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Review

A conceptual model for blockchain adoption intentions: A T-O-E framework perspective

Mustafa Ahmed hadi Almaher*, Sivadass A.L. Thiruchelvam, Abdul Aziz Bin Mat Isa

University Tenaga Nasional, Putrajaya Campus, Kajang 43000, Malaysia
*** Corresponding author:** Mustafa Ahmed hadi Almaher, must32729@gmail.com

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Abstract: Blockchain technology has increasingly attracted the attention of the financial service sector, customers, and investors because of its distinctive characteristics, such as transparency, security, reliability, and traceability. The paper is based on a Systematic Literature Review (SLR). The study comprehended the literature and the theories. It deployed the technology-organization-environment (TOE) model to consider technological, organizational, and environmental factors as antecedents of blockchain adoption intention. The paper contributes to blockchain literature by providing new insights into the factors that affect the intention to adopt blockchain technology. A theoretical model incorporates antecedents of blockchain adoption intention to direct an agenda for further investigations. Researchers can use the model proposed in this study to test the antecedents of blockchain adoption intention empirically.

Keywords: blockchain; adoption intention; technology-organization-environment (TOE) framework; attitude toward blockchain

1. Introduction

Commercial enterprises and businesses allow advanced communication technologies, like blockchain, across industries to stay ahead and improve efficiency (Bhardwaj et al., 2021). Blockchain, a recent revolutionary innovation in the technology space (Farnoush et al., 2021), offers new open-source-based opportunities for establishing novel digital operating systems and services (Lindman et al., 2017).

Blockchain can trace the material from the factory to the end users in manufacturing. Blockchain can guarantee authenticity, transparency, and trust in the supply chain (Haloul et al., 2024). This process is beneficial before the products reach the end user so that expired products can be identified, establishing customer credibility (Ahmad et al., 2019; Mukherjee et al., 2023). Blockchain has the potential utilization to be utilized by almost all industries. Blockchain is gaining popularity in the food industry for monitoring the process as food moves through the supply chain. Consumers become fascinated with knowing where their orders are produced and how they are generated. Food industry consumers can use blockchain to authenticate the origin of their purchases (Masmoudi and Gargouri, 2021; Ullah et al., 2023).

Similarly, blockchain has also been extended to the education sector in response to the Sustainable Development Goals (SDGs) announced by the United Nations (UN). Blockchain can empower educational institutions to achieve SDG goals (Altamimi et al., 2022; Beddu et al., 2022). Additionally, the emergence of blockchain technology has created new hope in the finance and banking industries to ensure transparency and reliability in the system (Ali et al., 2022; Kabir and Islam, 2021). Despite the

prominent features of blockchain, blockchain research is still in its infancy. Most research focuses mainly on technical issues (Lindman et al., 2017).

Additionally, the adoption of blockchain technology is slower than its potential. The gap between blockchain's potential and its current adoption has motivated scholars to understand the factors affecting technology adoption (Marengo and Pagano, 2023; Mehdi and Ali, 2023). Therefore, more studies are needed to expand the applications by investigating the antecedents of blockchain adoption intention (Ruangkanjanases et al., 2023).

Likewise, numerous studies have provided the rationale for the TOE framework's substantial, prominent, and pertinent role in comprehending technology adoption (Gangwar et al., 2014). TOE is a known model with three components that impact organizational adoption: Technology, organization, and environment. Kumar et al. (2022) suggested that TOE is a robust framework for predicting the integration of new technologies. Since this framework provides an all-inclusive understanding of new technology adoption (Eid Hamood and Thiruchelvam, 2023; Faasolo and Sumarliah, 2022), this study uses it as a framework and guideline to formulate a comprehensive model to predict blockchain adoption intention. Based on the gaps and recommendations, the study aims to investigate the following: "What are the key factors influencing the adoption of blockchain technology in the commercial sector for gaining a competitive advantage and enhancing operational performance?" So, the focus of the study was to investigate and identify the critical factors that impact the adoption of blockchain technology in various sectors, focusing on its role in enhancing operational performance and providing a competitive advantage in the commercial realm.

This study has important implications. First, we examined the extant literature and developed a new conceptual model that provides guidelines for future studies. Second, we delved into the discussion by formulating propositions indicating the relationships between predictors of blockchain adoption intention. Scholars can empirically test the model proposed in this study. The remainder of this paper is organized as follows. First, a literature review regarding TOE and blockchain adoption is presented. Next, by focusing on the antecedents of blockchain adoption intention, we developed and discussed propositions related to environmental, technological, and organizational factors. In the last section, conclusions and directions for future research are presented.

2. Methodology

The study is exploratory; therefore, it was planned to review the literature comprehensively using a Systematic Literature Review (SLR). An SLR is a standard tool in academic research for comprehensively analyzing existing scholarly literature on a specific topic, particularly in fields with a substantial body of knowledge. It aims to identify, evaluate, and summarize key findings and methodologies. The benefits of an SLR include offering a comprehensive overview of current knowledge, identifying research gaps, and providing a foundation for theoretical frameworks. The structured and methodical nature of SLRs enhances the credibility and reliability of the literature review process, making it a valuable tool for evidence-based research.

Search criteria and process

Additionally, the study utilized five registered databases (Scopus, PubMed, Web of Science, IEEE Xplore, and JSTOR) to search for related materials. Moreover, the search keywords were "blockchain technology", "blockchain adoption intentions", and "technology-organization-environment". These strings or keywords were searched with Boolean logical operators, i.e., "AND" and "OR", to make the search process more accurate and to the point. It followed a systematic process of inclusion and exclusion, which is given in the following lines.

