Issues in Auditing	28	Q2	United States of America
30	Kostić and Sedej	2022	Blockchain Technology, Inter-Organizational Relationships, and Management Accounting A Synthesis and a Research Agenda	Accounting Horizons	6	Q1	Denmark

No	Authors	Year	Title	Journal	Citation	Rank	Country
31	Dai and Vasarhelyi	2017	Toward Blockchain-Based Accounting and Assurance	Journal of Information Systems	366	Q1	United States of America
32	Liu et al.	2021	Blockchain s Impact on Accounting and Auditing A Use Case on Supply Chain Traceability	Journal of Emerging Technologies in Accounting	1	Q2	United States of America
33	Gusc et al.	2022	The Big Data, Artificial Intelligence, and Blockchain in True Cost Accounting for Energy Transition in Europe	Energies	7	Q1	Netherland, German, Poland
34	Alkafaji et al.	2023	The Impact of Blockchain on the Quality of Accounting Information: An Iraqi Case Study	Risks	5	Q2	Iraq
35	Yang and Yin	2023	Resilient Supply Chains to Improve the Integrity of Accounting Data in Financial Institutions Worldwide Using Blockchain Technology	International Journal of Data Warehousing and Mining	1	Q4	China
36	Bonyuet	2020	Overview and Impact of Blockchain on Auditing	The International Journal of Digital Accounting Research	35	Q2	United States of America
37	Alles and Gray	2023	Hope or hype Blockchain and accounting	The International Journal of Digital Accounting Research	1	Q2	United States of America
38	Desai	2023	Infusing Blockchain in accounting curricula and practice expectations, challenges, and strategies	The International Journal of Digital Accounting Research	0	Q2	United States of America
39	Al-Zaqeba et al.	2022	The effect of management accounting and blockchain technology characteristics on supply chains efficiency	Uncertain Supply Chain Management	15	Q2	Jordan
40	Hsieh	2018	The intellectual development of Yuji Ijiri	Accounting History	2	Q1	China
41	Sharma et al.	2022	Adoption of Blockchain Technology Based Accounting Platform	Academic Journal of Interdisciplinary Studies	0	Q3	India
42	Ivanchenkova et al.	2023	Analysis of the Risks of Using the Blockchain Technology in the Accounting and Audit of a Fuel and Energy Complex Enterprise	International Journal of Energy Economics and Policy	1	Q2	Poland

No	Authors	Year	Title	Journal	Citation	Rank	Country
43	Smith	2018	Implications of next step blockchain applications for accounting and legal practitioners: A case study	Australasian Accounting, Business and Finance Journal	14	Q2	United States of America
44	Chowdhury et al.	2023	Blockchain Technology in Financial Accounting: Emerging Regulatory Issues	Review of Economics and Finance	0	Q4	Bangladesh