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Factors influencing the adoption and usage of blockchain in e-commerce: A systematic literature review

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Businesses using e-commerce are worried about their databases and client's data security. Researchers have suggested businesses should adopt and use blockchain technology to address the security challenges in e-commerce. However, blockchain technology has flaws that inhibit acceptance, adoption, and usage such as high operating costs, signature verification, and cultural acceptance. This research paper aims to provide a snapshot of the field by identifying factors influencing the adoption and usage of blockchain technology in e-commerce. To achieve this, a systematic literature review was conducted using four online databases (WorldCat.org, ProQuest, Science Direct, and IEEE Xplore) and Google Scholar. Thematic analysis using Atlas.ti was used to evaluate 19 articles that meet the inclusion criteria. The study's key findings are institutional, market and technical factors that influence the adoption of blockchain in e-commerce. The research's novel contribution is to theory by developing a model for adopting and using blockchain technology in e-commerce. The practical contribution is for businesses and government entities to consider the importance of reducing costs (commission and transaction) while offering secure, scalable, traceable, legal, and compatible blockchains in e-commerce. The study contributes to SDG 8 by ensuring that banking and financial services are available to all by 2030.

Keywords: E-commerce, systematic literature review, Blockchain technology, institutional factors, market factors

Introduction

The world is changing in what is termed the Fourth Industrial Revolution (4IR) which is changing how individuals relate to one another, work, and their lives (Schwab 2017). The 4IR is a sequence of changes in the way economic, political, and social value is generated, traded, and distributed, where these changes have been aligned to take place in the digital environment across the world and to affect businesses as well as livelihoods (Ojubanire, Sebti, and Berbain 2022).

As a result of the COVID-19 pandemic, the growth of some digital technologies has been exponential (WHO 2020). Travel restrictions and the need to stay inside at all costs compelled the use of electronic commerce (WHO 2020). As brick-and-mortar stores closed and people remained indoors to avoid the virus, e-commerce offered a viable alternative (Shi, Yao, and Luo 2021). In addition to being a necessity, Zhou et al. (2021) further state that other factors that contributed to the growth of e-commerce was its efficiency, usefulness and ease of use. In 2019, Europe anticipated that the e-commerce industry would expand at a rate of 6% per annum by 2025, but in 2020, the growth rate surged to 16% (Jílková and Králová 2021).

The literature suggests that e-commerce platforms must deal with tremendous amounts of sensitive information such as banking details, personal information, and client choices, due to the nature of recording and processing every transaction that occurs on the platforms (Li, Fan, and Wu 2021; Xuan, Alrashdan, and Al-Maatouk 2020; Zhou et al. 2021). As existing e-commerce systems compute and maintain user information on a centralized cloud server, errors, fraud, and forgery may occur (Zhou et al. 2021). Very few e-commerce businesses have adopted blockchain and therefore security is a concern (Jain et al. 2023). Furthermore, e-commerce companies are concerned about the security of their databases (Xuan, Alrashdan, and Al-Maatouk 2020).

E-commerce challenges are argued to be multifaceted, and some transcend from individuals to those needing the organization's attention. This study focuses on both individual and organizational factors. The individual challenges include limited adoption of credit cards, high technology illiteracy rate, concerns over logistics, internet access and use, bandwidth costs, a lack of ICT infrastructure, trust, and security (Halaweh 2012; Johnson and Iyamu 2019; Kabanda and Brown 2010; Kikawa, Kalema, and Carol 2019; Mkansi 2022; Mthembu, Kunene, and Mbhele 2018; Nantembelele and Gopal 2018; Trieu 2017; Xiao, Zhu, and Li 2021).

The organizational challenges include logistics, lack of skilled personnel to develop e-commerce platforms, poor internet security, the legal frameworks to benefit the organization, misalignment between the business, IT, and operational units, stakeholder engagement, lack of top management support and financial resources as well as advertising and payment gateway costs (Johnson and Iyamu 2019; Kabanda and Brown 2010; Kikawa, Kalema, and Carol 2019; Mkansi 2022; Mthembu, Kunene, and Mbhele 2018; Nantembelele and Gopal 2018; Treiblmaier and Sillaber 2021). Among these, security is argued as an important challenge that e-commerce must address to become successful (Halaweh 2012; Johnson and Iyamu 2019; Kabanda and Brown 2010; Mkansi 2022; Mthembu, Kunene, and Mbhele 2018). Security is argued to include the ability to track

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the origins of an item through identifying contracts, sharing data used in the process, and protecting the system (Shi, Yao, and Luo 2021).

The use of blockchain technology is argued as a solution to address the security challenge in e-commerce (Duque and Torres 2020; Kocabas, Calik, and Cetinguc 2024; Pushpalatha et al. 2022; Shi, Yao, and Luo 2021). Blockchain technology is anticipated to be a significant disruptor for many commercial applications and processes, with enormous ramifications for e-commerce (Kocabas, Calik, and Cetinguc 2024; Treiblmaier and Sillaber 2021). Several studies have been conducted on the use of blockchain including in agriculture (Mavilia and Pisani 2022), supply chain (Asante Boakye, Zhao, and Adu-Damoah 2024), operations management (Shi, Yao, and Luo 2021), tourism and hospitality (Jain et al. 2023) and e-commerce (Pushpalatha et al. 2022). Some studies have considered blockchain as a financial technology (Akinwale and Kyari 2022) and argued for its application in fraud detection (Cai and Zhu 2016).

Blockchain is a decentralized, distributed directory that facilitates smart contracts that enable traceability assistance, record management, supply chain automation, payment applications, and other commercial interactions (Javaid et al. 2021; Pushpalatha et al. 2022; Tredinnick 2019). The use of a blockchain-based e-commerce approach will guarantee authenticity through blockchain track and trace capabilities (Rabieinejad et al. 2021). Furthermore, Xuan, Alrashdan, and Al-Maatouk (2020) state that track and trace capabilities are achieved through blockchain's core technology which is decentralized and encrypts data, which ensures data integrity and accountability as it records and encrypts the data in a chain of back-linked information blocks and forms a distributed database that is inaccessible to unauthorized users. The use of the track and trace capabilities creates a safe environment for e-commerce consumers and builds confidence through increased database security and protection against cyberattacks (Xuan, Alrashdan, and Al-Maatouk 2020).