- Inclusion criteria
    1) Studies published in peer-reviewed journals.
    2) No time was specified for the study, so all work related to the study could be included.
    3) Articles are written in English to facilitate understanding and synthesis.
    4) Focus on the adoption and impact of blockchain technology in various industries.
    5) Studies exploring the factors influencing technology adoption and its implications.
    6) The research addresses blockchain's role in enhancing operational performance and providing a competitive advantage.
    7) Articles providing empirical evidence and case studies related to blockchain adoption.
- Exclusion criteria
    1) Non-peer-reviewed articles, conference abstracts, or unpublished works.
    2) Research unrelated to blockchain technology adoption.
    3) Studies without a specific focus on factors influencing adoption and operational performance enhancement.
    4) Articles needing empirical evidence or case studies related to blockchain adoption.
    5) Research primarily focuses on technical or legal aspects of blockchain without exploring its impact on operational performance and competitive advantage.

The PRISMA flow diagram in **Figure 1** depicts more details regarding the study and Appendix (**Table A1**) shows the literature review matrix.

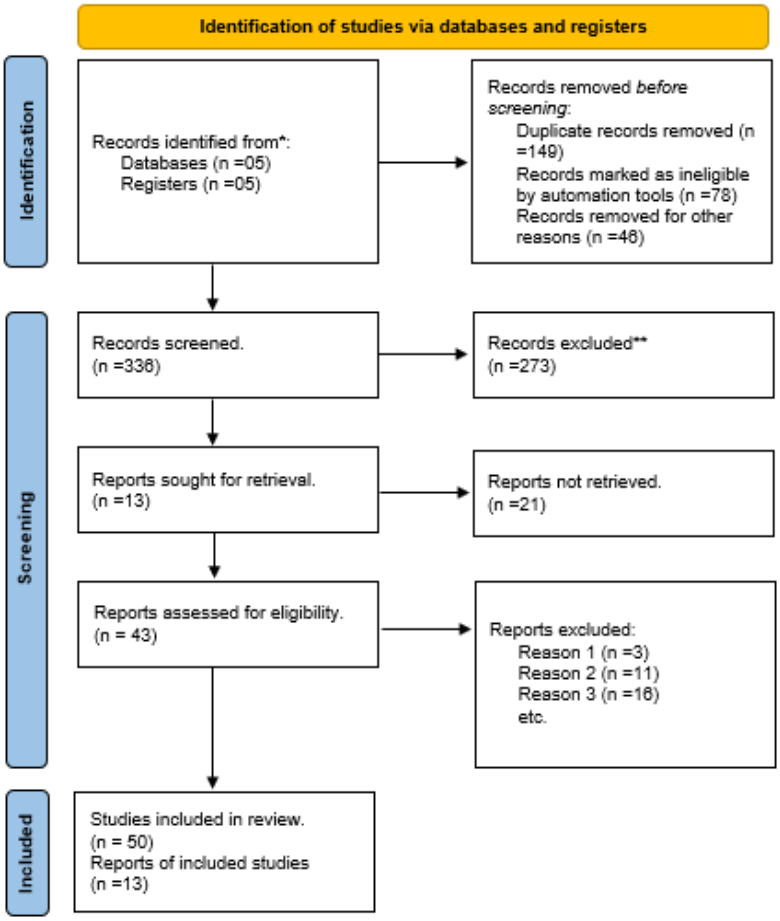

Figure 1. PRISMA diagram for the study.

3. Literature review

3.1. Technology-Organization-Environment (TOE)

Many models and theories are used to assess the intentions of individuals and organizations to adopt technology. The same applies to adopting blockchain technology (Long Chen, 2022; Jaurigue et al., 2023). The first model widely used in research is the Unified Theory of Acceptance and Use of Technology (UTAUT) model.

The UTAUT model provides a comprehensive framework and guidelines regarding technology adoption. This model presents certain perceived benefits, like ease of use, which is considered one of the potential elements in addressing needs and accepting technology. More understanding is needed in the case of blockchain, which may hinder its adoption. UTAUT emphasizes the importance of effort expectancy (Haloul et al., 2024).

The organization's second most widely used model is the Task-Technology Fit (TTF) theory. This model is pertinent. It creates alignment between blockchain's features and specific organizational context and tasking, critical for the technology's successful adoption. Therefore, organizations should assess their needs first to determine whether blockchain technology can best fit the system's operational requirements. The Information Systems Success Model (ISS) also offers beneficial insight into technology adoption and its successful implementation. In case blockchain

adoption is successful, there is a need to deliver high-quality systems and information. Through this, they ensure user satisfaction. At the same time, it generates tangible net benefits for the organization.

In 1990, Tornatzky and Fleischer originated the Technology-Organization-Environment (TOE) framework, which serves as a comprehensive lens for examining the adoption of information technology products and services within organizational settings (Awa et al., 2107; Gangwar et al., 2014; Lindman et al., 2017). This conceptual framework offers an inclusive approach, establishing a robust theoretical foundation for understanding the adoption dynamics of technologies. It compares three crucial elements within organizational contexts. The TOE framework asserts that technical, organizational, and environmental factors collectively influence technology acceptance and adoption at the organizational level (Qin et al., 2020). The versatility of the TOE framework is evidenced by its application in diverse domains, including e-commerce (Esfahbodi et al., 2022), banking (Nazim et al., 2021), food industry (Masmoudi and Gargouri, 2021), and education (Ullah et al., 2021).

The literature emphasizes the TOE framework's effectiveness, power, and prevalence in examining firm-level adoption processes (Gangwar et al., 2014). Substantiated by both theoretical and empirical support, previous studies have further validated the TOE framework's applicability across various sectors (Dehghani et al., 2022; Faasolo and Sumarliah, 2022; Kumar Bhardwaj et al., 2021; Nazim et al., 2021; Nath et al., 2022). This consistent endorsement underscores the framework's utility in investigating the complexities of technology adoption, positioning it as a valuable analytical tool for understanding the intricacies of organizational responses to emerging technologies.

