Looking beyond the hype: The challenges of blockchain adoption in accounting

Mohsina Akter [a,b,*], Tyge-F. Kummer [a], Ogan Yigitbasioglu [a]

[a] *School of Accountancy, Queensland University of Technology, 2 George St, Brisbane, 4000, QLD, Australia*
[b] *Department of Accounting and Information Systems, Jahangirnagar University, Savar, Dhaka 1342, Bangladesh*

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ABSTRACT

Blockchain has been hyped and considered a potential game-changer for the recording of accounting transactions as it enables triple-entry accounting and real-time reporting. However, there is very little knowledge of the uptake of blockchain in accounting, and most blockchain accounting research is conceptual, lacking empirical evidence. This study addresses this gap and examines the organisational factors that drive and hinder the adoption of blockchain in accounting, as well as the perceived benefits. Using the technology-organisation-environment (TOE) framework, we analyse interview data collected from blockchain experts and accountants (N = 19). The findings confirm the influence of nine context-specific factors, highlighting the challenges and lack of knowledge in understanding the usage and benefits of blockchain in accounting, its complex integration with existing accounting systems, and the increased costs associated with the adoption intention. This study provides novel empirical evidence of the factors by adequately contextualising an established theoretical framework in the context of accounting. The findings are useful for practitioners and the broader accounting information systems research community as they provide empirical insights into how context-specific factors influence blockchain adoption in accounting.

1. Introduction

Blockchain is considered to be a highly influential technological development in a variety of application areas, including finance, supply chain management, insurance, voting, healthcare, and government services (Beck et al., 2017; Centobelli et al., 2021; Hughes et al., 2019). Organisations across a range of industries are exploring ways to exploit the potential of this technology, which can lead to the creation of immutable, traceable, transparent, and trustworthy business solutions (Casino et al., 2019). While blockchain adoption is still low, evidence from corporate disclosures indicates that the focus has shifted from cryptocurrencies to business applications of blockchain (Stratopoulos et al., 2022). Similarly, Gartner reported that enterprise blockchain has started to climb out of the "trough of disillusionment" phase of the hype cycle, noting that 14 percent of blockchain projects moved into production in 2020 (a rise of 5 percent from 2019) with a further increase and integration with decentralised application and services by 2023 (Litan, 2021a, 2021b).

The rise of blockchain, with its unique design features, also opens up the possibility to shapeshift typical accounting procedures. Blockchain enables distributed immutable ledgers that record and verify transactions as they occur and distribute the same copy of the ledger to participating 'nodes' in the network (Iansiti & Lakhani, 2017; Swan, 2015). Therefore, it creates a chain of accounting records

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instead of retaining separate records and increases the transparency of information for everyone involved (Bonson & Bednarova, 2019; Deloitte, 2016). Consequently, the convergence of accounting and blockchain can enhance the trust and transparency of information (Cai, 2021).

Prior studies broadly focused on three areas of accounting that blockchain can influence: 1. record-keeping. This aspect considers how blockchain influences the recording of accounting transactions by introducing the concept of triple-entry accounting and real-time reporting (Cai, 2021; Dai & Vasarhelyi, 2017; Han et al., 2023). 2. auditing. This involves the use of blockchain as an auditing tool and the conduct of audit procedures in a blockchain-based accounting ecosystem (Lombardi et al., 2021; Rozario & Thomas, 2019). For instance, continuous or nearly real-time auditing through instantaneous confirmation of transactions by multiple nodes. and 3. blockchain-based assets. This stream of research examines the use and accountability of crypto assets, particularly for firms involved in the crypto business and exchange of crypto assets (Castonguay & Stein Smith, 2020; Pimentel et al., 2021).

In this study, we focus on the first aspect, the use of blockchain to record transactions in which blockchain can be leveraged to record accounting data, instantly share relevant information with interested parties, and increase the verifiability of information (Dai & Vasarhelyi, 2017). We refer to it as blockchain accounting in the paper (Cai, 2021; Demirkan et al., 2020).

Despite the growing interest in blockchain's applicability across several domains and the fact that researchers and practitioners acknowledge its potential benefits in accounting, the advancement and adoption of blockchain in accounting settings remain limited (Appelbaum et al., 2022; Tiron-Tudor et al., 2021). Moreover, most previous studies in the blockchain accounting context are conceptual or descriptive and mainly focus on the potential impact of the technology on accounting (Dai & Vasarhelyi, 2017; Li & Juma'h, 2022). While some studies on blockchain implementations showed accounting implications, they primarily focused on other aspects, such as accountability and trust in supply chains (Fortin et al., 2023; Rogerson & Parry, 2020). However, some commercial products claim to use blockchain in an accounting context. For instance, LUCA Plus,[1] claims to provide a blockchain-enabled cloud-based e-invoicing software for businesses. Other companies, such as Sara Technologies,[2] state that they provide services to their clients to establish blockchain-based accounting systems. Nevertheless, little is known about organisations' perceptions regarding the adoption or intention to adopt this technology in the accounting context, and empirical insights are scarce. This research aims to empirically examine the organisational adoption of blockchain accounting and poses the following research question: What are the reasons for the limited uptake of blockchain accounting? The paper is exploratory and provides insights into blockchain accounting adoption factors by capturing the views of industry experts and potential users.

To the best of our knowledge, this is the first empirical study that examines factors affecting the adoption of blockchain accounting in organisations based on professionals' experiences with clients and blockchain solution providers in several domains, including food supply chains and crypto assets. We adopt a qualitative approach to gain a comprehensive understanding of blockchain accounting adoption factors using the lens of the technology-organisation-environment (TOE) framework. In-depth semi-structured interviews with experts from various backgrounds, including accounting, are analysed to answer the research question (N = 19).

This study makes several contributions to the accounting and information systems literature. Firstly, it provides empirical evidence of the factors that facilitate and inhibit blockchain adoption intention in organisational accounting. The research also advances the blockchain and accounting literature by adequately contextualising an established theoretical framework, the TOE framework, in the context of accounting (Hong et al., 2014). Our qualitative study also provides a structured and comprehensive overview of enablers and challenges associated with adoption considerations, including aspects closely related to accounting. On a broader level, this study addresses the lack of alignment between accounting and accounting information systems research, which is a growing concern in the literature (Jans et al., 2023; Murthy, 2016). Finally, the research has significant practical implications. Business leaders can use the findings to develop strategies by getting a better understanding of the enablers and challenges of implementing blockchain accounting projects. Organisations can also use the factors as a checklist to determine the value of adopting blockchain for their accounting processes. Practitioners (i.e., professional accounting bodies, technology service providers, regulators) may find the findings valuable to understand how context-specific factors influence blockchain adoption in accounting and the role of different stakeholders in the process of adoption, which may support policy and standard development for the industry.

The paper proceeds as follows: The next section (Section 2) outlines the literature on blockchain accounting and the theoretical foundation of the study. Section 3 describes the research method. The findings and the discussion of the study's implications are presented in Sections 4 and 5, respectively. Finally, Section 6 concludes the paper.

2. Literature review and theoretical framework

In this section, we provide an overview of blockchain in accounting and the associated adoption literature. We conclude the section by developing the study's research framework.

2.1. Blockchain technology

Blockchain is a distributed database of records or transactions shared among participating parties without any central authority (Crosby et al., 2016; Kokina et al., 2017; Swan, 2015). It is also defined as a secured ledger of transactions recorded into blocks, chained together chronologically, and distributed across multiple nodes to create reliable provenance (Angelis & Ribeiro da Silva,

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[1] https://www.lucaplus.com.
[2] https://www.saratechnologies.com/blockchain-accounting-software.

2019; Peters & Panayi, 2016). It is decentralised, distributed, and immutable in nature (Swan, 2015; Yermack, 2017). Unlike a traditional database, blockchain does not require a centralised processing centre to verify the reliability of the information; instead, it decentralises and distributes the authority among non-trusting users in the network (Hughes et al., 2019; Peters & Panayi, 2016; Swan, 2015). Blockchain allows organisations to share ledgers with other participants (such as suppliers, banks, investors, auditors, and other stakeholders) and permits real-time updates to ledgers through peer-to-peer replications (Bonson & Bednarova, 2019; Crosby et al., 2016).

The characteristics of blockchain may vary for different categories of blockchain applications: public blockchains, private blockchains, and consortium blockchains (Attaran & Gunasekaran, 2019; Dai et al., 2019). Each of the blockchain types has advantages and limitations for its potential use in accounting. While transactions recorded in public blockchains are considered more immutable and secure because of high consensus algorithms (Dai et al., 2019), public blockchains are confronted with the issue of scalability and lower throughput for recording transactions in a distributed network (Coyne & McMickle, 2017; Dai & Vasarhelyi, 2017). Moreover, there have been concerns about the extent to which accounting information should be available on a public blockchain network (O'Leary, 2017). Alternatively, privacy and confidentiality make the private and consortium blockchains more appealing to enterprise accounting transactions in which organisations can share specific accounting records within organisational departments or groups of customers and suppliers. However, these types of blockchains resemble traditional accounting information systems and are susceptible to security issues as a small network could easily be compromised (Coyne & McMickle, 2017; Rückeshäuser, 2017). In assessing the practicability of blockchain types, it is important to carefully analyse the feasibility of design solutions to effectively address varying business requirements (Pedersen et al., 2019).

2.2. Blockchain in accounting

Blockchain can affect various accounting-related aspects, including the recording of transactions, auditing, and the creation of blockchain-enabled assets (Dai & Vasarhelyi, 2017; Pimentel & Boulianne, 2020).