There are three aspects to be looked at when examining blockchain technology which are categorized as technical, business, and legal (Ali et al. 2021). The technical aspect of blockchain technology is a database that maintains a fully transparent distributed ledger. The business aspect is a peer-to-peer network for exchanging transactions, value, and assets. Lastly, the legal aspect validates transactions, therefore replacing previously trusted entities (Treiblmaier and Sillaber 2021). The primary advantages of blockchain technology are that transaction information is stored in a decentralized and transparent manner, the database is run by a network of computers called nodes, so there is no single point of failure, information can be accessed in real time, and intermediaries are not required to complete transactions, therefore reducing transaction costs (Jain et al. 2023; Javaid et al. 2021; Tredinnick 2019).

Beyond security, blockchain may enhance e-commerce (Sharma 2019; Treiblmaier and Sillaber 2021). First, blockchain transactions on a single network remove the need for middlemen, allowing for quicker speeds and reduced prices (Mavilia and Pisani 2020). Second, blockchain improves supply chain management by storing and recording product data, allowing the monitoring of each product's lifespan, including who manufactured it, the raw material used, where it came from, where it was held, who purchased it, and who performed the transaction (Alam et al. 2021). Finally, blockchain technology inspires confidence and transparency in payments since every transaction is kept in a shared ledger and cannot be tampered with (Treiblmaier and Sillaber 2021). Therefore, e-commerce systems that use blockchain technology have high security, visibility, quicker processing rates, and traceability (Sharma 2019).

A focus on theories for blockchain adoption in e-commerce limits the broader understanding of the concept. Researchers have used the technology acceptance model (TAM) (Kocabas, Calik, and Cetinguc 2024) and technology organization and environment framework (TOE) (Asante Boakye, Zhao, and Adu-Damoah 2024) to understand the adoption of blockchain. These studies have argued the importance of perceived usefulness, perceived ease of use, attitude, technology, organization, and the environment in facilitating the adoption and use of blockchain in e-commerce. Kocabas, Calik, and Cetinguc (2024) argue that the use of TAM, Diffusion of Innovation, and the unified theory of acceptance and use of technology (UTAUT) while valid to understand cryptocurrency adoption (as an application of blockchain technology), limits its understanding as concepts such as trust, religious belief, social influence and social support are not considered. Jain et al. (2023) claim that awareness, trust, government regulations, supportive infrastructure and market certainty are important when looking at the adoption of blockchain in the tourism industry. Furthermore, a focus on specific theories in systematic literature reviews (SLRs) is not advocated as the intention of SLRs is to provide a snapshot of key arguments in the relevant field (Okoli 2015; Siddaway, Wood, and Hedges 2019) which may create a new understanding of the relationship among concepts and therefore a model (framework or theory) (Okoli 2015; Templier and Paré 2018).

Blockchain adoption is hindered by its shortcomings, which prohibit its broad use and public acceptance (Golosova and Romanovs 2018; Niranjanamurthy, Nithya, and Jagannatha 2019; Sarmah 2018). The first shortcoming of blockchain is its high energy consumption since energy is required to maintain a real-time ledger and to construct and connect with new nodes, resulting in higher operating costs (Golosova and Romanovs 2018). Another shortcoming is signature verification, in which every blockchain transaction must be digitally signed using a public-private cryptography scheme. The generation and verification of these signatures are computationally complex and represent the primary bottleneck in products used in everyday households (Sarmah 2018). The last and most significant factor is cultural acceptance as blockchain signifies a transition to a decentralized network that needs the buy-in of its users and operators (Niranjanamurthy, Nithya, and Jagannatha 2019). National governments have developed and managed traditional currencies and are posing a barrier to the broad adoption of blockchain

by financial institutions (Niranjanamurthy, Nithya, and Jagannatha 2019). Researchers argue there is a need to provide a snapshot of the field by understanding the adoption of blockchain to deepen our understanding (Akinwale and Kyari 2022) including in developing countries (Asante Boakye, Zhao, and Adu-Damoah 2024) and connected to e-commerce (Pushpalatha et al. 2022). Given the shortcomings of blockchain and the need to understand its adoption in e-commerce, the study poses the question; W*hat factors influence the adoption and usage of blockchain technology in e-commerce, in a global context?* The objective is therefore to identify factors that e-commerce platforms consider in adopting and using blockchain.

While the focus of the study is on a global scale, Africa is the continent that can benefit the most from the adoption and use of blockchain technology by increasing the number of e-commerce adopters by ensuring that banking and financial systems are decentralized (Mavilia and Pisani 2020). Research has shown that Africa has the resilience and ability to leapfrog technologies (Asongu and Odhiambo 2019; Mavilia and Pisani 2020; Motlik 2008; Rajasingham 2011). Africa has a higher ratio of mobile devices than telephones and computers (Kafyulilo 2014; Maliwichi et al. 2024; Motlik 2008; Rajasingham 2011). Internet penetration and use in Africa is higher with broadband as opposed to fixed (wired) cable (Kafyulilo 2014; Kouladoum 2024; Rajasingham 2011). The use of mobile money (such as M-pesa) is higher in Africa than in banking and is used to serve the unbanked population (Aker and Mbiti 2010; Asongu and Odhiambo 2019).

The adoption and use of blockchain technology in e-commerce in Africa fit the unique angle that Kabongo (2019) argues should be untangled to advance knowledge on business. To conduct business in e-commerce one needs to have access to finance and banking something African countries are struggling with (Mavilia and Pisani 2020; Mthembu, Kunene, and Mbhele 2018). With blockchain reducing the centralization of activities, more citizens may engage in e-commerce activities. The advancement of e-commerce with the use of blockchain will assist in attaining the sustainable development goal (SDG) number 8 (Union 2016; Waage et al. 2015), specifically, 8.10 which calls for strengthening the capacity of domestic financial institutions to provide banking and financial services to citizens. Such an approach assists with reducing the digital inequality and digital divide (Pollitzer 2018).

This article provides, theoretical, practical, and policy contributions that if adopted and implemented can assist African countries to leapfrog the centralized ledgers. The theoretical and novel contribution is a model for adopting and using blockchain in e-commerce. The practical contribution is for businesses and government entities to consider the importance of reducing costs (commission, and transaction) while offering secure, scalable, traceable, legal, and compatible blockchains in e-commerce. This will assist e-commerce developers, e-commerce users, managers, banks and financial institutions, scholars, policymakers, and blockchain users to improve their knowledge of blockchain technology and mitigate its downsides in adopting blockchain in e-commerce. Practices such as consideration for lowering costs, the market the business is operating in, regulations and the environment for the technology to flourish are important. For organizations, that would lead to an increase in profit margin, credibility and operating sustainably. For e-commerce users, that will allow them to trust the platforms and purchase frequently. The study contributes to the body of knowledge on the use of e-commerce. Lastly, the study contributes to policy by addressing SDG 8 by ensuring that banking and financial services are available to all by 2030 so that citizens can buy from e-commerce platforms.