In blockchain adoption intentions, a T-O-E framework perspective provides a structured approach to scrutinizing the interplay of technical, organizational, and environmental factors influencing organizations' decisions to adopt blockchain technology. This alignment bridges the gap between the theoretical underpinnings of the TOE framework and the practical implications observed in the specific context of blockchain adoption, facilitating a nuanced exploration of the adoption intentions within the dynamic and evolving landscape of technological innovation.

3.2. Blockchain technology

Blockchain is an emerging technology in which researchers and practitioners work (Ghode et al., 2020). Several experts predicted the transformational potential of blockchain since its conception in 2008 when the "Peer-to-Peer Electronic Cash System" known as Bitcoin was initially released (Lisdionoet al., 2022; Xu et al., 2021). Decentralized systems, such as Bitcoin technology, enable time-stamped, secure, and immutable data transmission across peer-to-peer networks, eliminating the involvement of any central authority (Narwane et al., 2021; Ssaharti, 2022).

By decomposing the governance system, this technology allows for a paradigm switch from centralized to decentralized and distributed authority, allowing for better decision-making (Aste et al., 2017). Distributed ledgers have a broad range of potential implementations in fields such as banking, healthcare, supply chains, governance, education, and energy. This distributed ledger was first restricted to the financial

industry as a decentralized monetary exchange record (Hughes et al., 2019; Makridakis and Christodoulou, 2019; Nazim et al., 2021; Taherdoost, 2022).

Scholars believe blockchain is crucial to future socioeconomic progress (Ruangkanjanases et al., 2023). Blockchain conquers complex issues related to the privacy, trustworthiness, and accessibility of fast and secure distributed databases (Alazab et al., 2020). Most advanced economies worldwide have widely implemented this technology, shifting towards digital payments. Evidence indicates that the evolution of blockchain has been broadly endorsed by developed countries that have grasped its potential (Nazim et al., 2021).

The implementation of blockchain is accompanied by various issues and challenges that add complexity to its adoption. Numerous adoption frameworks have been established to facilitate effective technology adoption. Nevertheless, choosing a suitable framework based on the conformity of its attributes with the industry can pose challenges for decision-makers (Taherdoost, 2022). The following section provides an extensive review of the blockchain adoption literature, which helps formulate a new conceptual framework that can be applied to different contexts.

3.3. Blockchain adoption intention

3.3.1. Regulatory pressure and intention to adopt blockchain technology

Regulatory pressure shapes organizations' intentions to adopt blockchain technology. It reflects dynamic relations between external forces and internal decision-making processes. The burgeoning regulatory landscape, driven by the need for enhanced security and transparency in various industries, substantially influences organizational behaviours. Studies have shown that regulatory frameworks, particularly those emphasizing data protection, financial security, and compliance standards, significantly impact the intention to adopt blockchain technology (Iranmanesh et al., 2023). Organizations operating in sectors subject to stringent regulatory oversight, such as finance and healthcare, are exceptionally responsive to these pressures, viewing blockchain as a strategic tool for ensuring compliance and mitigating regulatory risks (Afridi et al., 2023; Munim et al., 2022; Kouhizadeh et al., 2019; Rieger et al., 2019).

The explicit alignment of blockchain attributes, such as immutability and transparency, with regulatory requirements fosters a sense of trust and reliability, further bolstering the technology's attractiveness as a compliance-enabling solution. Consequently, the intention to adopt blockchain technology is intricately linked to the strategic imperative of navigating and adhering to evolving regulatory frameworks, with organizations recognizing blockchain's potential as a technological innovation and a proactive response to the evolving demands of regulatory environments.

3.3.2. Competitive pressure and blockchain technology adoption

Competitive pressure drives organizations' adoption intentions regarding blockchain technology, reflecting a strategic response to the evolving competitive settings. In highly competitive industries, pursuing innovation becomes paramount, and blockchain is increasingly recognized as a transformative tool that can confer a competitive advantage (Iansiti and Lakhani, 2017; Swan, 2015). Organizations perceive blockchain adoption to enhance operational efficiency, reduce costs, and

differentiate themselves from competitors by leveraging the technology's inherent attributes, such as transparency and traceability (Tapscott and Tapscott, 2016). Research indicates that industries such as supply chain and logistics, where competition is fierce, witness a heightened inclination towards adopting blockchain to streamline processes and gain a competitive edge (Li et al., 2021). The competitive pressure to stay abreast of technological advancements and outperform rivals propels organizations to explore and integrate blockchain solutions, influencing their adoption intentions. This strategic adoption aligns with the broader organizational goal of maintaining a competitive stance in the market, emphasizing the dynamic relationship between competitive pressures and the intention to adopt blockchain technology.

3.3.3. Cost concerns and blockchain technology adoption

Cost considerations are critical determinants in organizations' adoption of blockchain technology (Caldarelli et al., 2020). While blockchain is advertised for its potential to enhance operational efficiency and reduce costs in the long run, the initial implementation and integration expenses can pose a significant barrier. Studies indicate that organizations weigh the upfront financial investments against the long-term benefits, and perceived cost-effectiveness strongly influences their decisions to adopt Blockchain (Chowdhury et al., 2023; Yli-Huumo et al., 2016).

Aspects such as infrastructure development, training, and maintenance costs are critical factors that organizations meticulously evaluate. Research has highlighted that understanding the cost implications and the potential for long-term savings and efficiency gains significantly shapes organizations' adoption intentions toward blockchain technology (Hileman and Rauchs, 2017; Kshetri, 2017). Thus, the intricate balance between perceived costs and anticipated benefits emerges as a fundamental factor influencing the decision-making process around blockchain adoption.