In current accounting systems, transactions involving multiple parties are recorded in separate ledgers managed and owned by a central authority. All parties in the system are required to frequently reconcile their ledgers due to temporary (i.e., timing difference) or permanent (i.e., disputes and errors) discrepancies between the records (Sinha, 2020). External auditors are required to confirm the reliability of records to stakeholders, which is a costly and time-consuming process (Cai, 2021). Moreover, the lag time between the reporting period and the commencement of auditing increases the chances of manipulation and fraud (Cai, 2021). Given these drawbacks, conventional accounting systems are deemed to be insufficient against fraud and demand a more transparent accounting information system that can solve the fundamental trust issues among the parties involved (Cai, 2021). The distributed, decentralised, and immutable nature of blockchain has the potential to solve the problems associated with existing accounting systems through concepts such as the triple-entry accounting system (Bellucci et al., 2022; Dai & Vasarhelyi, 2017). Blockchain can support and advance triple-entry accounting as transactions between two parties are recorded in a third-party public ledger. Moreover, the real-time element of blockchain could also bring substantial efficiencies to the accounting process by eliminating the need for reconciliation across multiple ledgers (Karajovic et al., 2019).

Several studies indicate that gain in auditing efficiency is one of the key benefits of a blockchain-enabled accounting system (O'Leary, 2017; Rozario & Thomas, 2019). While in the current auditing process, transactions and balances are verified at the end of the reporting period, a blockchain-enabled recording process allows for the validation of transactions almost immediately (Vincent et al., 2020; Wang & Kogan, 2018). The instantaneous confirmation of transactions by multiple nodes can facilitate continuous auditing, also referred to as "real-time audit" (Schmitz & Leoni, 2019; Vasarhelyi & Halper, 1991). For example, to record purchase and payment of inventories, the traditional accounting system requires validation of the transaction by multiple departments and authorities (such as the manufacturing manager would ensure the authorisation of the purchase, the warehouse manager would confirm the receipt of inventory with proper quality and quantity), which is time-consuming and prone to potential human error and fraud. In a blockchain-based accounting system, all of these parties, as blockchain nodes, will validate inventory information before it is recorded in the network, optimising time and efficiency while enhancing the reliability of accounting information (Tan & Low, 2019). Blockchain integration with smart contracts can further improve the audit procedure (Rozario & Vasarhelyi, 2018). Smart contracts on the blockchain can autonomously verify and execute transactions through predefined software-driven conditions without the need for any intermediaries (Coyne & McMickle, 2017).

In addition to blockchain's implications for accounting and auditing, prior studies have investigated the issue of accountability of blockchain-based assets such as cryptocurrencies. This domain of research highlights firms involved with cryptocurrencies and the reporting and auditing practices of crypto assets (Luo & Yu, 2022; Pimentel et al., 2021; Ram, 2018). For example, Dyball and Seethamraju (2021), in examining the impact of blockchain on audit procedures, raised concerns about the absence of accounting standards and the lack of clarity around the reporting requirements of crypto assets in financial statements. Likewise, Pimentel and Boulianne (2020) identified three main financial reporting considerations of crypto assets, including crypto assets held by an entity, proceeds of crypto mining activities, and proceeds raised from Initial Coin Offerings (ICOs). ICOs represent a well-established approach for raising funds from investors via the issuance of crypto assets through blockchain (Adhami et al., 2018; Boulianne & Fortin, 2020). Notably, for ICOs, blockchain technology is recognised and utilised as a financial vehicle by involved parties, including firms and investors (Boulianne & Fortin, 2020).

While the convergence of blockchain and accounting has multifaceted implications, the focus of this paper is blockchain adoption in recording accounting transactions – a blockchain-enabled accounting system in which blockchain can be leveraged to record accounting data, to instantly share relevant information with interested parties and to increase the verifiability of information (Dai &

Table 1
Summary of Literature on Blockchain in Accounting.

Authors	Focus	Research Design	Key Findings
Alles and Gray (2023)	Impact of blockchain in accounting	Conceptual	The study emphasises the challenge of defining blockchain, its origins in Bitcoin, and the need for a more objective examination in accounting, focusing on factors like public vs. private blockchains and processing costs as validation criteria.
Han et al. (2023)	Impact of blockchain on accounting and auditing	Literature review	Identified four themes indicating the changes in accounting with blockchain: event approach to accounting, real-time accounting, triple-entry accounting, and continuous auditing.
Thies et al. (2023)	Blockchain-based triple-entry accounting	Literature review	Triple-entry accounting has the potential to enhance fraud prevention and real-time transaction verification. The study underscores the significance of transitioning from theoretical research to practical implementations while promoting a future research agenda that encourages interdisciplinary collaboration to drive triple-entry accounting's adoption.
Appelbaum et al. (2022)	Blockchain adoption in business and accounting	Conceptual	The major obstacles in the widespread adoption of blockchain in business and accounting include concerns related to functionality, data and process integrity, and regulatory compliance.
Bellucci et al. (2022)	Blockchain's potential in accounting	Systematic literature review	Blockchain has many potentials in accounting practices, including immutability of transactions, triple-entry bookkeeping, automation of repetitive tasks, real-time and continuous auditing, representation of cryptocurrencies in financial statements, value-chain management, and business model innovation.
Chou et al. (2022)	Accounting for crypto assets	Empirical	The study notes the challenges of applying existing accounting standards to crypto-assets due to their rapid evolution and fluid nature. Furthermore, it underscores the need for continuous monitoring by standard-setting bodies.
Luo and Yu (2022)	Financial reporting of crypto assets	Empirical	Identified discrepancies and potential misinterpretations of financial reporting between Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards (IFRS), particularly in how firms account for cryptocurrencies. The lack of guidance from both standards allows for subjective interpretation and classification of crypto assets, leading to inconsistencies in financial reporting across firms.
Pflueger et al. (2022)	Impact of blockchain on accounting	Conceptual	Blockchain accounting entails changes in the mode of organisation (substituting centralized institutions and intermediaries with a network of actors), governance (multi-modal governance where 'on-chain' form of governing comes to rely upon 'off-chain' existing forms) and trust (trust in abstract systems) of which accounting is part and product.
Centobelli et al. (2021)	Designing a blockchain-enabled accounting system	Conceptual	Proposed a three-level conceptual framework for a blockchain-based accounting environment organised into technological infrastructure with peer-to-peer interconnections, increased controls through permission and validation, and the integration of business and security applications.
Cai (2021)	Triple-entry accounting with blockchain	Case Study based on white papers and website information	Triple-entry accounting with blockchain is an efficient way to increase trust and transparency of accounting information and ensure better auditability and efficient accounting practices.
Dyball and Seethamraju (2021)	Audit of clients using blockchain	Empirical	A small group of Australian accounting firms are engaged with clients in cryptocurrency or blockchain businesses. Blockchain technology poses new and unique risks that firms must address while planning, designing, and executing audit methodologies for financial statements.
Garanina et al. (2022)	Impact of blockchain on accounting and auditing	Systematic literature review	Blockchain research in accounting is still normative, and issues that are widely discussed include the changing role of accountants, new challenges for auditors, opportunities and challenges of blockchain application, and the regulation of crypto assets. The analysis further shows that the accounting and auditing profession may shift to higher-profile advisory roles in a blockchain environment.
Li and Juma'h (2022)	Auditors' acceptance of blockchain	Empirical	Auditors' task needs (i.e., timestamping and a solution to double-spending) have a direct impact on their intention to use blockchain, whereas an auditor's accounting and software knowledge, as well as their technology awareness, influence task needs.
Lombardi et al. (2021)	Impact of blockchain on auditing	Systematic literature review	Blockchain disruption in auditing needs additional investigation to understand blockchain as a tool for auditing professionals, the efficiency of smart contracts enabling Audit 4.0 and cryptocurrency, and initial coin offerings as a catalyst for corporate governance and new venture financing.
Pimentel et al. (2021)	Auditing blockchain-based assets	Empirical	The key challenge of auditing blockchain firms is to obtain audit evidence related to the existence, ownership, and valuation of crypto assets. Nevertheless, while offering an audit opinion in this realm is difficult, it is not insurmountable.

Table 1 (*continued*)