This article is organized as follows: The next section explains the systematic literature review methodology with justifications for the database selection, inclusion, and exclusion criteria, data analysis, and quality assessment. The follow-up section will include results that address the key themes identified, followed by the discussion and conclusion section.

Research methodology

The research purpose was to identify factors influencing the adoption and usage of blockchain technology in e-commerce with a focus on the global context. To achieve the purpose, the study followed the interpretivism philosophy with a view that our understanding of the world is centred around humans and there are multiple subjective realities that the study considers (Walsham 2006). We partnered the interpretivist philosophy with the qualitative method by focusing on the context (Klein and Myers 1999; Sarker, Xiao, and Beaulieu 2013) which was global. The qualitative method engages with text and brings different arguments from articles that met the inclusion criteria during the review process.

A study can follow a specific type of literature review, such as a meta-analysis, narrative analysis (Siddaway, Wood, and Hedges 2019; Sorgenfrei et al. 2014), or a systematic literature review (Okoli 2015). A systematic literature review (SLR) is a type of literature review that gathers and evaluates several research publications or studies methodically (Asongu and Odhiambo 2019). The objective of an SLR is to offer a comprehensive overview of the relevant literature about a research issue or field (Kabongo 2019). The systematic literature review (SLR) synthesizes research on e-commerce and blockchain adoption. Ethics for non-human research was sought from the Research Ethics Committee (REC) within the School of Business Sciences (SBS) at the university.

In the field of Information Systems (IS) research, the use of a systematic literature review assists in providing a snapshot of the field and takes into account major arguments, the direction of the field, and possible issues that arise (Rowe 2014). A systematic literature review is a standalone research and does not require the use of a theory (as done in empirical research) (Okoli and Schabram 2010) but can contribute by developing a model or conceptual framework (Rowe 2014). Each systematic literature review must have a goal and this research's primary goal was explaining as argued by (Rowe 2014).

Therefore, this study contributes to adopting and using blockchain in e-commerce by developing a model.

Data sources and search terms

Between July and August of 2022, systematic searches were undertaken utilizing four electronic databases: ProQuest, WorldCat.org, Science Direct, and IEEE Xplore. Google Scholar was added to assist with reducing location bias. Table 1 summarizes the search terms (queries) in the databases. These databases have been argued by prior researchers in the field of IS as effective data sources (Ali et al. 2021; AlShamsi, Al-Emran, and Shaalan 2022; Pozzi, Pigni, and Vitari 2014; Roodt 2013; Sylvester, Tate, and Johnstone 2011; Wu et al. 2012).

Google Scholar was added as a database because it is increasingly regarded as a useful online resource for literature research and assessment (Boell and Cecez-Kecmanovic 2014) and assists in addressing location bias. Siddaway, Wood, and Hedges (2019) argue that WorldCat.org and Google Scholar are ideal databases to use for grey literature. Haddaway et al. (2015) have the same views on the use of grey literature and the authors argue that WorldCat.org and Google Scholar should be combined with other databases when conducting reviews.

Bias

Multiple forms of bias may exist in a systematic literature review, including evidence selection bias, publishing bias, reporting bias, researcher prejudice, and conflicting interests (Boell and Cecez-Kecmanovic 2014; Chauhan 2017; Drucker, Fleming, and Chan 2016; Hauge, Ayala, and Conradi 2010; Okoli 2012). According to Millett (2011), a written protocol should always be constructed and followed to minimize bias in a systematic literature review. This research used an SLR protocol and a data extraction sheet. Any deviation from the procedure might result in **reporting bias**. According to Drucker, Fleming, and Chan (2016) and Boell and Cecez-Kecmanovic (Boell and Cecez-Kecmanovic 2014), **researcher bias**, which is closely connected to reporting bias, may also be a concern while doing a systematic literature review. While influenced by the interpretivist philosophy, the researchers adhered to the protocol to mitigate reporting and researcher bias by paying attention to the inclusion criteria and documenting the process.

According to Boell and Cecez-Kecmanovic (Boell and Cecez-Kecmanovic 2014) and Millett (2011), **evidence selection bias** arises when a systematic literature review does not include all available data on a subject. To prevent this, the researchers have collected information from all four electronic databases and the web database. To reduce bias in this study even further, all papers considered for this research report have been peer-reviewed and analyzed for important sources of bias. Cooper and Hedges (1993) state that **publication bias** arises when an author decides to incorporate only published journal papers in his or her study. The researchers have incorporated grey literature such as conference proceedings and articles from Google Scholar (Haddaway et al. 2015) to address the bias.

Lastly, according to Drucker, Fleming, and Chan (2016), systematic evaluations undertaken with industry links may be susceptible to **competing bias**. The authors have no conflicts of interest and the study was undertaken independently of any affiliation with organizations.

Inclusion and exclusion criteria

The study inclusion criteria were papers focusing on the use of blockchain technology and e-commerce as these concepts are connected to the main research question. We engaged with peer-reviewed conference papers and journal articles as the study intended to use credible sources and reduce bias. The papers analyzed were published between 2019 and 2022 as the use of e-commerce experienced a boom due to the widespread COVID-19 and lockdown restrictions in many countries.

The study included articles that used qualitative and quantitative methods. Qualitative studies are used to create arguments in line with the research questions. However, quantitative studies may be included to provide evidence (statistics) for arguments. Lastly, the study considered articles written in English as foreign studies tend to lose their significance in translation since researchers are only fluent in English.

The exclusion criteria were studies that do not engage with blockchain technology and e-commerce, studies published before 2019, and that are not peer-reviewed. The study also excluded papers that had no full-text articles and duplicates.

Data extraction

Before extracting articles, a data extraction sheet was produced to establish what data needed to be collected and to preserve a complete record of searches undertaken. Overall, the searches in the databases generated 4,625 results. Systematic literature reviews are known for having a high number of articles in the first searches but end up analyzing a limited number of them. Hauge,

Table 1: Keywords and database search summary.

