International Journal of Information Systems and Project Management (IJISPM)
2025,13(1), e3, DOI: 10.12821/ijispm130103

RESEARCH ARTICLE

Blockchain adoption factors

Carlos Bernardino
Advance/ISEG (Lisbon School of Economics and Management), Rua do Quelhas, nº 6, 1200-781 Lisbon, Portugal, cmbernardino@phd.iseg.ulisboa.pt

Francisco Cesário
ISEG (Lisbon School of Economics and Management), Rua do Quelhas, nº 6, 1200-781 Lisbon, Portugal, cesariomail@gmail.com

Carlos J. Costa
Advance/ISEG (Lisbon School of Economics and Management), Rua do Quelhas, nº 6, 1200-781 Lisbon, Portugal, cjcosta@iseg.ulisboa.pt

Manuela Aparicio
NOVA Information Management School (NOVA IMS), Universidade Nova de Lisboa, Campus de Campolide, 1070-312, Portugal, manuela.aparicio@novaims.unl.pt

João Tiago Aparicio
INESC-ID, Instituto Superior Técnico, University of Lisbon, R. Alves Redol 9, 1000-029 Lisbon, Portugal, joao.aparicio@tecnico.ulisboa.pt

Abstract
Blockchain technology is a distributed ledger that promises transformative changes across various sectors, yet its adoption and integrations in small and medium-sized organizations remain limited. This study investigates the factors that influence the adoption of blockchain technology, emphasizing the significance of Trust and Security as key moderators. Using a questionnaire distributed to a diverse group of employees and analyzing responses through Structural Equation Modeling (SEM-PLS), we constructed a predictive model of blockchain adoption. Our analysis reveals that Performance Expectancy and Social Influence positively affect the intention to adopt blockchain, indicating that perceived effectiveness and peer support drive adoption. Trust significantly enhances this intention, underscoring the importance of confidence in the technology's reliability and security. Environmental Concerns present a barrier, suggesting sustainability perceptions can deter adoption. This study conclusively demonstrates that promoting trust, addressing environmental sustainability, and leveraging social influence are pivotal for accelerating blockchain adoption in small and medium-sized organizations.

Keywords
blockchain; blockchain adoption; technology acceptance; technology use behavior.

Received: 21 March 2024 | Accepted: 24 October 2024

1. Introduction

Blockchain is the result of numerous technological innovations that spanned several decades, integrating data, functionalities, services, and microservices (Bernardino et al., 2022). The concept for this decentralized technology first came from Nick Szabo in 1988. The idea became a reality ten years later when the Bitcoin whitepaper (Nakamoto, 2017) was published, which aimed to instigate change within a failing financial world dominated by authority. It later became clear that complex financial instruments and declining trust among institutions played key roles in the 2008 crisis (Dhillon et al., 2021a). Such issues emphasized the need for reform within our financial system, addressing these problems and considering institutional trust and transparency. In 2009, the first Bitcoin block was mined, marking the beginning of the cryptocurrency era.

In 2015, following numerous criticisms regarding Bitcoin's closed nature to modifications, which limited the dissemination of the technology, the Ethereum blockchain was born (Buterin, 2013). This new blockchain started as a hard fork of the Bitcoin blockchain and is widely recognized as a successor to the Bitcoin protocol (Dhillon et al., 2021b). It caused a paradigm shift not only in the world of finance by continuing the penetration of Decentralized Finance (DeFi) but also more broadly by bringing the technology into discussion in academia, society, and especially within organizations with the introduction of smart contracts. These contracts represented a unique innovation, adding a new level of functionality and complexity to blockchain technology by enabling the development of decentralized applications not limited to the domain of decentralized finance. They introduce a programable behavior in technology.

As distributed technological infrastructure is gaining traction, blockchain's widespread adoption is reaching several industry sectors. Insurance, logistics, supply chain, management, healthcare, energy, telecommunications, Internet of Things, and finance are examples of that (Bruneau & Matei, 2012; Clincy & Shahriar, 2019; Dhingra et al., 2024; Gan & Lau, 2024; Jena, 2022; Ni & Irannezhad, 2024; Rachad et al., 2024; Tsolakis et al., 2021; Zhang et al., 2024; Zhao et al., 2016). A trend is observed among C-suite executives, with around 33% (approximately 1000) either already harnessing or contemplating the adoption of blockchain technologies (Gan & Lau, 2024). However, despite its array of potential advantages, blockchain technology remains underexploited, particularly among individuals and smaller enterprises (Yli-Huumo et al., 2016). Energy consumption has been an important factor in blockchain adoption (Aparicio et al., 2022).

This research employs the Unified Theory of Acceptance and Use of Technology (UTAUT) to investigate a model that identifies factors influencing the adoption of blockchain technology. According to this model, the key drivers of technology adoption include performance expectancy, effort expectancy, social influence, and facilitating conditions. There has been limited application of the UTAUT theory in studying blockchain acceptance and usage. We aim to explore the components that affect blockchain technology adoption and find strategies to encourage its uptake among individuals and small businesses.