Authors	Focus	Research Design	Key Findings
Tiron-Tudor et al. (2021)	Blockchain in accountancy organisations	Systematic literature review	To implement blockchain, its benefits must be emphasised in all accounting and auditing organisations, and managers should formulate strategies to navigate workplace dynamics, skills, personalities, and responsibilities.
Demirkan et al. (2020)	Blockchain's potential in accounting and cybersecurity	Literature review	Blockchain will influence accounting and auditing services and will have a significant impact on many companies. The findings suggest various means for implementing blockchain effectively for various cybersecurity and accounting issues.
Kend and Nguyen (2020)	Impact of blockchain on auditing	Empirical	In most cases, blockchain audit practices are at the stage of understanding or persuasion, and the findings suggest rethinking the assumed impact of blockchain technologies on audit practices.
Pimentel and Boulianne (2020)	Blockchain in accounting research	Literature review	There is a common interest between academic and practitioner literature in exploring whether blockchains could disrupt the accounting profession. The authors call for the pursuit of more applied research to gain a better understanding of blockchains and identify best practices through robust case studies.
Smith and Castonguay (2020)	Impact of blockchain on accounting and auditing	Conceptual	Blockchain users, including organisations, audit committees, and external auditors, must assess increased regulations, governance, and internal control-related issues in utilising blockchain for financial reporting and assurance purposes.
Bonson and Bednarova (2019)	Implication of blockchain for corporate accounting	Conceptual	The potential challenges of blockchain in accounting are scalability, flexibility, suitable architecture, and cybersecurity. The incorporation of blockchain into accounting requires a consensus between regulators, auditors, and other parties.
Karajovic et al. (2019)	Implications of blockchain in the accounting profession	Conceptual	Blockchain has various benefits as it enables triple-entry accounting, which allows trustworthy recording and automated taxation. However, the challenges are its scalability, cybersecurity, and lack of skilled accountants.
Moll and Yigitbasioglu (2019)	Role of internet-related technologies in accountants' work	Literature review	Blockchain and other internet-related technologies need to be investigated further to understand the required accounting for firms and determine accountants' competencies and skills.
Rozario and Thomas (2019)	Blockchain audit	Conceptual	The benefits of blockchain are improved audit quality through an autonomous audit as well as increased trust between auditors, financial statement users, and regulators. The challenges are computational power storage capabilities, cybersecurity risk, litigation risk, the vulnerability of smart contracts, and regulatory acceptance.
Schmitz and Leoni (2019)	Impact of blockchain on accounting and auditing	Literature review	The benefits of blockchain are increased efficiency in recording, reconciling, and auditing while saving costs and time and reducing human error. The challenges are the limited ability to detect fraudulent transactions and wider adoption to maximise the benefit.
Tan and Low (2019)	Implications of blockchain in accounting	Conceptual	Blockchain will strengthen accounting systems by reducing error and fraud, and it will also change the role of accountants and auditors. However, a blockchain-based accounting system does not guarantee a true and fair view of financial statements.
Carlin (2018)	Blockchain accounting	Conceptual	This research argued that blockchain has the potential to drive the recording process beyond the double-entry paradigm.
Rozario and Vasarhelyi (2018)	Impact of blockchain on audit	Conceptual	Blockchain integration with smart contracts can ensure transparent and timely audit reporting and improved audit quality.However, the challenges include the lack of regulatory support, security and privacy, scalability, and flexibility.
Wang and Kogan (2018)	Blockchain-based transaction processing system	Conceptual	Proposed a design for a blockchain-based transaction processing system that will ensure real-time reporting, and continuous monitoring, thus preventing fraud and preserving information integrity.
Coyne and McMickle (2017)	Blockchain accounting	Conceptual	The authors identified the following challenges: the desire for confidentiality in public blockchains, the possibility of manipulation of private blockchains, and limited transaction verification.
Dai and Vasarhelyi (2017)	Implications of blockchain in accounting and auditing	Conceptual	The benefits of blockchain include transparency and security, real-time reporting, continuous verification, and automated assurance. However, the challenges include substantial storage and resources, unavailable blockchain schemes for accounting, lack of awareness and understanding, scalability, and regulatory pressure.
Kokina et al. (2017)	Adoption and implication of blockchain in accounting	Conceptual	Blockchain benefits include the reduction of human error and fraud, elimination of reconciliation needs, continuous verification and better transparency of information.

Vasarhelyi, 2017).

2.3. Potential benefits of blockchain in accounting

Blockchain's unique technical specifications have a range of potential benefits and challenges for accounting practices. Table 1 provides an overview of the academic literature investigating the potential of blockchain in accounting. According to these studies, the potential benefits of blockchain include increased trust and transparency of information, real-time reporting, efficient recording, continuous auditing, and reduced human error and fraud (Bellucci et al., 2022; Dai & Vasarhelyi, 2017; Karajovic et al., 2019). The real-time access to the ledger, consensus protocol to add a transaction in the network, and validation of transactions by network participants lead to an increased level of trust and transparency of accounting information, whereby immutable features make the manipulation or alteration of records theoretically nearly impossible (Deloitte, 2016; Mainelli & Smith, 2015; Swan, 2015). As can be seen from Table 1, most of the studies, particularly in the context of accounting and record-keeping, are conceptual and discuss blockchain implications on accounting in a broader sense. While there are studies that provide empirical evidence, including Li and Juma'h (2022), who empirically analyse blockchain's potential as a shared database and a solution to the double-spending problem for auditing, and Kend and Nguyen (2020), who document the impact of emerging technologies, including blockchain, on the Australian audit and assurance profession, there is a distinct lack of empirical studies focusing on enablers and inhibitors associated with blockchain adoption in organisations' recording process (i.e., blockchain accounting).

2.4. Potential limitations of blockchain in accounting

In addition to the purported benefits of blockchain, scholars and professionals have also discussed the potential limitations of the technology itself and the challenges related to its adoption in accounting. Blockchain's adoption raises concerns about issues surrounding cybersecurity and scalability (Karajovic et al., 2019; Rozario & Thomas, 2019). Although the technology is considered immune to hacking and resistant to manipulation, the control of the absolute majority of computing power by a group (51 percent attack) and the loss or theft of digital wallet private 'keys' entail cybersecurity threats (Coyne & McMickle, 2017; Rozario & Thomas, 2019). Recording transactions in the blockchain does not necessarily imply that the transaction has occurred in the real world, indicating the need for regulatory support to prevent the misuse of blockchain and smart contracts (Alles & Gray, 2020; Dai & Vasarhelyi, 2017). Further, Schmitz and Leoni (2019) argue that blockchain has limited ability to detect fraudulent financial transactions that were fraudulent from the beginning. Another concern is the scalability of blockchain for financial transactions and other business purposes, particularly for public blockchains (Smith & Castonguay, 2020; Toufaily et al., 2021). The low transaction throughput and high consumption of storage and computational resources associated with public blockchains limit its scalability, requiring further development for its widespread adoption across organisations (Dai et al., 2019; Peters & Panayi, 2016). Moreover, the literature recognises the complexity of auditing blockchain-based assets and the lack of requisite knowledge and skills of auditors (Pimentel et al., 2021).

2.5. Blockchain adoption

Most of the prior blockchain accounting literature examines the consequences of blockchain for accounting practices and the profession as a whole. For example, Dai and Vasarhelyi (2017) and Rozario and Thomas (2019) discuss the potential of the technology for accounting and auditing purposes, explaining how the strengths of the technology could be utilised in practice to improve the current accounting and auditing processes while outlining related challenges. However, there is a distinct lack of studies in the context of organisational blockchain accounting adoption focusing on enablers and inhibitors associated with the adoption decision. Moreover, most prior studies follow either a conceptual or literature review approach, with a particular lack of empirical evidence to understand the limited uptake of blockchain accounting in organisations. While Li and Juma'h (2022) empirically examine the importance of blockchain features in auditing, the study focuses on the auditing aspect and auditors' acceptance of the technology instead of organisational adoption.

Blockchain adoption has also been studied in contexts other than accounting, including supply chain management (Orji et al., 2020; Queiroz & Wamba, 2019; Wong, Leong, et al., 2020), information systems (Holotiuk & Moormann, 2018; Malik et al., 2021), the public sector (Koster & Borgman, 2020), and financial services (Kulkarni & Patil, 2020) either at individual or organisational levels. According to the literature, the adoption factors, although not an exhaustive list, identified at the organisational level include 1. the relative advantage, 2. organisations' IT resources, 3. trading partner pressure, 4. inter-organisational trust, 5. firm size, 6. complexity, 7. cost, 8. government support, 9. competitive pressure, and 10. availability of specific blockchain tools. While these studies provide valuable insight into the factors associated with the adoption of blockchain, they also highlight domain-specific differences, and it is unclear which of these factors influence the adoption of blockchain in an accounting context.

2.6. Theoretical framework

Researchers who address the adoption of new technologies can choose from a large body of theoretical frameworks. One stream of research focuses on the individual's decision to accept a new technology. This research stream applies theories such as the Technology Acceptance Model (Davis, 1989) and Venkatesh et al. (2003)'s Unified Theory of Acceptance and Use of Technology model. However, since blockchain-based systems are major investments, we believe that a user is unable to make an adoption decision on their own.

Instead, we follow the alternative research stream that focuses on system adoption as an organisational decision. Thus, we consider technology adoption theories at the organisational level.

While institutional theory is used to explain innovation adoption in organisations, it mainly focuses on the role of external environmental pressures on the adoption decision (Scott, 1995). Diffusion of Innovation theory is also applied to examine an organisation's technology adoption process but is limited to technological and organisational aspects and tends to ignore the environmental aspects of the technology adoption (Verma & Bhattacharyya, 2017). As the decision to adopt technology in an organisation depends on a variety of internal and external factors, the technology–organisation–environment (TOE) framework, developed by Tornatzky and Fleischer (1990), offers a more comprehensive lens, and therefore is selected as the theoretical frame for this study (Fig. 1).

Previous research acknowledged TOE as a multi-perspective framework that provides a strong basis for analysing multiple factors of technology adoption across different types of organisations (Gangwar et al., 2015; Verma & Bhattacharyya, 2017; Yeh & Chen, 2018). In the TOE framework, the technological context refers to internal and external technologies applicable to the organisation to achieve its business objectives. The organisational context refers to factors relating to the organisation itself (such as characteristics and resources) affecting the organisation's readiness to adopt innovation. The environmental context demonstrates the setting in which the organisation performs its day-to-day business operations, its industry, competitors, government interaction, and the regulatory environment (Tornatzky & Fleischer, 1990).

For this study, the TOE framework serves as a useful analytical tool to explore blockchain's inherent qualities, organisations' motivations, capability, and culture, and the influence of the external environment on blockchain accounting adoption in organisations. In addition, the framework is flexible, allowing applications to different technological, sectoral, and geographical contexts with reasonable explanatory power (Nilashi et al., 2016) and for the integration of new factors (Baker, 2012).