Database	Query
WorldCat.org	• su:(Blockchain) AND su:(E-commerce)
ProQuest	• su:(Blockchain) AND su:(E-commerce) AND (kw:(Challenges) OR kw:(Issues) OR kw:(Problems))
Science Direct	• su:(Blockchain) AND (kw:(Adoption) OR kw:(Acceptance)) AND su:(E-commerce)
IEEE Xplore	• su:(Blockchain) AND (kw:(Adoption) OR kw:(Acceptance)) AND (kw:(Challenges) OR kw:(Issues) OR kw:(Problems))
Google Scholar	• The acceptance of blockchain in ecommerce • The adoption of blockchain in ecommerce

Ayala, and Conradi (2010) used the systematic literature review methodology and while their first search arrived at 24,289 articles, they only analyzed 112 for their study. Ibidunni, Ufua, and Opute (2022) used the same methodology with their first search providing them with 52,430 articles but only analyzed 127 for their research. Williams, Nocera, and Casteel (2008) had 227 articles in their first search and ended up analyzing only 9 articles. Mulibana and Rena (2021) conducted a systematic literature review on innovation activities with the initial search producing 2,774 articles but analyzed 44 articles for their study. Thus, for systematic literature reviews, the focus should not be on having a high number of articles to include (read) but, on ensuring the screening and extraction stages are thorough (Okoli 2015; Siddaway, Wood, and Hedges 2019; Templier and Paré 2018).

The findings (out of the 4,625 results) were inspected for duplicates and 199 results were removed. The 4,426 remaining studies were then evaluated to determine their relevance to the study. 4330 articles were eliminated because they did not include the relevant keywords in their titles. Of the 96 articles remaining, 72 articles were removed because the abstract did not include the search terms or relate to the research question.

The remaining 24 articles were examined on the inclusion and exclusion criteria with the results being the removal of five (5) articles. The reasons for removing the articles included one of the articles looking at the use of smart lockers in blockchain, another looking at the compute offloading technique, and yet another looking at product traceability, all of which are not relevant to the broad blockchain understanding in e-commerce. One article was found not to contain useful information that assists in addressing the research question. The fifth article couldn't be retrieved due to a lack of full-text availability. Thus, there were only 19 publications that matched all criteria and were included as shown in Table 2. The included articles, together with their pertinent data, were downloaded, saved to Zotero, and a project was created on Atlas.ti version 9 where both researchers had access to the project for data analysis. Figure 1 is a PRISMA flowchart that describes the research selection procedure.

Data analysis

Using Atlas.ti, we employed thematic analysis to analyze the 19 articles. Thematic analysis, according to Clarke and Braun (2013), is a reflexive and flexible technique for analyzing qualitative data that gives a rich and complete description of acquired data. Maguire and Delahunt (2017) created a comprehensive guide for analyzing a systematic literature review based on the works of Clarke and Braun (2013).

The first step required reading and rereading the data. The researchers must be well acquainted with the whole data corpus or data body, the 19 articles. All 19 articles were uploaded in the project created on Atlas.ti, read and reread by each author. The authors took notes and recorded first impressions of the articles. The second step involved identifying the initial codes. Coding lowers large amounts of data into meaningful parts. The researchers used inductive coding (Maguire and Delahunt 2017) as no theory (model or framework) was guiding the study. At this point, the authors agreed on which article to code and each coded it. The authors convened to assess the coding of the first manuscript and understanding of the codes to create consensus in the analysis. Our agreement was 92% based on the initial codes and their meanings. We then decided which codes to use and continued to code the other 18 articles. When clarity was needed, we would convene over Microsoft Teams for a discussion.

The third step involved searching for themes. Themes are often comprised of codes extracted from the data and grouped based on their apparent relevance to a research issue. The researchers grouped codes with similar meanings or engaged in the same aspect. Codes that did not belong to any theme were placed under the theme 'extra'. The fourth step involves reviewing the themes developed from the third step. During this step, the researchers evaluated, amended, and elaborated on the basic themes established in the third step. The target was to ensure internal homogeneity between themes and external heterogeneity among the themes. Factors that must be considered are, what does the topic imply? How do subthemes connect and relate to the primary topic, if any? How are the topics interconnected?

The fifth step involved refining and naming the themes. This is the last stage of refining the themes, and the goal is to find the essence of each subject by defining them. The results section is organized according to the main themes identified, applications, and challenges of blockchain in e-commerce. These themes connect to the research sub-questions. The last step is developing a write-up which this manuscript stands for. To ensure the study provides a manuscript that is structured according to the demands of a systematic literature review, we followed the principle by (Siddaway, Wood, and Hedges 2019) that requests the manuscript to have an introduction section followed by methodology, results, discussion and conclusion sections.

Quality assessment

Williams, Nocera, and Casteel (2008) state that the major goal of evaluating the quality of systematic reviews is to establish the trustworthiness of the reviews' conclusions. Because it entails assessing the methodological quality of a study's design and execution rather than the actual impact of the intervention being researched, quality assessment is critical for determining the overall strength of the evidence on specific research issues (Williams, Nocera, and Casteel 2008). The papers included were evaluated based on criteria to determine their quality and ranked as 1, 2, or 3.

The ranking of 3 was the highest an article can achieve including studies that have been conducted qualitatively, studies that do not include bias, studies that are not location or sector-specific, studies that answer the research question, and studies that add a novel contribution. Seven articles were graded with 3.

The ranking of 2 was medium and included studies conducted with mixed methods, studies that do not include bias, studies that are partially location or

Table 2: Included articles and their key findings.