3.3.4. Perceived risk and blockchain technology adoption

Perceived risk constitutes a complex aspect influencing organizations' intentions to adopt blockchain technology. At the same time, blockchain offers enhanced security and transparency. It also has concerns regarding security vulnerabilities, regulatory uncertainties, and technological immaturity, which can create perceived risks (Shadab et al., 2018). Organizations critically assess potential risks associated with blockchain adoption, particularly in sectors where data integrity and privacy are paramount. Research indicates that a thorough evaluation of these risks and effective risk mitigation strategies significantly impact the adoption decision (Xu et al., 2016).

Striking a balance between blockchain's potential advantages and perceived risks becomes essential. Organizations that successfully navigate and mitigate these concerns are more inclined to embrace blockchain technology. Understanding perceived risk in the context of blockchain adoption underscores the complex nature of decision-making processes and the need for strategic risk management strategies to foster widespread adoption.

3.4. Functional benefits and blockchain technology adoption

Functional benefits constitute a crucial driving force behind organizations' intentions to adopt blockchain technology. The potential for improved operational efficiency, enhanced traceability, and increased transparency positions blockchain as

a transformative solution to various organizational challenges (Bharadwaj et al., 2013; Tapscott and Tapscott, 2016). Research suggests that organizations actively seek tangible, functional benefits, such as streamlined supply chain processes, reduced fraud, and enhanced data integrity, which align with their broader strategic objectives (Iansiti and Lakhani, 2017; Mougayar, 2016). The functional benefits of blockchain are particularly pronounced in industries requiring secure and transparent transactions, such as finance and healthcare. As organizations perceive the tangible advantages of adopting blockchain, including cost savings and improved business processes, their adoption intentions are strongly influenced by blockchain's functionality (Andoni et al., 2019; Swan, 2015). Hence, understanding and harnessing these functional benefits emerge as pivotal factors shaping the strategic adoption decisions of organizations about blockchain technology.

3.5. Service quality and blockchain technology adoption

Service quality considerations play a significant role in organizations' decisions to adopt blockchain technology, especially in sectors where reliability, security, and efficiency are paramount. Blockchain's ability to provide high-quality and secure services is a critical factor influencing adoption intentions (Chuang et al., 2011; Khazaei, 2020). Studies indicate that organizations prioritize blockchain solutions that align with their service quality expectations, ensuring a seamless and trustworthy experience for internal and external stakeholders (Iranmanesh et al., 2023; Nazim et al., 2021).

The reliability and resilience of blockchain networks, coupled with the assurance of data integrity, contribute to enhanced service quality perceptions, thereby positively impacting adoption intentions (Makhija et al., 2018; Wang et al., 2022).

As organizations increasingly recognize the potential for blockchain to enhance service quality through secure and transparent transactions, their strategic decisions to adopt this technology are intricately tied to the assurance of superior service standards. Aligning blockchain capabilities with service quality expectations becomes a pivotal factor in navigating the complex landscape of technology adoption.

3.6. Researcher's voice

Several conflicts and synergies need to be considered while implementing blockchain technology. There can be regulatory pressures to enhance transparency and security, which may cause a competitive conflict in an organization or its policies (Halou et al., 2024; Marengo and Pagano, 2023; Yli-Huumo et al., 2016). Cost can be the second conflict factor to consider during its initial implementation (Wahab et al., 2020). It may conflict with the functional benefits and operations. In the same way, perceived risks from regulatory and security vulnerabilities may be the source of conflict inside the organization. However, it ensures reliable services and security. Moreover, competitive dynamics can drive organizations to prioritize functional benefits for a competitive edge and create conflicts regarding resource allocation in rapidly evolving environments. The organization is supposed to process all these kinds of programmatic issues to balance the conflicts and the synergies and make a better decision in adopting blockchain technology (Lin et al., 2021).

In blockchain adoption, regulatory pressures wield influence as organizations align with evolving security and transparency mandates, particularly in finance and healthcare (Lisdiono et al., 2022). Concurrently, competitive pressures drive the exploration and integration of blockchain for operational efficiency and differentiation, notably in innovation-centric sectors. Cost considerations become pivotal, with organizations carefully weighing initial investments against long-term benefits.

Perceived risks, including security vulnerabilities, are strategically navigated to embrace Blockchain (Salim et al., 2022). Functional benefits, such as enhanced efficiency and data integrity, align with strategic objectives, especially in sectors like finance and healthcare. Service quality considerations further guide organizations to perceive blockchain as a transformative tool. In navigating this intricate landscape, striking a nuanced balance between risks, costs, benefits, and regulatory demands becomes essential for widespread blockchain adoption (Daradkeh, 2018). The summary of the literature is given in **Table 1**. Additionally, **Figure 2** was generated from the literature used for the study, which also asserts the need to adopt blockchain technology for safety, security, operational efficiency, and transparency. Moreover, the public accept blockchain due to its decentralized, temper-resisted system. Moreover, it is accepted to protect sensitive information. It promotes smart contract it can optimize operations and processes.

Table 1. Summary of themes and constructs.

Themes	Key constructs
Regulatory Influences	Enhanced security and transparency
	Compliance alignment
	Trust-building
Competitive Dynamics	Operational efficiency
	Cost reduction—Differentiation
	Innovation-centric industries
	Optimization
Cost Considerations	Initial investment evaluation
	Long-term cost-effectiveness
	Infrastructure, training, and maintenance costs
Perceived Risks	Security vulnerabilities
	Regulatory uncertainties
	Strategic risk navigation
	Mitigation strategies
Functional Benefits	Improved operational efficiency
	Enhanced traceability
	Increased transparency
	Streamlined processes
	Reduced fraud

Table 1. (*Continued*).

Themes	Key constructs
Service Quality	Reliability and security
	Trustworthy experience
	Assurance of data integrity
	Seamless transactions
Strategic Decision-Making Factors	Balancing risks, costs, and benefits
	Alignment with regulatory demands
	Strategic adoption as a transformative tool

Figure 2. Word cloud from literature (Source: Author).