This research gathered quantitative data to enrich the literature on blockchain technology adoption and use. We surveyed to operationalize a theoretical framework aiming to contribute insights that could benefit individuals, corporations, and policymakers interested in utilizing blockchain technology.

The paper is organized as follows. Section 2 presents the Research Background. Section 3 outlines the research model and hypotheses. Section 4 describes the methodology and the empirical study, with the results provided in Section 5. Section 6 offers a discussion of the findings. Finally, Section 7 concludes the paper by summarizing the main findings and contributions to research, discussing practical implications, addressing the study's limitations, and suggesting opportunities for future research

2. Research background

A fundamental characteristic of blockchain is its decentralized nature, operating on a distributed data structure based on nodes. These nodes maintain the consistency of data decentralization through consensus mechanisms, which are essential for validating new transactions and allowing them to be added to the blockchain (Dhillon et al., 2021). Consensus processes ensure that all blocks are verified and agreed upon by most participants before being added to the data structure, known as the “Merkle Tree”. All transactions are recorded and aggregated into a dataset known as a block. Each block, once confirmed, is cryptographically linked to its predecessor, creating a chain of blocks — true to the system's name (Abreu et al., 2018). This architecture guarantees both the temporal sequencing and the traceability of every transaction (Yawalkar et al., 2023).

A central aspect of consensus lies in the fact that mining is used to achieve consensus and to prevent users from the problems of double spending, while simultaneously validating all transactions (Dhillon et al., 2021). This is vital in protecting the blockchain against criminal activities and human errors (Patrício & Ferreira, 2020). The blocks possess an immutable and unbreakable nature, ensuring that once data is recorded, it remains unchangeable and permanent, which is fundamental for the blockchain's security and trustworthiness (Prasetyo, 2018). Furthermore, using advanced cryptographic methods provides a transparent, robust, and efficient framework for recording and managing transactional data, bolstering privacy and security. Blockchain technology has the potential to make a big impact on reaching Sustainable Development Goals by supporting solutions that are more open, safe, and environmentally friendly. This affirmation is principally supported by the research efforts led by the United States and China (Bernardino et al., 2022).

The emergence of a novel blockchain version, adept at facilitating decentralized transactions and decentralized applications (DApps), poses a challenge to traditional commercial giants. The OpenSea marketplace is an example of a worldwide store where anyone can buy Non-Fungible Tokens without a central authority (Chalmers et al., 2022; White et al., 2022). In this evolving digital landscape, companies are finding themselves less reliant on centralized architectures or intermediaries for trust. This shift towards blockchain technology could revolutionize their operations by decentralizing systems, slashing transaction costs, and enhancing safety, transparency, and speed (Al-Jaroodi & Mohamed, 2019; Christidis & Devetsikiotis, 2016; Clincy & Shahriar, 2019).

A study that compares blockchain development platforms for developers, highlights some of the challenges faced by organizations that are attempting to transform the way they interact with other organizations, stating that some platforms are not suitable and revealing that the best platform depends on their needs (Clincy & Shahriar, 2019). Within the healthcare sector, India leads in research output, with IEEE Access being the foremost journal in publication volume (Dhingra et al., 2024). The attributes of blockchain, including security, traceability, transparency, and cost efficiency, have the potential to enhance supply chain transparency, bolster record-keeping, and combat the issue of drug counterfeiting (Dhingra et al., 2024; Rachad et al., 2024). The MediBlock platform reunifies the information distributed among different healthcare institutions, giving users the possibility to exercise the right of self-determination, changing from the traditional status to a more user-centered development (Bae et al., 2021). The COVID-19 pandemic has compelled insurance companies to transition from their traditional methods to digital platforms, with blockchain emerging as a pivotal technology for revolutionizing operations by enabling swift, transparent, and secure exchanges of verifiable data across all parties (Rachad et al., 2024).

A significant milestone in incorporating blockchain into industry models was enhancing food safety and authenticity through tracking premium products (Clincy & Shahriar, 2019). In 2018, the United Nations' World Wildlife Fund (WWF) initiated the "Blockchain Supply Chain Traceability Project," aimed at combating illegal, unreported, and unregulated (IUU) fishing activities within the tuna sector of the Western and Central Pacific Ocean. By employing blockchain technology, the project established a transparent and secure tracking system covering the tuna supply chain from catch to consumer, including fishing vessels, processing plants, and markets. This innovation allowed WWF and its collaborators to authenticate the origin and legality of the tuna, ensuring its sustainable capture and transportation (Tsolakis et al., 2021). In 2019, VeChain, PwC, and Walmart China introduced the Walmart China Blockchain Traceability Platform on ThorChain, aiming to establish a secure food traceability system for comprehensive logistics management. VeChain ThorChain was tested and implemented 23 product lines. Q.R. Codes are central in this use case. Each product has a unique Q.R. Code that provides detailed and live product information. By using blockchain technology, which is secure and cannot be tampered with, everyone involved in the supply chain can share their information more openly, leading to better oversight and coordination (Clincy & Shahriar, 2019; Tan et al., 2018).