No.	Author	Grade	Findings
1	(Ali et al. 2021)	3	Blockchain is a decentralized, transactional database system that improves business operations and facilitates the exchange of reliable data throughout the chain. Therefore, this new technology allows users to validate, maintain, and synchronize the contents of a duplicated data sheet (a transaction ledger).
2	(Taherdoost 2022)	1	A review was conducted of the many domains in which blockchain acceptability has been examined, however certain sectors and major applications are not addressed in the adoption studies. Research revealed that blockchain has several advantages for IIoT. Another research focuses on the deployment of blockchain in the IIoT as an essential technology that may boost system security and confidence.
3	(Janssen et al. 2020)	3	This study's literature review presented the current state of knowledge regarding the adoption of blockchain technologies, unrestricted by context, and helped to identify three groups of factors: institutional (norms and culture, regulations and legislations, governance), market (market structure, contracts and agreements, business process), and technical (information exchange and transactions, distributed ledges, shared infrastructure). The environment in which blockchain is implemented will determine how various aspects interact with one another. Moreover, variables influencing the adoption of blockchain technology vary on their intended use.
4	(AlShamsi, Al-Emran, and Shaalan 2022)	2	This assessment revealed research shortcomings. TAM and TOE were the most used approaches for understanding blockchain usage and adoption. Technological, sociological, and psychological variables in blockchain adoption are little understood. Despite blockchain's immaturity, supply chain management is the dominating sector that uses the technology. Trust, perceived cost, and social influence drove blockchain acceptance. Majority of the examined blockchain adoption studies (77%) used questionnaires and 50% of the studies collected data from senior management, professionals, and consultants.
5	(Queiroz and Wamba 2019)	1	In this research, the authors examined Indian and American blockchain adoption trends in the supply chain management (SCM) business. Their PLSSEM-estimated model validated the recommended model. It indicated considerable blockchain adoption discrepancies across the surveyed countries. According to their results, logistics and supply chain management specialists' blockchain adoption remains in its infancy. Their suggested model correctly characterized behavioural intention (63.9% and 69.2% for India and the US, respectively), exceeding the UTAUT benchmark and performing comparably to UTAUT2.
6	(Koens et al. 2021)	1	This article proposes approaches for determining if a certain situation is suitable for blockchain technology. Such techniques are predicated mostly on the scenario's intrinsic technological drivers. In real-world circumstances, blockchain-based solutions are occasionally adopted despite these approaches' arguments to the contrary. Given the intrinsic absence of technological motivations in many cases, the decision to use blockchain technology may seem unreasonable. The studies original finding is that blockchain acceptance may be explained by non-technical factors, such as philosophical views, network effects, economic incentives, and overcoming stalemate.
7	(Prewett, Prescott, and Phillips 2020)	3	Blockchain technology has the potential to significantly alter conventional business approaches. Intelligent business leaders have already started to investigate the potential influence of blockchain on their sectors and their competitive positions within those industries. Among the principal advantages of blockchain are greater transparency of shared transaction histories, enhanced security of recorded transactions, improved traceability of products through complex supply chains, increased efficiency, speed of transaction processing under certain conditions, and reduced costs resulting from a diminished need for trust in trading partners.
8	(Marikyan et al. 2022)	2	The purpose of this study was to address the dearth of research on technology adoption from the user's viewpoint. According to the protection motivation theory, the research analyzed cognitive components and found that four out of five factors had a substantial influence on use intention. The larger variation in the dependent variable is explained by the coping components, with response efficacy and self-efficacy having the greatest influence on the intention to use. Also examined were the moderating impacts of personal innovativeness, subjective knowledge, and objective knowledge on the predictive power of the variables.
9	(Ismanto et al. 2019)	1	Numerous businesses in Indonesia have embraced the use of e-commerce. However, it is not flawless and might be improved. Implementation of blockchain technology has the potential to enhance e-commerce and resolve e-commerce issues. Blockchain facilitates peer-to-peer (p2p) payments by reducing the need for commission fees and limiting the contact between buyers and sellers. The smart contract will enforce the condition guaranteeing justice and safety. While ledgers provide a transparent and decentralized ecosystem, As Blockchain is still considered a young technology, it is incomplete and immature. There are hazards associated with the use of blockchain technology and cryptocurrencies, such as money laundering and the existence of a black market, that have prevented several nations, including Indonesia, from enacting explicit blockchain implementation regulations.

(*Continued*)

Table 2: Continued.

No.	Author	Grade	Findings
10	(Zheng and Lu 2021)	2	For the study of blockchain application and acceptance, as well as blockchain-centric management concerns, it is necessary to comprehend blockchain's technical features, prospective benefits, implementation risks and governance, adoption and absorption, and commercial value. Moreover, the integration and collaboration of blockchain with other emerging technologies, such as IoT, cloud computing, and 6G, determine that the relevant research objects are not just one or two businesses, but the entire blockchain network – and even the business ecosystem.
11	(Blakemore 2021)	1	The author of Blockchain Technology and the Law contends that broad adoption of a new technology necessitates legislation that aligns the technology with consumer expectations, or that history teaches the same. It's possible that blockchain engineers may, in one way or another, learn the lessons of financial history, and that they will ultimately achieve success only by reconstructing the financial system they first built against.
12	(Xuan, Alrashdan, and Al-Maatouk 2020)	3	For this article, we learn that the integration of blockchain technology into the database system of e-commerce company platforms is crucial for preventing data breaches. This strategy is much superior to constructing a conventional database system, which is vulnerable to hacker attacks, or employing blockchain technology as the only database system, which is inefficient for regular company operations. With its efficient and reliable repository, the suggested system can support the commercial operations of online retailers.
13	(Zhou et al. 2021)	2	This study utilizes the Ethereum blockchain, IPFS, and smart contracts for storing product information and assessing the reputations of online shoppers. Due to the distributed and decentralized nature of the Ethereum blockchain and IPFS, it is very difficult for attackers to alter product information and reputation data recorded on the blockchain and IPFS. In addition, the suggested blockchain-DRS can withstand typical assaults, such as unjust ratings and collusion, by constructing the reputation assessment scheme with appropriate consideration of real transaction circumstances.
14	(Liu and Ye 2021)	1	In this article, the authors used TAM and the fundamental characteristics of blockchain and performed an empirical investigation. They gather 254 surveys about blockchain applications and analyse the replies using SmartPLS3.0. The findings indicate that trust and information quality has a favourable influence on the behavioural intentions of users, except for output quality.
15	(Duque and Torres 2020)	3	Information asymmetry causes uncertainty in e-commerce transactions. E-commerce is inefficient due to paper, logistical challenges with information exchange, and an excess of intermediaries. Uncertainty and inefficiency may be handled by knowing the transaction's counterparties, the origin of the items or service, and how to resolve possible difficulties. In this context, DLT could address uncertainty in transactions from four perspectives: (i) by enabling the identification of transaction parties; (ii) by programming certainty through smart contracts; (iii) by enabling the traceability of the object along the value chain; and (iv) by enhancing data analysis for combating illicit trade, fraud, counterfeiting, and terrorist acts. DLT may help trade inefficiencies by enhancing data exchange and paperless commerce, eliminating the middleman, and employing 3D printing to reduce shipping.
16	(Tang et al. 2020)	2	This article organizes blockchain ethics into micro-, meso-, and macro-levels (blockchain implications for institutions and society). Each aspect's underlying concepts and ethical repercussions are analyzed. Given blockchain decentralization's importance, its ethical ramifications for government, the economy, and society are studied. Finally, new understanding, technology, application, and regulation (UTAR) principles for ethical blockchain usage are offered.
17	(Clohessy and Acton 2019)	2	The Irish government may play a major role in promoting the advantages of blockchain technology, according to studies on the low level of blockchain knowledge and the lack of information regarding feasible commercial use cases. The study's results indicate that Irish universities and/or other Irish course providers must develop new blockchain-based curricula that include basic abilities. It was reassuring to notice that SME blockchain adopters used cloud-based blockchain platforms and technologies to overcome their initial poor organizational readiness levels.
18	(Treiblmaier and Sillaber 2021)	3	The authors argue that blockchain has created a 'trustless system' that B2B, B2C, B2G, and C2C are using that need to be questioned. The paper looks at blockchain potential by considering the technical, legal, organizational, quality and consumer issues.
19	(Malhotra, O'Neill, and Stowell 2022)	3	As blockchain expands, companies will make different judgments. The paper offers examples such as how Apple's walled garden OS and Android's open garden OS quickly proliferated, scaled up, and crowded out other viable systems. Symbian couldn't save Nokia's phone business. COVID-19 shows that global supply networks and ecosystems are susceptible to catastrophes. Post-COVID upheavals need rethinking value generation and building new ecosystems. IBM's digital health pass demonstrates this.