There is empirical support to illustrate that the framework is strongly applicable to the organisational-level examination of innovation adoption (Hameed et al., 2012). Moreover, it is a well-established framework in innovation adoption research and has been used to explain the adoption of various technological innovations such as ERP systems (Al-Shboul, 2019; Bradford et al., 2014), big data (Baig et al., 2019; Verma & Bhattacharyya, 2017), Extensible Business Reporting Language (XBRL) (Cordery et al., 2011; Doolin & Troshani, 2007), cloud computing (Alshamaila et al., 2013; Walther et al., 2018), social media (Schaupp & Bélanger, 2014) and artificial intelligence and robotics (Nam et al., 2020).

The applicability of the TOE framework is also demonstrated for blockchain adoption in non-accounting contexts. For example, Gokalp et al. (2020) applied the framework to explore organisational adoption of blockchain-based supply chain systems in organisations, while Orji et al. (2020) further confirmed the relevance of the TOE framework in a study of the adoption of blockchain in the freight logistics industry. In line with the TOE framework suggested by Tornatzky and Fleischer (1990), we categorise our findings based on the three dimensions: technology, organisation, and environment, which each affects the technology adoption intention. The TOE framework is commonly used as a foundation to explore context-specific factors within each dimension (Baker, 2012). We follow this approach and adopt the framework by determining the relevant aspects for each dimension.
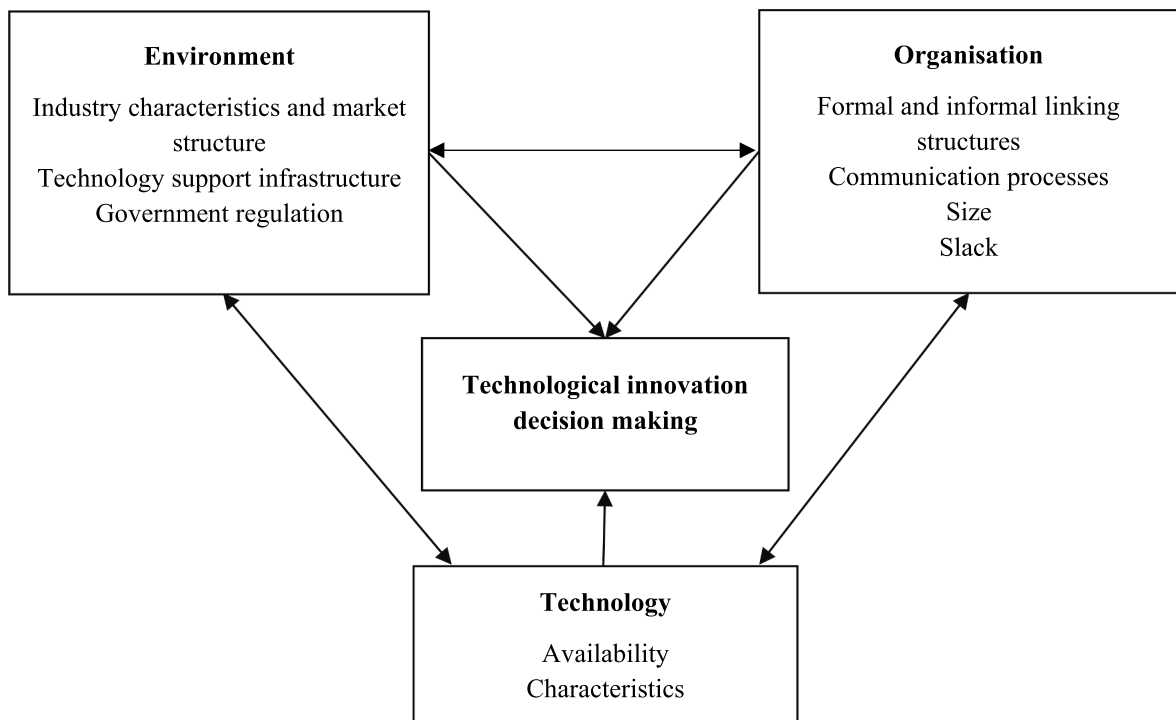

Fig. 1. Technology-Organisation-Environment Framework. Source: Tornatzky and Fleischer (1990).

3. Research design

Given the paucity of relevant theoretical and empirical research, this study adopts a qualitative research method using an in-depth semi-structured interview approach to yield an enriched, comprehensive understanding of factors influencing blockchain adoption in accounting. Qualitative research provides us with insights into the meanings that participants attribute to the problems and the identification of ways participants make sense of the phenomenon under investigation (Cooper & Schindler, 2008; Patton, 2002; Yin, 2009). Qualitative research is best suited to address descriptive, interpretive, and explanatory problems (Bluhm et al., 2011), particularly in areas with limited available research (Alshamaila et al., 2013; Kwon et al., 2014). As an emerging technology, many of the features, benefits, and challenges of blockchain, particularly for accounting purposes, are not well understood and thus are insufficiently explored. Blockchain is currently on a path of diffusion across industries, where industry leaders are looking at how to leverage and adopt the technology in different sectors (including accounting) and facing challenges related to adoption (Deloitte, 2020). The qualitative method allows for the investigation of organisations' perceptions about the adoption of blockchain accounting as well as the development of a consensus on the subject being studied.

3.1. Sample and data collection

In-depth semi-structured interviews supplemented by open-ended questions were carried out since they allow for discussing predetermined themes related to blockchain accounting and exploring unknown themes through additional probing during the interview (Aberbach & Rockman, 2002; Flick, 2018; Kvale, 2007). We conducted 19 in-depth semi-structured interviews with experts from different backgrounds to gain insights into the research problem. Participants were selected following the purposeful sampling technique based on the criteria of having knowledge or experience in the blockchain space and/or accounting space, understanding the issue under investigation, and being willing to share their knowledge and experience. The sample represents a diverse background of participants in terms of seniority and expertise, including experts from three Big Four accounting firms, IT professionals, blockchain experts, senior managers, and chief executive officers (CEOs) of organisations.

Potential participants were recruited through LinkedIn (Qu & Dumay, 2011). While we approached participants from different countries, the final sample largely included participants from Australia and the USA. Due to the COVID-19 pandemic, all the interviews were conducted via Zoom except one that was conducted in person. The interviews lasted between 30 and 45 min. They were digitally recorded and transcribed. Furthermore, a well-designed interview protocol was used to ensure data consistency across individuals (Patton, 2002). Theoretical saturation was achieved after nine interviews as no new information or patterns emerged in subsequent interviews (Guest et al., 2006). The data collection was completed after 19 interviews.

All the interviewees were broadly categorised into two groups: those with an accounting background (9) and those without an accounting background (10) based on their educational qualifications. All had at least three years of work experience. All interviewees were familiar with blockchain technology, were involved in decision-making roles, and had work experience with the technology. The only exception is I16 – a manager with an accounting background at an Information Technology & Services company. While I16 was familiar with the technology and was able to communicate the reasons why her employer did not use blockchain, she was the only interviewee who did not have any professional experience with the technology itself. However, none of the participants had experience

Table 2
Participant's Profiles.

ID	Specialisation	Back-ground	Work Experience (in years)	Blockchain Experience (in years)	Gender	Organisation/Industry
I1	IT professional	NAcc	25–30	6	Male	Software Development
I2	Manager	Acc	25–30	1	Male	Professional Accounting Body
I3	Tax advisor	Acc	5–10	5	Female	Law firm
I4	Chief executive officer	NAcc	15–20	6	Female	Blockchain Solution Provider/ Crypto Accounting
I5	Director	Acc	30–35	4	Male	Public Sector
I6	Chief operating officer	NAcc	25–30	4	Female	Blockchain Solution Provider/Food
I7	Legal advisor	NAcc	1–5	4	Male	Law Firm
I8	Senior analyst	NAcc	10–15	4	Male	Blockchain Solution Provider/ Food
I9	Chief experience officer	NAcc	5–10	5	Female	Information Technology & Services
I10	Blockchain strategy leader	Acc	5–10	7	Male	Big Four Accounting Firm
I11	Chief executive officer	Acc	25–30	4	Male	Accounting & Business Consultancy Firm
I12	Chief risk officer	NAcc	20–25	4	Male	Information Technology & Services
I13	Blockchain analyst	NAcc	1–5	1	Male	Information Technology & Services
I14	Technical advisor	Acc	1–5	2	Female	Professional Accounting Body
I15	Manager	Acc	1–5	2	Male	Big Four Accounting Firm
I16	Manager	Acc	5–10	0	Female	Information Technology & Services
I17	Manager	NAcc	5–10	5	Male	Big Four Accounting Firm
I18	Director	NAcc	15–20	8	Male	Big Four Accounting Firm
I19	Chief executive officer	Acc	20–25	1	Female	Information Technology & Services

Acc- Participant with an accounting background; NAcc- Participant with a non-accounting background.

with an actual blockchain-based accounting solution, so their views were in relation to the intention to adopt blockchain solutions for accounting rather than actual adoption. Table 2 summarises the demographic profile of the interviewees.

3.2. Data analysis

Using NVivo 12 software, we utilised Saldana (2016) first cycle and second cycle coding methods to code interview data. This method was used to describe the reverberative nature of coding, namely comparing data to data, data to code, code to category, category to category, category back to data, and starting with another cycle (Saldana, 2016). We performed multiple iterations of data analysis to extract and validate the findings. Initially, interview transcripts were imported into NVivo software and subjected to a comprehensive examination. Subsequently, the underlying concepts were identified, coded, and categorised into different parent nodes and child nodes (themes and sub-themes). Finally, all the themes and sub-themes were mapped to the three factors of the TOE framework.