4. Theoretical support for the study

4.1. UTAUT (Unified theory of acceptance and use of technology)

The Unified Theory Acceptance Use Technology (UTAUT) model serves as a cornerstone in understanding technology adoption within organizations, offering a comprehensive framework to analyze user acceptance (Samartha et al., 2022). Its inclusion of critical factors such as performance expectancy, effort expectancy, and social influence provides a robust foundation for evaluating and adopting blockchain adoption (Gao and Li, 2021). Performance expectancy summarizes users' perceptions of how adopting blockchain technology improves their performance or facilitates their work tasks. Similarly, effort expectancy considers the perceived ease of use, acknowledging that users are more likely to adopt intuitive technologies that require minimal effort to operate. Additionally, the social influence factor recognizes the impact of peers and colleagues on individual adoption decisions, which is particularly pertinent in organizational settings (Kapnissis et al., 2022). However, blockchain's unique characteristics, such as decentralization and immutability, may not neatly align with traditional measures of performance expectancy. Users may need help grasping the full potential of blockchain technology in enhancing performance, especially if they need a clearer understanding of its underlying mechanisms (Wamba and Queiroz, 2019).

Moreover, UTAUT's focus on individual perceptions may overlook broader organizational dynamics and structural complexities that influence blockchain adoption (Lee and Lim, 2019). Additionally, the hierarchical structure of an

organization and existing power dynamics could significantly impact how users perceive and ultimately adopt blockchain technology.

4.2. TOE (technology, organization, and environment) framework

The Technology Organization Environment (TOE) framework offers a comprehensive lens through which organizations can assess the various factors influencing blockchain adoption (Seshadrinathan and Chandra, 2021). It enables organizations to evaluate how well blockchain aligns with existing systems and processes, considering compatibility and interoperability (Tran and Nguyen, 2021).

Furthermore, the organizational dimension of the TOE framework investigates factors such as organizational structure and culture, recognizing that successful blockchain adoption requires alignment with organizational goals and values (Hartley et al., 2022). Finally, the environmental aspect considers external pressures, such as regulatory demands and competitive dynamics, which can significantly shape the adoption landscape. It also admits that the TOE framework offers organizations a comprehensive approach to assessing blockchain adoption, allowing them to simultaneously consider technological, organizational, and environmental factors. This holistic perspective minimizes the risk of oversights or gaps in adoption strategy and empowers organizations to develop a well-rounded approach. Despite challenges posed by the rapid evolution of blockchain technology and dynamic regulatory environments, the TOE framework enables organizations to adapt effectively through continuous monitoring and adjustment. By developing a proactive stance towards adoption, the framework encourages organizations to anticipate challenges and opportunities, enhancing their readiness for integration. Moreover, the structured nature of the TOE framework streamlines decision-making processes, facilitating efficient resource allocation and providing a more precise strategic direction for blockchain adoption.

4.3. TTF (task-technology fit)

Task Technology Tit (TTF) offers a focused approach to evaluating blockchain adoption by examining its alignment with specific operational tasks within an organization. Organizations can identify areas where blockchain could bring significant value by assessing the compatibility between blockchain technology and the tasks at hand. Also, TTF could reveal how blockchain enhances the traceability of products, reducing the likelihood of fraud and errors. This practical focus allows organizations to tailor their blockchain adoption strategy to address specific operational needs, ensuring a more targeted and practical integration (Turi et al., 2023).

However, while TTF excels in evaluating specific operational tasks, it may need attention to blockchain's broader strategic implications and emerging functionalities. Blockchain's potential to disrupt existing business models and processes extends beyond individual tasks, impacting organizational structures and workflows on a larger scale. Thus, while TTF provides valuable insights into immediate task alignment, organizations must complement this perspective with a broader strategic vision to capitalize on blockchain's transformative potential fully.

4.4. ISS (information system success) models

Information system success (ISS) models provide a structured approach to evaluating blockchain's impact on information systems, focusing on system quality, information quality, and user satisfaction. By considering data accuracy, reliability, and user satisfaction, ISS models contribute to a holistic understanding of blockchain's impact on information management. This systematic evaluation facilitates evidence-based decision-making, allowing organizations to gauge the success of their blockchain implementation against well-defined criteria. However, ISS models may face challenges in capturing the full spectrum of blockchain's unique attributes. The criteria traditionally used in ISS models may need adaptation to accommodate blockchain's decentralized nature and cryptographic security features. Moreover, the subjective nature of user satisfaction, a key component in ISS models, could be influenced by factors beyond the technological aspects of blockchain, including organizational culture and change management strategies. Therefore, while valuable, ISS models require customization to ensure they effectively capture the nuances of blockchain adoption and provide a comprehensive evaluation.

4.5. TAM (technology acceptance model)

The Technology Acceptance Model (TAM) focuses on users' perceptions of technology, addressing perceived ease of use and usefulness. Its emphasis on user-centred design aligns well with the human-centric aspects of technology adoption, shedding light on individuals' attitudes toward blockchain within organizations. TAM's simplicity and user-focused approach make it a practical tool for understanding the initial adoption stages of blockchain. However, TAM may oversimplify the complexities of blockchain adoption within organizational settings. Its focus on perceived ease of use and usefulness may only partially capture blockchain's unique characteristics, such as decentralization and cryptographic security. Additionally, TAM's individual-centric approach may not fully address blockchain adoption's collaborative and networked nature, where multiple stakeholders must interact seamlessly. Therefore, while TAM provides valuable insights into individual perceptions, its application in the context of blockchain adoption should be complemented by a more comprehensive examination of the technology's distinct features and the organizational context.