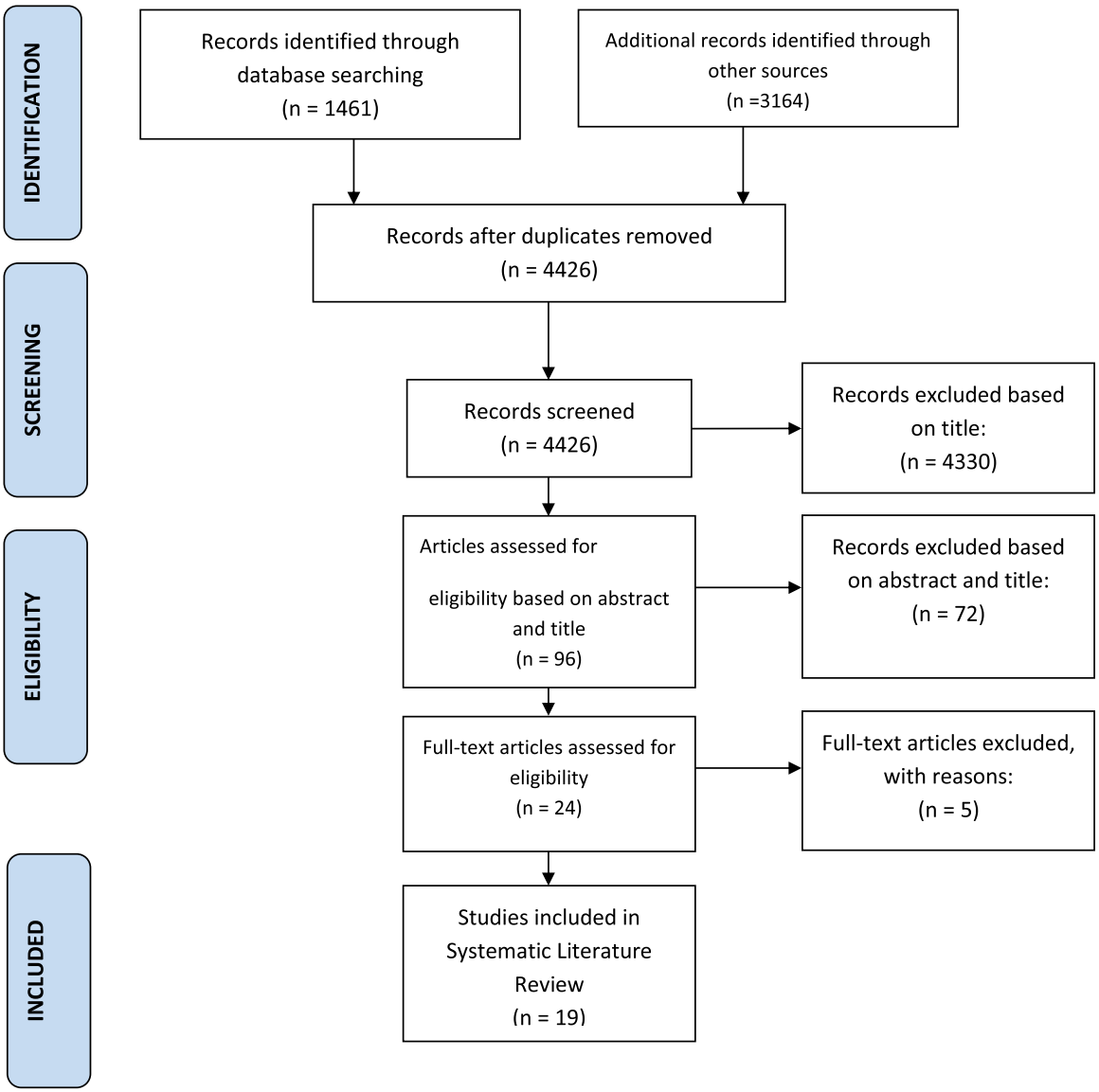


Figure 1: Prisma flowchart.

sector-specific, studies that answer the research question, and studies that add a novel contribution. Six articles were graded with 2.

The ranking of 1 was the lowest. A paper ranked 1 was based on a study that has been conducted quantitatively, may include bias, is location or sector-specific, and may not fully answer the research question. The study had six articles graded as 1.

Table 2 contains the summary utilized for the examination and analysis of articles. The columns of the table were constructed with the help of the data extraction sheet. This was achieved after reading the articles and classifying them according to the relevance of their content to the subjects under investigation. Included are the author(s), grade (or rank), and findings from the article.

Results

Apart from most of the studies being graded as 3 and therefore having a direct relationship to the research question, the study found that the qualitative method was the main method with 15 studies out of 19. One study used the quantitative method. The mixed method (a combination of qualitative and quantitative methods) was used twice.

Six studies used action research as the strategy. This was followed by a case study and grounded theory with five studies each. Phenomenology and survey were each used in a single study. One of the studies was a systematic literature review. Therefore, most of the research studies were qualitative.

The review revealed knowledge about adopting and using blockchain in e-commerce is limited, regardless of context. The study identified three themes with subthemes that influence the adoption of blockchain in e-commerce: institutional, market-related, and technical factors.

Institutional factors

Blockchain enhances supply chain management by storing and retaining product data, allowing for the monitoring of each product's lifespan. Blockchain does this by

using cryptography to guarantee that data is neither changed nor deleted (Xuan, Alrashdan, and Al-Maatouk 2020; Koens, Van Aubel and Poll 2021). Companies including AIRBUS, IBM, and Walmart are experimenting with blockchain technology to monitor goods and services throughout the global value chain across various sectors (Duque and Torres 2020).

Manufacturers, exporters, shippers, customs, transporters, insurance companies, and consumers can track the origin, raw materials, parts, routes, ingredients, and components of their products and services, as well as the implementation of labour and environmental standards, using blockchain (Xuan, Alrashdan, and Al-Maatouk 2020). Businesses can independently monitor and validate the chain using blockchain technology (Duque and Torres 2020).