The analysis followed the initial coding of the first cycle coding methods (Saldana, 2016). Initial coding, also known as 'open coding', aims to break down the qualitative data into discrete parts, examine them closely, and compare them for similarities and differences (Corbin & Strauss, 2015). Initially, 48 codes were identified based on 252 code references, forming the basis for the classification, aggregation, and categorisation in the second cycle coding process. In the second cycle coding, we followed the axial coding method and further reclassified, reanalysed, and categorized codes identified in the first cycle coding. The second cycle coding produced a list of categories and sub-categories. For instance, the benefits of blockchain in accounting mentioned by participants were included in different sub-categories, such as "efficiency", "trust and transparency", "improved reputation", and all these sub-categories were further recorded in a new category labelled as "perceived benefits". After the second cycle coding, codes were reclassified into the broader themes of the TOE framework (technology, organisation, and environment) to provide an overview of factors influencing blockchain accounting adoption intention in the organisation.

4. Empirical findings

The analysis of the interview data revealed nine key factors and themes pertaining to the intention to adopt blockchain in accounting, structured into three distinct categories (technology, organisation, and environment) of the TOE framework. In addition, many of the nine themes included several sub-themes, which are presented in the following sections.

4.1. Technological factors

4.1.1. Perceived benefits
Participants of our interviews recognised several benefits that affect the intention to adopt blockchain in accounting. The following benefits were identified:

4.1.1.1. Efficiency. Efficiency was frequently mentioned by interviewees as a direct benefit of blockchain accounting. Blockchain efficiency in the accounting process covers several elements, including speeding up the transaction process, bringing efficiency in audit through instantaneous verification, increasing data accuracy and quality, and reducing errors and potential financial reporting fraud. Interviewees perceived that the existing accounting systems often suffer from slow transaction processes due to reconciliation requirements and are susceptible to errors and fraud. Blockchain can speed up the accounting processes by reducing the reconciliation needs of accounting data across multiple ledgers, automating the accounting and auditing processes through smart contracts, and verifying transactions almost immediately through an immutable, distributed network. Automatic reconciliation and real-time verification can help reduce the time and effort involved in the transaction process and reduce human errors, improving data accuracy and quality. For example, during the COVID-19 pandemic, the Australian Government allowed the early release of super funds from multiple accounts, provided that the total amount did not exceed $10,000 in one financial year (ATO, 2020). The announcement created an administrative challenge for superannuation funds as an individual's request to withdraw funds from multiple accounts required reconciliation across accounts to verify the maximum ceiling, which involved a longer processing time and subsequently increased the chances of error. The use of blockchain could speed up the reconciliation of withdrawal information across multiple accounts and decrease the risk of human error. One of the experts involved in technology-related solutions for the superannuation sector stated:

> *"[…] instead of having six records of the same transaction, you have got one record on blockchain which any participant is able to access. And it is the same record. That is very helpful when you look at financial services, and we look at superannuation" [I12]*

Participants viewed that the benefits of blockchain to be more prevalent in publicly listed companies compared to private companies as publicly listed companies are subject to increased disclosure requirements such as the 10-K report, a comprehensive report required to be filed by publicly traded companies in the USA to protect the interest of stakeholders (Alford et al., 1994). Moreover, increased efficiencies in record keeping would more likely benefit public blockchains because of the network effect as private blockchains are viewed like a central database, as commented by one of the experts:

> *"[you get] the benefits of a public blockchain because of the network effects […], and if you are not getting those, then you could just be using a third-party cloud database."[I15]*

4.1.1.2. Trust and transparency. Almost all participants agreed that the main gain of blockchain is the increased transparency of accounting information and trust in the network, which is likely to influence the organisational adoption decision. According to participants, the transparency and trust of information are associated with the unique features of the technology, such as the distributed-decentralised network, traceable and immutable records, and distributed data security. There was a consensus among all the participants that blockchain's promise to provide the same copy of the ledger across the network would increase the transparency and reliability of the information, and the traceability and immutability of records would make it difficult to manipulate information as well as facilitate fraud detection. Even if any attempts are made to manipulate records, the likelihood of identifying these attempts would be enhanced. A CEO of a software company offering blockchain solutions commented:

> *"[…] if you do not trust […] the people that you have to do business with, and you want to make sure that you have that record, that something has been taken if you want to see if something has been tampered with, the blockchain is going to trace that up." [I4]*

Interviewees further noted that blockchain serves as a database layer that works in the background for record-keeping and may not be visible to users. While users may not be aware of the underlying technology powering the accounting system, they would value the increased transparency and auditability of the accounting records.

> *"Individuals may not even hear about blockchain. It is just running in the background. All are going to focus on account receivables, invoice and things are functioning in a much more reliable manner. That is the goal." [I10]*

4.1.1.3. Improved reputation. Participants noted that the technology could offer organisations opportunities for strategic development by creating a reputation of innovativeness and conveying a high-tech impression to stakeholders.

> *"Company wants to say they are using blockchain, and so they want to sound high tech. […] it is the desire of the company to have a differentiating factor relative to their competitors." [I1]*

4.1.2. Trialability

Participants also mentioned that all the benefits of blockchain are potential rather than actual, remaining largely unproven in the accounting context. The efficiency of the technology is not yet evident because of the lack of use cases:

> *"So, how much can I decrease my cost through the implementation of blockchain, and how much more efficiently and effectively will I operate through the blockchain? Now, these two questions have not yet been answered because we do not have any use cases." [I14]*

Other participants commented that it may be difficult to create triable solutions because blockchain affects the entire accounting process, including taxation and auditing:

> *"Accounting itself is a complex process, super fragmented, if you want to trial, the whole process of accounting from getting invoice to the […] calculation of taxes, as a company you have to consider everything […]." [I17]*

This makes trials challenging, as it is difficult to pilot selected parts. Participants further indicated the need for available blockchain-led accounting solutions in the market. The release of more blockchain accounting products by technology vendors could promote the usage and benefits of blockchain in accounting.

4.1.3. Complexity

Blockchain's complexity was commonly recognised in the interviews as a barrier to its adoption. There was consensus among the accountant and non-accountant participants that blockchain itself is complicated and that its integration with accounting and existing systems is a complex process. The complexity and lack of standard interfaces and possible incompatibility of legacy systems may offset the benefits derived from the technology and make it difficult to implement. For instance, if an organisation intends to implement blockchain with its current system, the system may need to interface or at least share data efficiently, which is a time-consuming and complicated process (Prewett et al., 2020). Likewise, while blockchain, in conjunction with smart contracts, allows for automatic recording and rapid verification of accounting information, audit of smart contracts is a complex process that requires comprehensive knowledge of the technology (Dai & Vasarhelyi, 2017). Moreover, complexity involves coordination in the blockchain networks as the blockchain-led accounting ecosystem requires a large number and diversity of parties working together to produce value with the technology. The integration of the technology requires infrastructural and other related changes in the organisation, as summarised by one respondent:

> *"Integrating a blockchain to an existing system is really hard […] in larger companies, it's legacy in-house software systems that have been built are complicated and getting to the point where transactions are actually initiated and hooking in that blockchain mechanism is super challenging wherein the cost to implement far exceeds the expected benefit." [I18]*

Multiple parties are involved in the accounting ecosystem, including suppliers, tax authorities, accounting firms and regulatory and standard-setting bodies. The interoperability and interfaces of existing systems are complex as stakeholders may have different technologies, standards and regulations that need to be incorporated for transitioning to a decentralised model. For instance, businesses would need to consider the tax implications when they use blockchain for recording information. This can be complex, particularly when firms operate in multiple jurisdictions with different reporting requirements.

4.1.4. Perceived cost

Some interviewees raised concerns about the costs involved in developing and maintaining a blockchain network, which may not be justified by the expected benefits. The high initial investment (such as infrastructure and integration costs), the learning cost to become acquainted with a blockchain-based accounting system, and the enormous computational resources required for public

blockchains influence adoption decisions. While the perceived cost associated with blockchain accounting implementation was identified as one of the major challenges, some participants perceived that large-scale adoption could make the system cost-effective over time. However, blockchain adoption decisions entail a careful analysis of costs and benefits. In this regard, two issues have been revealed from the interviews: the issue of incentivisation and savings of audit fees. According to experts, businesses may not be motivated to incur costs or make huge investments in blockchain for accounting because they may not see the immediate benefits or returns on their investment. They may be more focused on short-term performance and survival than long-term innovation and transformation. As mentioned by one of the blockchain experts:

> *"[…] the incentivisation to join this network is in question […] the way I see decisions being made in business […]. Everyone is planning for the next one to three years, not incentivised to get returns five years from now. I have to show performance today." [I18]*

There were mixed opinions among the participants regarding the impact of cost-saving from a blockchain accounting audit. While a group of participants viewed that the cost of investment in a blockchain-enabled recording process could be offset in the long run by savings made from audit fees, others mentioned that efficient auditing through third-party verification is only one aspect of auditing that organisations could address through adopting blockchain accounting. Therefore, the effect on the bottom line is questionable.

4.1.5. Perceived privacy risk

Participants of the interviews did raise concerns about users' willingness to share personal and sensitive information in the blockchain network. The openness of public blockchain was recognised as a disadvantage in terms of privacy and confidentiality. One participant argued that data privacy might create governance issues, making it difficult to comply with regulations. In many countries, privacy is governed by a Privacy Act rather than being a general right.

> *"I think there would be resistance by companies to put information onto a distributed network that was public. There may even be legal problems with that […] there are a lot of strict rules and regulations around handling privacy in Australia." [I2]*

However, privacy issues vary based on the type of blockchain used and the nature of the information shared. As mentioned in the literature, data are more accessible and visible in public permissionless blockchains, whereas private permissioned blockchains can provide organisations with the necessary level of confidentiality by controlling access to the ledger to only authorised parties (Coyne & McMickle, 2017). Consequently, a trade-off between security and secrecy arises, as the control of data by a group of participants in the private permissioned network could increase the chances of security risk. In this regard, participants highlighted a hybrid blockchain model that contains a public blockchain with an additional layer of transaction privacy as a potential solution, as it could leverage the benefits of public blockchains while mitigating privacy issues.