4.6. Researchers' voice

In the discourse surrounding the adoption of blockchain technology, the TOE framework stands out as a comprehensive and robust model ideally suited to addressing the complexities inherent in organizational settings. Unlike TAM, which primarily focuses on individual perceptions, the TOE framework takes a holistic approach by considering technological, organizational, and environmental factors that collectively shape the adoption landscape. With its decentralized architecture and far-reaching implications, blockchain demands an evaluation beyond individual attitudes and beliefs. The strength of the TOE framework lies in its ability to account for the intricate interplay between technological innovations, existing organizational structures, and the broader environmental context. Blockchain adoption often entails

significant organizational restructuring and alignment with industry standards and regulatory frameworks. The TOE framework's emphasis on understanding organizational dynamics and environmental factors provides a comprehensive lens to navigate these complexities effectively.

Furthermore, the TOE framework's adaptability to changes ensures its relevance in a rapidly evolving technological landscape. It offers a strategic roadmap for organizations aiming to integrate blockchain into their operations seamlessly. The TOE framework is the most suitable approach for understanding and promoting successful blockchain adoption within organizational frameworks by encompassing various factors beyond individual acceptance.

Moreover, the TOE framework holds significant promise for facilitating the adoption of blockchain technology within organizational contexts. By considering the interplay between technological innovations, organizational structures, and environmental dynamics, the TOE framework provides a comprehensive framework for understanding the complexities inherent in blockchain adoption. Blockchain's decentralized architecture and transformative potential necessitate an evaluation beyond individual attitudes and beliefs, requiring organizations to navigate regulatory landscapes, industry standards, and organizational processes. The TOE framework's holistic approach enables organizations to assess and address these multifaceted factors, facilitating the seamless integration of blockchain into their operations. Moreover, the TOE framework's adaptability to changes ensures its continued relevance in guiding organizations through the evolving landscape of blockchain technology, making it a valuable tool for promoting successful adoption and implementation within organizational frameworks. Based on the literature and theoretical perspective, the study came up with the following proposed model, which can be tested in future studies as shown in **Table 2** indicates the Theory application and limitations and conceptual model are presented in **Figure 3**.

Table 2. Theories application and limitations.

Theory	Key Focus	Strengths	Limitations
UTAUT	User acceptance of technology	Considers performance and effort expectancy	We need to be more concise in understanding blockchain's complexities
		Addresses social influence	It may not fully capture technical intricacies
TOE Framework	Organizational adoption factors	A holistic view of tech, organizational, and environmental factors guide strategic decision-making	Balancing weight among framework elements
			Adapt quickly to tech evolution
TTF	Task-Technology fit	Focuses on practical application	It may need to address the transformative impact on an organization
		Tailors' adoption strategy for specific tasks	Limited applicability in rapidly evolving tech landscapes
ISS Models	Information system success	Comprehensive evaluation criteria	We may need help to accommodate blockchain's unique attributes
		A systematic approach to assess the success	Subjective nature of user satisfaction
TAM	Technology acceptance model	User-centric approach	Oversimplifies blockchain complexities
		Practical for understanding initial adoption	Limited scope for organizational dynamics

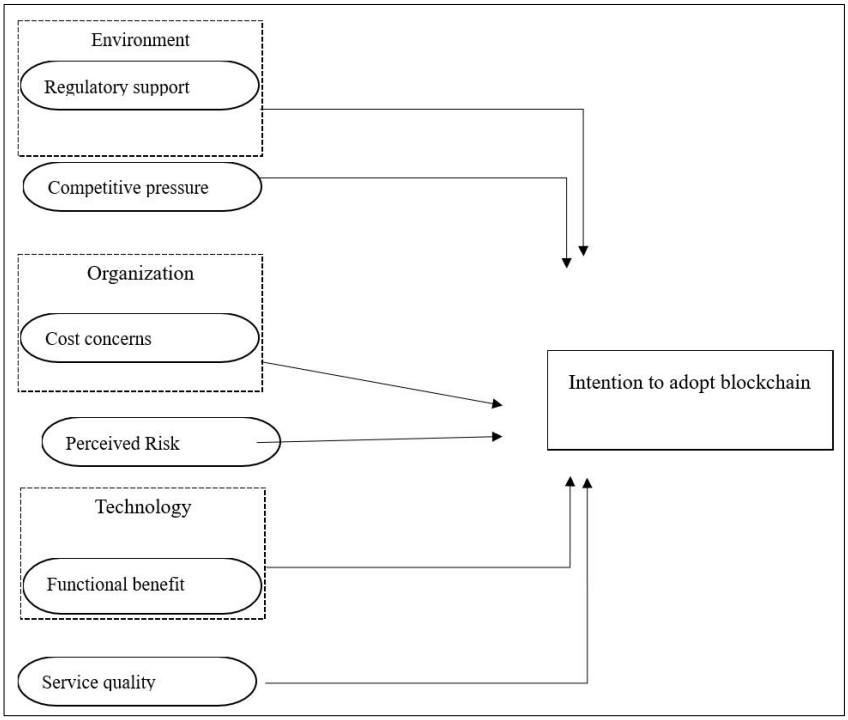

Figure 3. Proposed conceptual model.

5. Discussion

The findings of previous studies underscore the significance of various factors influencing the intention to adopt blockchain technology. Regulatory support emerges as a critical determinant, with studies by Pham and Thi Nguyet (2023) indicating a positive association between regulatory support and blockchain adoption intention, particularly within Journalism in Vietnam. Conversely, Dehghani et al. (2022) highlight how high uncertainty in regulatory environments may dampen behavioural intentions towards blockchain adoption. Including regulatory support is pivotal because it navigates the regulatory landscape and compliance requirements inherent in technological integration (Pham and Thi Nguyet, 2023).