Governments are starting to see the need to integrate blockchain into their operational processes and outputs to enhance public services and remove governance challenges such as fraud, corruption, and inefficiency (Queiroz and Wamba, 2019; Ali et al. 2021). The extent of blockchain adoption may be impacted by laws and regulations (Ali et al. 2021; Koens, Van Aubel and Poll, 2021), due to the unpredictability of government regulations and global differences, leading to blockchain not reaching its full potential (Malhotra, O'Neill, and Stowell 2022).

This suggests that blockchain has not been adequately reviewed, and hence, the difficulties in its acceptance were due to the immaturity of the technology itself (Ali et al. 2021; Koens, Van Aubel and Poll, 2021). In addition, interoperability and compatibility issues may occur due to the lack of a standardized protocol for government agencies to use blockchain-based solutions (Malhotra, O'Neill, and Stowell 2022).

Blockchain technology must overcome the cultural opposition of market obligations to be embraced (Janssen et al. 2020; Taherdoost 2022). Consumers and corporates' reluctance to change may avoid blockchain adoption (Marikyan et al. 2022). Customers must recognize that all electronic transactions are more secure, comprehensive, and protected when using blockchain.

Intermediaries' duties and operations, such as payment processors like Visa and Mastercard, will alter (AlShamsi, Al-Emran, and Shaalan 2022). They will be expected to invest in and alter their platform to be blockchain-based while continuing to deliver services and nurture customer ties (Janssen et al. 2020). There is limited information among enterprises, customers, and authorities regarding the possible use cases for blockchain (Marikyan et al. 2022). To understand its social influence, individuals are urged to consider how this revolutionary technology might be integrated into company strategy and personal pursuits (Janssen et al. 2020).

The method by which blockchain will be managed is a significant challenge, given that technology, by definition, is not the subject of regulation; rather, it is the numerous uses of the technology that may need legislative constraints (Janssen et al. 2020). There are six regulatory/legal hurdles to overcome before blockchain technology can be used: the legal nature of blockchain and distributed ledger; recognition of blockchain as immutable, tamper-proof sources of truth; the right to be forgotten; the legal validity of documents stored in the blockchain; the legal validity of financial instruments; and the use of smart contracts (Janssen et al. 2020). To make blockchain widely available, regulations must be rewritten or changed to accommodate its properties (Blakemore 2021).

Market factors

In addition to increasing the security of online transactions, blockchain technology may improve e-commerce efficiency by aggregating all blockchain transactions into a single network, eliminating the need for middlemen and allowing businesses to operate at faster and cheaper prices (Duque and Torres 2020). Blockchain supports peer-to-peer transactions by removing the need for commission fees, minimizing buyer-seller communication, and ensuring justice and safety will be enforced by the smart contract, while ledgers create a decentralized and transparent environment (Ismanto et al. 2019).

It may seem that traditional business practices are inapplicable to blockchain since this technology is predicated on removing middlemen and avoiding the associated transaction fees (Malhotra, O'Neill, and Stowell 2022). In the short term, the costs of adoption and implementation of blockchain for existing businesses can be extremely high, particularly for occupants with large existing back-office processes, complex legacy IT systems, and processes designed to comply with existing standards, which may require expensive redesign (Zheng and Lu 2021; Taherdoost 2022). In the long term, businesses adopting and using blockchain will realize the reduction of transaction fees and increase trust.

Blockchain technology fosters confidence and transparency in the payments sector since every transaction is recorded in a shared ledger that cannot be changed (Queiroz and Wamba 2019; Liu and Ye 2021). As a result, e-commerce systems enable enhanced security and visibility, as well as quicker transaction processing rates and transaction traceability (Treiblmaier and Sillaber 2021). Due to the characteristics of a distributed ledger, it becomes harder for unlawful operations to occur (Duque and Torres 2020).

Migrating old contracts to the new blockchain technology may need the conversion of existing papers or contracts to the blockchain's equivalent format. Currently, there is a lack of transparency around smart contracts, restricting them to simple agreements (Janssen et al. 2020). Risks associated with the development and management of contracts to handle all the interactions involved in blockchain deployment are somewhat connected to vendor risk. To develop and manage interactions between the blockchain administrator and all participating nodes, service-level agreements (SLAs) are necessary (Prewett, Prescott, and Phillips 2020).

Due to its peer-to-peer and distributed nature, blockchain technology can enhance existing security systems and achieve more secure data storage, eliminating risks such as Distributed Denial of Service (DDoS) assaults (Xuan, Alrashdan, and Al-Maatouk 2020). Blockchain

has the potential to tackle illegal activities such as money laundering, illicit trade, and counterfeiting (Duque and Torres 2020).

Technical factors

Using a blockchain-based e-commerce approach ensures legitimacy by using the blockchain's tracing features (Zhou et al. 2021). According to Xuan, Alrashdan, and Al-Maatouk (2020), these are achieved through blockchain's core technology, which is decentralized and encrypts data, ensuring data integrity and accountability as it records and encrypts the data in a chain of back-linked information blocks and forms a distributed database that is inaccessible to unauthorized users. The results are a safe environment for e-commerce consumers and the ability to build confidence through increased database security.

The time needed to complete transactions might impede blockchain technology's mainstream adoption. Unlike other transaction processing networks, such as Visa and Mastercard (2000 tps average and 10,000 tps respectively at peak time), the blockchain (specifically bitcoin) processes one transaction per second (tps), with a potential maximum of seven transactions per second (tps) (Janssen et al. 2020). To avoid this constraint, each block's size must be increased. This will, however, result in other issues, such as blockchain bloat and increased size (Zheng and Lu 2021). The scalability of blockchain systems is an additional barrier (Janssen et al. 2020). As the transactional amounts required by services exceed Bitcoin transactions, the blockchain is not yet mature enough to support them.

Different backdoors may be used to weaken the system if access and administration are dispersed across multiple nodes (Janssen et al. 2020). Because many networks utilize the same code, if hackers discover a security flaw, the whole system may be badly impacted. As a result, the largest barriers to the widespread implementation of blockchain technology are ensuring the integrity of other users on the distributed ledger and executing transactions consistently and securely (Janssen et al. 2020). Furthermore, businesses must handle the integrity and security of data stored in ledgers (Clohessy and Acton 2019). A transparent record, like with many other ledgers, may be desirable, and when employing blockchain, companies must guarantee that data can only be viewed by those with the necessary rights (Tang et al. 2020).