> *"[You need] a public blockchain that allows transactions to be private. So, using a public blockchain for private transactions is a unique use case […]. If there is a company that is planning to put some sort of proprietary information, or just information about themselves out in the public that otherwise would not be public." [I15]*

The issue of privacy differs across publicly traded and private organisations due to their different level of accountability and disclosure requirements. This also has varying impacts on adoption considerations. As noted by participants:

> *"[…] private companies, they would be obviously a lot more hesitant to show on-chain data. So, there is some sort of differentiation, […] of what [they] show on chain in a public or a private company." [I15]*

4.2. Organisational factors

4.2.1. Insufficient knowledge

The interviewees of this research were markedly in agreement regarding the inadequate knowledge, understanding, and skills in the blockchain accounting space.

4.2.1.1. Lack of blockchain understanding. A lack of understanding of blockchain was frequently cited as a barrier to its adoption. Participants acknowledged that while employees are aware of the technology, they do not grasp its application in business and accounting contexts. Because of insufficient knowledge, businesses are not able to understand what problems could be solved by blockchain and the value it could bring to the accounting domain.

In the context of accounting, participants raised concerns about the difference and uniqueness of the blockchain-based accounting system compared to the traditional accounting system and pointed to the required education and training of accountants and auditors, who are going to play a key role in implementing blockchain in accounting. According to participants, accountants and auditors need a solid understanding of how to record and audit transactions in the blockchain space, who will control and be accountable for users' data, and how reliable and secure accounting information is in the blockchain space:

> *"I think a couple of the biggest challenges that we have as one is people do not understand the security of blockchain. Because you are sharing data now on a ledger system, they are unsure who gets to see my data. How is it secure! The thing is, they do not want personal information on the general ledger system because they do not understand the technology." [I6].*

4.2.1.2. Misconceptions. There is a lot of misconception and confusion surrounding blockchain and other applications such as cryptocurrencies, including Bitcoin. Bitcoin is a digital asset used as a medium of exchange and one of the applications of blockchain (PwC, 2016). The interviews revealed that blockchain is too often linked to the turmoil of Bitcoin. The negative image of Bitcoin surrounding fraud, speculation, and hacking is also reflected in the perception of blockchain, as many people do not understand the difference

between Bitcoin and blockchain or assume that blockchain application in other areas inherits the same risks as Bitcoin. The clarification of this misrepresentation through education is important for adoption initiatives in all sectors, including accounting:

> *"I think most people think blockchain is Bitcoin, and so there is a long way to go with the education." [I1]*

In addition, the interviews revealed a misconception regarding inadequate blockchain regulations:

> *"A lot of clients that we work with are somewhat worried to enter the space or continue to go into space with just the unclear regulatory future that exists." [I15]*

Accounting bodies (e.g., the International Accounting Standards Board – IASB) release accounting standards (e.g., the International Financial Reporting Standards). However, the reports generated by the technology have to comply with these standards, not the technology itself. Therefore, it seems that regulatory concerns regarding crypto assets are carried over to the blockchain accounting space even though these concerns do not apply to this context.

4.2.2. Organisation's innovativeness

The study's findings showed that the organisation's values, practices, and attitudes of employees influence the acceptance and adoption of new technology, such as blockchain. An innovative culture is expected to mobilise the technological change within the organisation and help realise blockchain's full potential. According to participants, organisations that are open to accepting new ideas, value technology, and want to develop a competitive information system would be more likely to initiate technological change. For example, organisations already using cloud accounting might be more willing to adopt blockchain accounting.

> *"[…] it will probably be more likely how tech-savvy that organisation is. So, if it is tech-savvy and it is already using cloud-based accounting software, if it is already using digital signing solutions, I think that will be the driving factor." [I11]*

A culture of innovativeness is also positively viewed to impact employees' willingness and openness to change. Commonly, employees are likely to resist technological change, in this case to blockchain, as they are concerned about the impact of technology on their regular working process.

> *"A lot of people that have been there really careful with not sharing any of their data. […] So now suddenly you are saying, let us have a shared database. So that is the challenge […], actually behavioural change and people's acceptance of this technology." [I1]*

4.2.3. Top management support

It was recognised through the interviews that top management's innovativeness, strong support, and efforts would facilitate blockchain adoption across organisations. For example, one of the participants noted that the suggestion for using this technology might come from the IT staff or accountants, but it would not move to the adoption stage until supported by top management:

> *"Of course, they [CEO and CCO] listen to the heads of their innovation groups. But it is not until you get to the top that things move." [I10]*

4.3. Environmental factors

4.3.1. External pressure

The interview findings revealed that the blockchain accounting adoption decision could be derived from the extent of influence exerted by external parties. Two types of external pressure were conceptualised through interviews:

4.3.1.1. Competitive pressure. Participants perceived that the adoption and usage of blockchain accounting may derive from market forces. The greater the adoption of blockchain accounting by competitors in the industry, the higher the pressure on other firms in the industry to adopt this technology. The pressure from the competitive market and the fear of missing out on the competition will likely force organisations to explore blockchain accounting.

> *"[…] if they reduce their costs because they have gone with blockchain and have changed the way they are doing business, which will force the other companies to follow." [I1]*

4.3.1.2. Trading partners' influence. Trading partners can be business partners, customers, suppliers, and software vendors (Cordery et al., 2011). The findings showed that pressure from upstream and downstream business partners could push organisations to use blockchain for their accounting systems. For example, when an organisation announces its intention to transact and maintain records through blockchain, it tends to compel other business partners related to that organisation, such as suppliers and distributors, to use the same network for trading and maintaining cooperation.

> *"[…] suppose you are Wal-Mart, and you sort of sit at the top of the ecosystem, and people buy all sorts of stuff from you all around the world […] you are going to use a blockchain solution […] to track everything with this blockchain solution. If I am part of Wal-Mart network, I am going to use it […], so suddenly, everyone has to be on it […] that is a way that they could experience pressure." [I10].*

Appendix B provides a summary of factors identified within three dimensions (technology, organisation, and environment) and their interaction with the accounting domain.

5. Discussion

We set out to answer the question: What are the reasons for the limited uptake of blockchain accounting? Our findings provide a rich account of nine key factors and different facets of these factors concerning technology, organisation, and environment. We determine three categories of factors: 1. Accounting-relevant factors (Accounting) 2. General factors (Generic), and 3. Other factors identified in the literature that did not emerge from the interviews (Table B1, Table B2, and Table B3 in Appendix B).

Within accounting-relevant factors, the benefits of blockchain are recognised as one of the key drivers, consistent with previous studies on adoption intentions (Gokalp et al., 2020; Orji et al., 2020; Wong, Leong, et al., 2020). Blockchain's benefits are more pertinent for publicly listed companies, given their obligations to disclose transparent financial information to the public and safeguard stakeholders' interests. The findings suggest that publicly listed companies could enhance transparency and efficiency of financial reporting, auditing, and governance through a blockchain-enabled accounting system.

The efficacy of blockchain in streamlining the recording processes could be attained through the network effect of public blockchains, which have a larger and more diverse user base than private or permissioned blockchains. The network effect of blockchains is also emphasised in earlier studies on blockchain adoption in supply chain management (Sternberg et al., 2021; Xu et al., 2021). However, the use of public blockchains for accounting purposes comes with increased risks because accounting functions are more standardised and regulated and require a high level of accuracy and compliance. Notwithstanding, the suitability of different blockchain models for accounting is determined by the specific context and scope of their integration into an organisation's accounting practices, such as the extent of transparency and efficiency desired in the recording process. This is also evident in prior research on blockchain in supply chain management, where the selection of blockchain types is contingent upon the factors such as the specific design features of the technology and the corresponding business requirements, including considerations of privacy and competition (Pedersen et al., 2019; Wang & Wegrzyn, 2022).

Another benefit of blockchain accounting revealed from interviews is the efficient auditing of financial transactions without relying on data provided by clients, in line with prior studies exploring blockchain's potential in auditing (Lombardi et al., 2021; Rozario & Vasarhelyi, 2018). However, blockchain does not guarantee the validity and accuracy of the accounting information that is entered into the systems, as it depends on the inputs and validations of the participants. Questions are also being asked about how fraudulent transactions in a network can be detected and how to ensure the accountability of information. Our interviews reveal that auditors still need to perform additional procedures to ensure that the financial information on the blockchain is complete and accurate, such as testing the company's internal controls and verifying the source and quality of the data. Blockchain is a powerful tool that can enhance the efficiency and reliability of accounting, but it is not a substitute for professional judgment and due diligence. While blockchain's potential to bring efficiency to financial reporting in terms of increased trust and transparency is recognised, uncertainties and risks surrounding these benefits make it difficult for businesses to take advantage of the technology. Participants raised concerns about potential integration and interface issues with existing accounting systems and the number of actors in the accounting process, consistent with the study conducted by Appelbaum et al. (2022) on impediments to blockchain adoption. Organisations are also hesitant to adopt blockchain accounting solutions because they may require a significant change in the existing technology infrastructure and business processes, as well as a shift in the trust relationships with traditional intermediaries such as auditors.

Inadequate knowledge and expertise exasperate the problems, i.e., the benefits, costs, and risks associated with blockchain are not widely realised in practice, particularly in the area of accounting. Our interviewees suggested experimenting with the technology through pilot projects that can clarify many of the unknowns surrounding blockchain accounting, such as the associated risks and costs, how efficiently transactions and audits will be executed, and what skills and expertise may be required of accountants and auditors. Hence, unless more blockchain-based accounting solutions are available, it may be difficult for organisations to adopt the technology as they likely lack the skills and expertise required to deploy blockchain accounting.