Consequently, regulatory support is pivotal in shaping blockchain adoption intention. In addition to regulatory factors, competitive pressure emerges as a driving force behind blockchain adoption. Competitive pressures incentivize organizations to embrace technological advancements to gain a competitive edge (Faasolo and Sumarliah, 2022; Shi and Yan, 2016). Faasolo and Sumarliah (2022) emphasize the importance of competitive pressure as an antecedent to blockchain adoption, particularly in supply chain management. These pressures motivate organizations to leverage blockchain technology to enhance operational efficiency and maintain industry competitiveness. Thus, competitive pressure positively influences blockchain adoption intention. Organizational considerations, such as cost concerns, also impact the intention to adopt blockchain technology. While blockchain offers manifold benefits in terms of operational optimization and performance enhancement (Bhardwaj et al., 2019; Kumar Bhardwaj et al., 2021), concerns about the high initial costs associated with research and development, implementation, and human resources may deter adoption (Faasolo and Sumarliah, 2022; Taherdoost, 2022).

Indeed, Faasolo and Sumarliah's (2022) findings corroborate the negative effect of cost concerns on blockchain adoption intention within supply chain management. Thus, cost concerns negatively affect the intention to adopt blockchain. Moreover, perceived risks associated with blockchain adoption, including data security and confidentiality concerns, pose additional barriers to adoption (Angelis and Ribeiro da Silva, 2018; Narwane et al., 2021; Prewett et al., 2019). However, adopting blockchain hinges on the perceived balance between expected benefits and associated risks (Angelis and Ribeiro da Silva, 2018). Alaklabi and Kang (2018) further underscore the adverse influence of perceived financial, privacy, and security risks on blockchain adoption intention. Hence, we hypothesize that a higher perceived risk negatively affects blockchain adoption intention. From a technological perspective, functional benefits influence blockchain adoption intention.

The transformative potential of blockchain technology across various industries underscores its attractiveness and utility (Ruangkanjanases et al., 2023). Blockchain facilitates transparent and trustworthy transactions, enhancing authenticity and traceability in supply chains (Mukherjee et al., 2023). Furthermore, the perceived benefits of blockchain significantly influence adoption intention (Hasan et al., 2022; Knauer and Mann, 2020; Li et al., 2005). Therefore, we propose that functional benefits positively impact blockchain adoption intention. Additionally, information system quality emerges as a critical determinant of blockchain adoption intention. High-quality information systems characterized by accuracy, timeliness, and credibility foster favourable intentions toward blockchain adoption (Dehghani et al., 2022; Liu and Ye, 2021). Given the pivotal role of information quality in driving business growth and advancement (Liu and Ye, 2021), we posit a positive relationship between information system quality and blockchain adoption intention.

6. Conclusion and recommendations

Blockchain technology attracts attention from customers, investors, and industry stakeholders because of its unique features, such as transparency, security, reliability, and traceability. Despite this growing interest, the adoption of blockchain technology has been slower than expected, prompting the need for further research to understand the factors influencing its widespread use. Additionally, there remains a notable gap in the research that comprehensively examines the factors influencing the intention to use blockchain technology. This study leverages the TOE framework to address this gap, encompassing technological, organizational, and environmental factors as critical antecedents to blockchain adoption intention. These factors include functional benefit, information system quality, cost concern, perceived risk, regulatory support, and competitive pressure.

This study contributes to the existing literature by presenting a comprehensive model for predicting blockchain adoption intention guided by the TOE framework. It further proposes a set of propositions that explore the relationships between various antecedents of blockchain adoption intention. This study sheds light on the critical determinants that affect the integration of blockchain technology across industries, ultimately providing valuable insights for future empirical studies. The proposed theoretical research model, introduced in this study, serves as a valuable roadmap for

future research in this domain. Researchers can use this model to empirically test and validate the various antecedents of blockchain adoption intention, further advancing our understanding of how this transformative technology can be embraced within different sectors. Thus, this study lays the groundwork for future investigations, offering a comprehensive perspective on the factors influencing blockchain adoption and the potential implications for industry, policy, and innovation. This body of research highlights the evolving nature of blockchain adoption. It underscores the need for more comprehensive investigations into the factors that can accelerate its widespread acceptance across various industries and regions.

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Appendix

Table A1. Review matrix.

Study	DV	ID	Theory	Context	Industry/population
Lee and Lim (2019)	Intention to use blockchain	Perceived usefulness Trust Cost Facilitating conditions Perceived operational usefulness	Unified Theory of Acceptance and Use of Technology (UTAUT)	United States	University Students
Wong et al. (2019)	Intention to adopt blockchain	Relative advantage Complexity Cost Upper management support Market dynamics Competitive pressure Regulatory support	Technology, Organization and Environment (TOE) Framework	Malaysia	SMEs
Wamba and Queiroz (2019)	Blockchain technology adoption intention	Performance Expectancy Facilitating Conditions Effort Expectancy Social influence	UTAUT	Brazil	Supply Chain
Wahab et al. (2020)	The intention of blockchain adoption	Performance expectancy Effort expectancy Social influence Facilitating condition Relative advantage	UTAUT 2	Conceptual paper. Malaysia	Warehouse operations
Alazab et al. (2020)	Intention to Adopt Blockchain	Trust UTAUT variables System quality Information quality Service quality Task technology fit User satisfaction Task characteristics	UTAUT Task technology fit (TTF) Information system success (ISS) models	Australian Chamber of Commerce and Industry (ACCI)	Industries supply chain

Table A1. (*Continued*).