The adoption of blockchain requires a substantial amount of computerization (Janssen et al. 2020). Thus, some governments, such as those in underdeveloped nations, are not equipped to implement blockchain-based solutions. Because blockchain mandates the distribution of data over several nodes, the complexity of the problems to be solved increases due to the high bandwidth, storage demand, and processing power required to run an active node (Prewett, Prescott, and Phillips 2020). This may prevent certain parties and regions from realizing the benefits of blockchain technology for national services.

Existing blockchains, including technical protocols and smart contracts, must be standardized on various levels (Clohessy and Acton 2019; Liu and Ye 2021). Because of this lack of standardization, multiple blockchains are incompatible, and the data they hold does not adhere to market rules and practices (Ali et al. 2021; Duque and Torres 2020; Treiblmaier and Sillaber 2021). The implementation of blockchain will entail the use of standardized technologies and a single reference data standard.

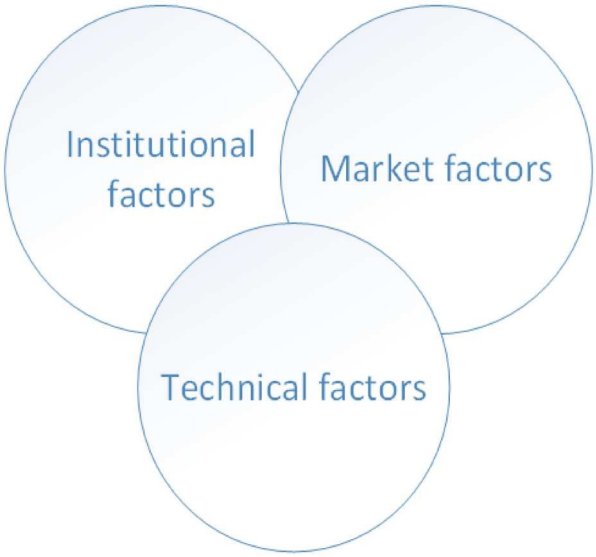


Figure 2: Factors for the adoption and use of blockchain technology in e-commerce.

Figure 2 (the Venn diagram) presents the relationship among the factors influencing the adoption and the use of blockchain technology in e-commerce. The institutional, market and technical model provides factors that e-commerce platforms argue are needed for blockchain adoption and use.

Discussion

In their research on digital platforms, de Reuver, Sørensen, and Basole (2018) notice that adopting digital platforms (including blockchain) is intertwined with institutions, and the formal structures are expected to authorize new entrants. Unfortunately, the institutions are using this 'gatekeeper' (Kazan et al. 2018) role to block the adoption of blockchain with the notion that the technology is used to foster money laundering. These findings relate to our study by showing the role that laws and regulations play in limiting immature technology (such as blockchain) to realize its full potential and therefore the impact of the institutional factor in blockchain adoption and use in e-commerce.

Mavilia and Pisani (2022) discuss the adoption of blockchain in the agricultural sector in South Africa and argue that the use of the technology will assist in reducing costs, especially in the operational supply chain which accounts for two-thirds of the cost of goods. They also contend that smart contracts and transparency are important in adoption. These findings coincide with the current study as these market factors are important in adopting and using blockchain in e-commerce.

Xuan, Alrashdan, and Al-Maatouk (2020) found that data security is important in the architecture of e-commerce as organizations use the data for decision-making. This finding coincides with this study's finding as data security is the leading technical factor e-commerce platforms consider in blockchain adoption and use. De Reuver, Sørensen, and Basole (2018) and Kazan et al. (2018) concur that without reliable internet connection and electricity, adoption and use of digital platforms such as blockchain technology will be limited as they require high bandwidth and processing power as our findings have explained in the technical factors.

The model created is unique and therefore provides a novice contribution to theory. The model is novice in that it has included market factors that previous research has suppressed as an environmental factor. The model diverts from previous frameworks such as the technology, organization and environment (TOE) by not only focusing on the technical factors but also considering institutional factors. The institutional factors include both internal and external to the e-commerce business.

Conclusion

Blockchain adoption and use have been argued as important for e-commerce organizations. The increase in e-commerce during the COVID-19 pandemic necessitated providing a snapshot of the field and how the issue of security is important in the adoption of blockchain. Therefore, the purpose was to look at factors influencing the adoption and use of blockchain in e-commerce. We limited our study to analyzing papers published between 2019 and 2022 as it is the period that e-commerce has achieved a major rise due to COVID-19 restrictions in different countries.

The results showed that factors influencing blockchain adoption and use in e-commerce are categorized into three; institutional, market-related and technical. The institutional factors include supply chain management, track and trace, laws and regulations, compatibility of the blockchain, immaturity of the blockchain, and culture. The market-related factors are costs, legacy systems, smart contracts, transparency and the ability to tackle illegal activities. Lastly, the technical factors include data security, processing time, scalability, integrity of users, standardization, high bandwidth, storage and processing power.

The research's novel contribution is to theory through a model that considers the institutional, market-related and technical factors in blockchain adoption and use in e-commerce. The research contributes to the body of knowledge on e-commerce and the use of blockchain technology by reviewing relevant articles in several databases that discuss the use of blockchain in e-commerce. The research contributes to policy by providing an option for SDG 8 to exist through empowering businesses and citizens with multiple avenues that can foster economic growth by ensuring e-commerce businesses may employ blockchain to foster sustainability and create employment. These contributions assist African businesses, scholars, policymakers, practitioners, government and financial institutions, and e-commerce users to comprehend and advance their knowledge on the use of blockchain which is vital in 4IR. The practical contribution is for businesses and government entities to consider the importance of reducing costs (commission, and transaction) while offering secure, scalable, traceable, legal, and compatible blockchains in e-commerce.

This study has important repercussions, although it is not without constraints. Despite an extensive search, only thirteen papers discussed the factors that restrict the use of blockchain technology in e-commerce. Only eight of the thirteen publications gave significant insights, and none of the research explicitly mentioned blockchain with e-commerce.

Due to time constraints (our project operated for five months), only five databases were used to search for literature; as a result, pertinent publications from other databases may have been omitted from this investigation. In addition, the inclusion criteria limited this assessment to English-language works published between 2019 and 2022. This may have reduced the researcher's chances of locating other relevant studies. Furthermore, articles were not excluded based on methodology; hence, methodological flaws in the evaluated studies may have affected the findings of this study.

The limitations of this study and its results might provide direction for further investigation into this topic. Future research should validate the model by conducting qualitative or quantitative studies at the organizational level. Researchers in developing countries should also provide insights into blockchain adoption in their countries to balance with publications from developed nations.

Disclosure statement

No potential conflict of interest was reported by the authors.

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