In addition to accounting-centric factors, we also find factors that typically influence an organisation's blockchain adoption decision and are also evident in an accounting context. For instance, cost is always a major concern in an organisation's decision to embrace a new technology (Hoxha & Sadiku, 2019; Wong, Leong, et al., 2020). Our interviewees also recognised cost as a barrier to blockchain accounting deployment. However, the widespread use (network effect) could make the technology cost-effective in the long run. Similar to other blockchain adoption studies (Gokalp et al., 2020; Orji et al., 2020; Wong, Tan, et al., 2020), we also found that blockchain adoption in the field of accounting needs to be supported by top management, innovative organisational culture, and external parties. Organisations already using emerging technologies, such as cloud accounting, are more likely to adopt blockchain-based accounting solutions. In addition, the market's desire for up-to-date and transparent financial information as well as a competitive information system, can act as a catalyst for blockchain adoption in the accounting environment. For example, the existence of information asymmetry and agency problems create opportunities for organisations to mislead financial information to external parties (Watts & Zimmerman, 1983). Alternatively, stakeholders, such as investors and lenders, always strongly desire updated, traceable, and reliable financial information in order to secure their investment (Yu et al., 2018), which are the key promises of a blockchain-enabled accounting system. The participants also emphasised the influence of trading partners, wherein trading partners already using a blockchain platform could invite or indirectly influence other business partners to be a part of the network. The impact of trading partners is well documented in the literature pertaining to technology adoption, such as Electronic Data Interchange (EDI) (Iacovou et al., 1995; Lee & Lim, 2003). A notable example is the adoption of EDI by major retailers, such as Walmart, to share electronic documents among trading partners, leading to the requirement for all suppliers to use the technology (Emmelhainz, 1993). Our findings suggest that a similar network effect could also drive blockchain adoption in accounting.

We also recognise that some factors (such as organisation size, scalability) noted in the literature (Clohessy & Acton, 2019; Orji et al., 2020; Toufaily et al., 2021) did not surface in our interviews. A possible explanation might be that the adoption of blockchain

accounting is not necessarily restricted by size but may depend on organisations' needs and innovativeness or other factors. It is also possible that at the pre-implementation stage of blockchain accounting, our participants considered scalability a less relevant or a temporary problem.

Among the factors identified, interviewees with an accounting background were more concerned about barriers, whereas non-accounting participants highlighted enablers associated with an organisation's blockchain accounting adoption decision. Further, accountants stressed the importance of technological aspects compared to organisational and environmental factors. A possible explanation can be that experts with an accounting background were more sceptical of blockchain's unique attributes and financial reporting capabilities than non-accounting experts. However, both groups of participants demonstrated the importance of perceived benefits, insufficient knowledge, and trialability factors to an organisation's blockchain accounting adoption decision. In addition, accounting professionals underscored the importance of public blockchains to accounting and their relevance to organisations' adoption intention. Public blockchains, in particular, are perceived to add more value to organisations' accounting processes than private blockchains.

The basic TOE framework illustrates the potential of interactions between technological, organisational, and environmental factors. Our findings show direct influence as well as the interrelated interactions of the factors that influence the adoption decision, as presented in Fig. 2. For example, the perceived benefits of blockchain in accounting are a critical driver for its adoption, while the complexity, risk, high initial cost, and insufficient knowledge restrict the benefits of the technology. Trialability, on the other hand, could bring evidence of the benefits of blockchain in accounting and justify the adoption decision. For trialability, there is a need for available blockchain-led accounting tools, knowledge, skills, and top management support. Similarly, inadequate knowledge of the technology increases adoption complexity and limits the extent of support from top management, thereby inhibiting adoption. Factors related to the external environment, such as external pressure, act as adoption enablers by creating appeal for the benefit of blockchain usage in accounting. In a nutshell, the intention to adopt blockchain accounting could be directly influenced by the set of factors derived from the analysis as well as by their interrelated interactions and influences.

5.1. Theoretical implications

While the potential of blockchain in accounting is often outlined in the literature (Cai, 2021; Dai & Vasarhelyi, 2017), there is a lack of empirical studies concerning its adoption in organisations' accounting. This research contributes to the existing literature by empirically determining factors that influence the intention to adopt blockchain accounting. We use the TOE framework, an established theoretical framework, to understand enablers and inhibitors associated with an organisation's adoption decision. The findings show how this theory can be applied to structure the findings and determine the impact of relevant factors under different dimensions. Our qualitative study provides a structured and comprehensive overview of blockchain adoption challenges in the accounting environment, including aspects closely related to accounting. The research advances the blockchain adoption literature in the context of accounting.

In addition to corroborating existing blockchain adoption literature, our study provides evidence of accounting-relevant factors (such as perceived benefits, trialability, complexity, and inadequate knowledge) on the adoption decision that were not empirically supported by earlier research. Blockchain accounting research, so far, discussed the potential benefits and challenges of the technology
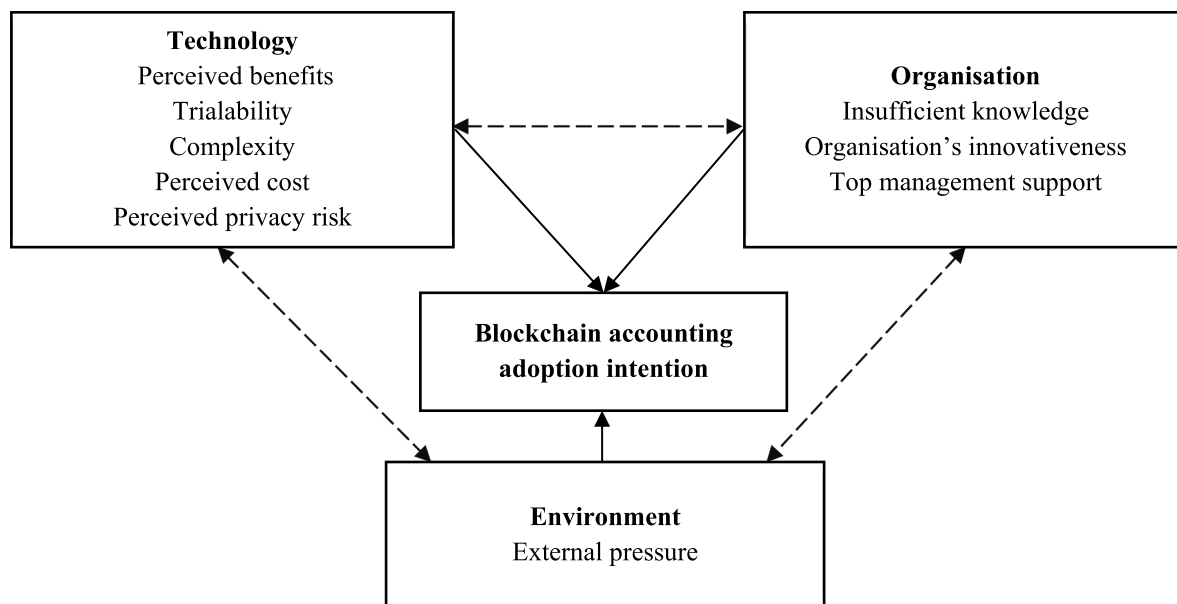
Fig. 2. Contextual Influences on Blockchain Accounting Adoption.

without assessing its relevance to the adoption decision. This research adds to the body of knowledge by empirically assessing whether these benefits have any impact on organisational-level adoption decisions. Moreover, previous research focused on individual blockchain acceptance (Li & Juma'h, 2022; Queiroz & Wamba, 2019) as well as organisational adoption and deployment (Clohessy & Acton, 2019; Orji et al., 2020; Wong, Leong, et al., 2020). Our study contributes to the latter research stream since blockchain accounting affects the entire accounting information systems and is a major investment decision, and there is limited choice for individuals. Instead, organisational acceptance of blockchain accounting is crucial.

By mapping the influential factors for blockchain accounting adoption to the TOE framework, this research provides a systematic analysis of the drivers and barriers related to adoption decisions. This study also confirms the relevance and applicability of the TOE framework to the blockchain accounting sphere, as the research findings suggest that the adoption decision depends not only on the technology itself but also on other factors internal and external to the organisation. The research findings show the direct effects of contextual factors on technology adoption as well as the interactions between factors. Given the complex nature of technology adoption, identifying these interactions is important to understand their effects (Doolin & Troshani, 2007). Moreover, by uncovering the impact of accounting-relevant and general adoption factors spanning technology, organisation, and the external environment, our research emphasises the need for a holistic consideration to implement blockchain in accounting. This is in line with extant research that argues that exploring different relevant aspects of technology adoption results in greater predictive power in evaluating the organisational adoption process (Nilashi et al., 2016).

5.2. Practical implications

Research on technology adoption in areas such as accounting is highly relevant for organisations, accounting firms, technology service providers, legislators, researchers, and practitioners. Our findings provide insights for managers and business owners by revealing opportunities and barriers they will likely face when implementing blockchain accounting projects. The findings provide a cumulative overview of specific considerations as to why organisations choose to adopt or not adopt blockchain in their accounting process. The barriers identified further explain the slow adoption of blockchain in accounting. Organisations can also use these nine key factors as a checklist to determine the value of blockchain adoption in accounting.