Study	DV	ID	Theory	Context	Industry/population
Khazaei (2020)	Intention to adopt blockchain	Perceived security Perceived trust Performance expectancy Innovativeness Social influence Effort expectancy Technology awareness	UTAUT	Malaysia	SMEs
Knauer and Mann (2020)	Blockchain technology adoption	Perceived usefulness Perceived risk Perceived ease of use Trialability Felt independence The level of principles knowledge	Technology Acceptance Model (TAM)	German	Consumers
Ghode et al. (2020)	Adoption of Blockchain	Inter-organizational trust Relational governance Data transparency Data immutability Interoperability Product Type Social influence	Grey theory	Not context-dependent	Supply chain
Lu et al. (2020)	Intentions to Adopt Blockchain	Qualitative key findings: Consumers did not express stronger intentions to use blockchain Consumers were concerned about the risk of losing private keys	Not mentioned	Not mentioned	Consumers
Caldarelli et al. (2020)	Intention to adopt blockchain	Effort expectancy Performance expectancy Social influence Facilitating conditions	UTAUT	Italy	Social media
Nazim et al. (2021)	Intention to adopt blockchain	Performance expectancy Effort expectancy Social influence Facilitating condition Relative advantage	UTAUT TOE Framework	Malaysia	Bank

Table A1. (*Continued*).

Study	DV	ID	Theory	Context	Industry/population
Lin et al. (2021)	Intention to Adopt Blockchain	Trust Attitude Subjective norm System quality Information quality Service quality	Information success model (ISS) and the Theory of Planned Behavior (TPB)	China	Food industry
Masmoudi and Gargouri (2021)	Intention to use blockchain technology	Trust Performance expectancy Effort expectancy	UTAUT2	France	Food
Ullah et al. (2021)	Blockchain technology adoption	Compatibility	TAM	Malaysia	Education
Tran and Nguyen, (2021)	Blockchain technology adoption	Performance expectancy Social influence Facilitating condition Transparency	UTAUT	Vietnam	Firms from grocery retailing, travel, finance, and banking, e-commerce, hospitality, and logistics/supply chain industries
Kabir and Islam (2021)	Intention to use blockchain technology	Social influence Trust Perceived usefulness Perceived ease of use	TAM	Bangladesh	Bank industry
Bhardwaj et al. (2021)	Blockchain technology adoption intention	Regulatory support Upper management support Relative advantage Perceived usefulness Perceived ease of use Cost Compatibility Complexity	TAM TOE Diffusion of innovation (DOI)	India	SMEs
Sciarelli et al. (2022)	Intention to adopt blockchain	Perceived usefulness Attitude	TAM	Italy	SMEs
Saurabh and Dey (2021)	Blockchain technology adoption intention	Cost Traceability Trust	Graph theory	India	Agrifood supply chains

Table A1. (*Continued*).

Study	DV	ID	Theory	Context	Industry/population
Gao and Li (2021)	Blockchain technology adoption intention	Security Privacy Trust Ease of use Usefulness Perceived enjoyment Subjective norm	TAM	China	Blockchain-based game users
Aslam et al. (2021)	Blockchain adoption	Transparency Reliability Traceability	TAM	Pakistan	Oil industry
Hartley et al. (2022)	Blockchain adoption intentions	Relative advantage Compatibility Complexity	Innovation diffusion and institutional theory	USA	Supply chain professionals in 15 organizations
Salim et al. (2022)	Intention to adopt blockchain technology	Cost Innovativeness	Theory of reasoned action (TRA)	UAE	Blockchain experts
Munim et al. (2022)	Blockchain technology adoption	Lack of expertise in technology Lack of supply chain partner collaboration Operation cost	multi-criteria decision-making (MCDM) framework	Norway	Oil and gas
Kapnissis et al. (2022)	Intention to adopt blockchain technology	Social influence Trust	UTAUT	Greek	Shipping industry
Altamimi et al. (2022)	Blockchain technology adoption	Usefulness Ease of use Attitude Convenience Facilitating condition Cost Effort expectancy Social influence	TAM	Jordan	Higher education
Wang et al. (2022)	Blockchain technology adoption	Perceived usefulness Perceived ease of use	TAM	China	Construction Industry
Esfahbodi et al. (2022)	Adoption Intention for Blockchain	Perceived usefulness Perceived ease of use Perceived enjoyment Cost Traceability	TAM	China	E-commerce

Table A1. (*Continued*).

Study	DV	ID	Theory	Context	Industry/population
Dehghani, Popova, et al. (2022)	Adoption Intention for Blockchain	Standardization Data quality Perceived interoperability Lack of technological knowledge Volatility	TOE	North America	Organizations in different sectors
Faasolo and Sumarliah (2022)	Intention to implement blockchain	Regulatory support Upper management support Relative advantage Cost Competitive pressure Complexity	TOE	China	SMEs
Nath et al. (2022)	Blockchain adoption	Compatibility Trust Top management consideration Relative advantage Regulatory support	TOE Diffusion of innovation (DOI) theory	Bangladesh	Apparel industry
Marikyan et al. (2022)	Blockchain adoption intention	Perceived threat vulnerability Response cost Response efficacy Self-efficacy	Protection Motivation Theory (PMT)	UK	Individuals
Iranmanesh et al. (2023)	Blockchain adoption intention	Transparency Alignment Adaptability Agility	Contingency theory	Malaysia	TIME
Pham and Thi Nguyet (2023)	Blockchain adoption intention	Performance expectancy Effort expectancy Facilitating condition Technology readiness Trust Technology affinity Regulatory support	UTAUT	Vietnam	Press industry
Ruangkanjanases et al. (2023)	Blockchain usage intention	Trust Satisfaction Security Social influence Functional benefit Relationship quality	Not mentioned	Indonesia	Individuals

Table A1. (*Continued*).

Study	DV	ID	Theory	Context	Industry/population
Chowdhury et al. (2023)	Blockchain technology adoption	Volatility Uncertainty Complexity Ambiguity Usefulness Ease of use Resilience	TAM	UK	Managers in organizations
Mukherjee et al. (2023)	Intentions to adopt the blockchain	Performance expectancy Effort expectancy Facilitating condition Technology readiness Trust Regulatory support Upper management support Relative advantage Attitude	TAM TPB UTAUT	India	Retail supply chain