The study also highlights the importance of granting access to blockchain-based accounting services to be tested and trialled by potential adopters. While companies such as IBM, Microsoft, Amazon, and R3 have developed purpose-built blockchain solutions for different services (Balasubramanian et al., 2021), there are limited commercial solutions specifically for blockchain accounting purposes. In addition, software providers can contribute to increasing awareness of their products, as our findings suggest that there are misconceptions and a lack of understanding about the technology and its potential in accounting.

Our finding concerning risks and uncertainties associated with blockchain implementation shows confusion regarding the applicable guidelines and frameworks in the blockchain accounting space. However, such regulations apply only to crypto assets as there are no technological requirements to meet accounting information system obligations from accounting standard setters.

5.3. Limitations and future research directions

The study has some limitations that may provide avenues for future research. We collected data from a group of industry experts with substantial client experience and blockchain solution providers rather than actual users in the accounting domain, as this research examines the pre-implementation stage of blockchain accounting. Moreover, the lack of blockchain use cases in the accounting domain makes it difficult to seek opinions from actual blockchain accounting users. Consequently, we interviewed experts who have not used or adopted blockchain in accounting, implicating that we are unable to validate actual use or anticipated future adoption based on the interviews. Future research could capture the experiences of actual users to see whether and under what conditions (i.e., types of blockchain, accounting areas covered) blockchain adds value to accounting.

We identified key drivers of blockchain accounting adoption at the organisational level. Future studies could validate these factors and determine their relative significance through quantitative techniques. Future studies could also investigate blockchain accounting adoption in different research settings in terms of a particular industry, market, or geography that would help contextualise the findings to various legal, political, and cultural jurisdictions.

6. Conclusion

Our exploratory study provides empirical insights into the organisational-level adoption of blockchain in accounting. Grounded in the TOE framework, the findings provide a rich account of nine factors that directly influence the blockchain accounting adoption intention of organisations and the possibility of interactions and impacts of these factors. The main concern that emerged in our findings was the lack of knowledge and understanding of the usage and benefits of blockchain in accounting, its complex integration with existing accounting systems, and the increased costs. All stakeholders need to be educated and trained to reduce the uncertainties and barriers related to adoption. Still, the value of blockchain in accounting is mainly "hypothetical" at this stage, as such, the findings highlight the importance of pilot projects so that potential adopters can familiarise themselves with the technology. Overall, our findings support the notion that an organisation's intention to adopt blockchain in accounting is not merely technological. It also requires support and knowledge from different levels of the organisation and needs to be propelled by actors in the external environment. This study extends the research on blockchain accounting and paves the way for further empirical research in the blockchain accounting domain.

CRediT authorship contribution statement

Mohsina Akter: Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Tyge-F. Kummer:** Conceptualization, Supervision, Validation, Writing – original draft, Writing – review & editing. **Ogan Yigitbasioglu:** Conceptualization, Supervision, Validation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendices

Appendix A. Interview Questions

Interview Questions.
1. Demographic Questions.
2. Years of experience.
3. Academic/Industry Position (e.g., CEO, Partner, Lecturer, Professor).
4. Role.
Fundamentals of blockchain and blockchain accounting
5 Could you please share your views about blockchain technology?
……………………………………………………………………………….
6 To what extent do you think your organisation or colleagues are aware of blockchain technology?
……………………………………………………………………………….
7 What is your view about accounting and auditing services and the accountants' role in the context of blockchain technology?
……………………………………………………………………………….
8 In your opinion, what are the benefits and risks of blockchain technology over existing technology for accounting services?
……………………………………………………………………………….
Adoption of blockchain accounting:
9 What are the different types of technology your organisations are using for accounting purposes?
……………………………………………………………………………….
10 How effective do you think your organisations in accepting innovation?
……………………………………………………………………………….
11 What challenges do you think organisations are confronted with the adoption of new technology?
……………………………………………………………………………….
12 Does your organisation plan to use a blockchain-based accounting system in the near future? Why?
……………………………………………………………………………….
13 What factors do you think will motivate or resist blockchain accounting in your organisation?
……………………………………………………………………………………….
14 Do you think that the blockchain adoption consideration differs between publicly traded and private organisations?
…………………………………………………………………………………..
15 Do you think that any aspects of auditing could influence the decision to adopt blockchain in accounting?
……………………………………………………………………………….
Factors influencing blockchain accounting adoption within the TOE framework:
Technological factors
16 What technological factors do you think may impact the adoption of blockchain accounting? Why?
……………………………………………………………………………….
17. To what extent do you think innovation's characteristics, such as (perceived benefit, relative advantage, compatibility, complexity, computational resources, cost, data security and privacy) affect the intention to adopt blockchain accounting?
……………………………………………………………………………….
18 Which types of blockchain (public, private or hybrid) do you think would be strategically flexible and cost-beneficial to adopt for organisations' accounting?
……………………………………………………………………………….
19 How easy or difficult will it be to integrate blockchain to the organisation's existing accounting system?
……………………………………………………………………………….
Organisational Factors.

20 What organisational factors do you think may impact the adoption of blockchain accounting? Why?

…………………………………………………………………………………….

21 What is the impact of factors such as (top management support, organisation size, and employees' knowledge) on the adoption of a blockchain-based accounting system?

…………………………………………………………………………………….

Environmental Factors.

22 What environmental factors do you think may impact the adoption of blockchain accounting? Why?

…………………………………………………………………………………….

23 To what extent do you think that (regulatory pressure, government statement, industry, and competitive pressure) influence the adoption of a blockchain-based accounting system?

…………………………………………………………………………………….

Appendix B

Table B1
Overview of Findings: Technological Factors.

Technological Factors				
Domain	Factors	Examples	Related blockchain adoption literature	Sample Quote
Accounting	Perceived benefits	Increased transparency in financial reporting.Reduced reconciliation needs of accounting data across multiple ledgers.Efficient auditing through instantaneous verification.	Gokalp et al. (2020); Hoxha and Sadiku (2019); Kamble et al. (2019); Kulkarni and Patil (2020); Malik et al. (2021); Orji et al. (2020); Wong, Leong, et al. (2020).	"[you get] the benefits of a public blockchain because of the network effects […], and if you are not getting those, then you could just be using a third-party cloud database."[I15]
	Trialability	Pilot projects in the accounting domain. Influence different aspects of accounting, including taxation, auditing, and accounting standards.	New factor	"Accounting itself is a complex process, super fragmented, if you want to trial, the whole process of accounting from getting invoice to the […] calculation of taxes, as a company you have to consider everything […]." [I17]
	Complexity	Lack of user interfaceBlockchain integration with the existing accounting system.	Gokalp et al. (2020); Orji et al. (2020); Toufaily et al. (2021); Wong, Leong, et al. (2020).	"Integrating a blockchain to an existing system is really hard […] in larger companies, its legacy in-house software systems that have been built are complicated and getting to the point where transactions are actually initiated and hooking in that blockchain mechanism is super challenging […]." [I18]
Generic	Perceived cost	High initial cost and computational resources.Issue of incentivisation and audit fees.	Hoxha and Sadiku (2019); Kulkarni and Patil (2020); Orji et al. (2020); Wong, Leong, et al. (2020).	"[…] the incentivisation to join this network is in question […]. Everyone is planning for the next one to three years, not incentivised to get returns five years from now." [I18]
	Perceived privacy risk	Privacy issues to sharing information in public blockchains.Lack of specific regulations and inadequate guidelines regarding financial reporting and change in regulation.	Balasubramanian et al. (2021); Kulkarni and Patil (2020); Orji et al. (2020); Toufaily et al. (2021).	"[…] private companies, they would be obviously a lot more hesitant to show on-chain data. So, there is some sort of differentiation […]." [I15]
Others (Factors mentioned in literature)	Scalability	n.a.	Gokalp et al. (2020); Toufaily et al. (2021)	n.a.

Table B2
Overview of Findings: Organisational Factors.

Organisational Factors				
Domain	Factors	Examples	Related blockchain adoption literature	Sample Quote
Accounting	Insufficient knowledge	Inadequate knowledge about the reliability and security of accounting information.Misconception surrounding	Clohessy and Acton (2019); Malik et al. (2021); Toufaily et al. (2021)	"[…] a couple of the biggest challenges that we have as one is people do not understand the security of blockchain.

Table B2 (*continued*)

| Organisational Factors | | | | |
Domain	Factors	Examples	Related blockchain adoption literature	Sample Quote
Generic	Organisation's innovativeness	blockchain accounting and other applications of blockchain. Innovative culture, Willingness and openness to change.	Balasubramanian et al. (2021); Orji et al. (2020).	[…] sharing data now on a ledger system, they are unsure who gets to see my data, how is it secure!" [I9] "I think it will probably be more likely how tech-savvy that organisation is. So, if it is already using cloud-based accounting software, if it is already using digital signing solutions, I think that will be the driving factor." [I11]
	Top management support	Top management innovativeness and efforts.	Clohessy and Acton (2019); Gokalp et al. (2020); Koster and Borgman (2020); Orji et al. (2020).	"Of course, they [CEO and CCO] listen to the heads of their innovation groups. But it is not until you get to the top that things move." [I10]
Others (Factors mentioned in literature)	Organisation size	n.a.	Balasubramanian et al. (2021); Clohessy and Acton (2019); Gokalp et al. (2020); Orji et al. (2020)	n.a.

Table B3

Overview of Findings: Environmental Factors.

| Environmental Factors | | | | |
Domain	Factors	Examples	Related blockchain adoption literature	Sample Quote
Generic	External pressure	Competitive information systems, Business partners' influence to participate in blockchain-based trading and transactions.	Fosso Wamba et al. (2020); Gokalp et al. (2020); Orji et al. (2020); Wong, Leong, et al. (2020).	"And if they reduce their costs because they have gone with blockchain and have changed the way they are doing business, that it will force the other companies to follow." [I1]

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