A thorough analysis of 452 scholarly and industry articles pinpointed areas like taxation, how to handle crypto assets and liabilities in accounting, and specific auditing methods that could be revolutionized by adopting blockchain technology in accounting (Cong et al., 2018; Jayasuriya & Sims, 2022). Factom, Libra, and Verady are companies creating blockchain solutions tailored for the auditing sector, aiming to lighten auditors' workloads, decrease fraud, and improve current processes, alongside other advantages (Abreu et al., 2018). Emerging trends in the field include new accounting methods, real-time accounting, triple-entry accounting, and continuous auditing. Given blockchain's strengths in offering unchangeable, append-only, shared, authenticated, and consensus-based data, coupled with artificial intelligence's (AI) capacity to learn from data and identify patterns for better decision-making, it is anticipated that continuous auditing will evolve to incorporate both AI and blockchain. This integration will create a sophisticated ecosystem that enhances audit processes (Han et al., 2023). A new system for marketplace identification was designed, focusing on the automated and decentralized establishment and auditing of secure, reliable attributes. It was developed and evaluated using Ethereum, which is a public blockchain, and Hyperledger Fabric, a permissioned blockchain (Yawalkar et al., 2023).

The Theory of Planned Behavior, Theory of Reasoned Action, Diffusion of Innovations Theory, and Social Cognitive Theory are instrumental in understanding and predicting technology adoption and success (Taherdoost, 2019). Models like DeLone and McLean's, the Technology Acceptance Model (TAM), and the Unified Theory of Acceptance and Use of Technology (UTAUT) employ these theories to evaluate the proliferation and effectiveness of emerging technologies. UTAUT theory is one of the most comprehensive theories that explain and identify the main determinants of technology acceptance (Tamilmani et al., 2022). This concept emphasizes the importance of concentrating on factors related to user acceptance to increase the adoption and utilization of technology. Improving the system quality can lead to increased user satisfaction, leading to increased use, and ultimately to positive individual and organizational impacts.

Recent studies by Yli-Huumo et al. (2016) reveal that Bitcoin dominated the discussion in 80% of selected academic papers, highlighting its prominence in scholarly discourse. Remarkably, the earliest articles on this topic were not published until 2012, underscoring the novelty of the subject. Additionally, the research indicated that academic authors have produced more scientific papers than industry ones. The United States has been the primary contributor to this body of work, with Europe (notably Germany and Switzerland) and Asia also making significant contributions (Bernardino et al., 2022). The studies have placed a strong emphasis on issues such as security, privacy, protocol design, energy efficiency, waste management, usability, and transparency. Companies that fully acknowledge the capabilities blockchain of blockchain are poised to gain the most benefits from adopting the technology (Ni & Irannezhad, 2024), which also suggests that the transformative impact on business processes is more significant than the technological aspects in deciding to implement blockchain. According to certain researchers, shifting to blockchain requires extensive changes in business operations (Tan et al., 2018). An examination of scholarly articles on blockchain applications in business identified key areas of focus, including governance, integrity verification, finance, data management, privacy and security, education, health, the Internet of Things, industrial management, and process management as the main fields of deployment (Casino et al., 2019).

Our research uncovered a study that integrates the DeLone & McLean model with the technology acceptance model (Janze, 2017), and more recently, we've identified substantial research on the unified theory as it relates to the acceptance and use of blockchain technology. Significant findings include factors such as facilitating conditions, initial trust, and performance expectancy influencing bankers' intentions to adopt blockchain for financial transactions (Jena, 2022). Additionally, from the perspective of clients, it was found that information quality has the most significant positive effect on customers' intentions to utilize international payment services provided by banks that incorporate blockchain technology (Dam et al., 2020). According to most scientific studies, the primary blockchain use case is supply chain management. Studies based on the UTAUT adoption model assign facilitating conditions as the primary motivator for adopting this technology in this industry (Kabir et al., 2021).

Research (Saberi et al., 2019) identified the main obstacles to blockchain adoption across inter-organizational, intra-organizational, technical, and external dimensions. Meanwhile, a study by Sim & Kamaruddin (2023) applying the Theory of Planned Behavior (TPB) to assess the intent to adopt blockchain technology in the textile manufacturing industry in Johor revealed significant findings. There was a strong correlation between the attitude towards blockchain technology and the intention to use it. The study also identified a moderate connection between perceived behavioral control and usage intention, alongside a strong relationship between subjective norms and the intention to adopt blockchain technology. Alshurafat et al. (2022), in their study that integrates technostress elements with the technology acceptance model to investigate how technostress affects auditors' willingness to adopt blockchain technology, discovered that technostress impacts the perceived usefulness and ease of use of blockchain. They found that both perceived ease of use and perceived usefulness significantly predict auditors' attitudes towards adopting the technology, with perceived usefulness also being a crucial determinant of their behavioral intention to use blockchain technology.

Raddatz et al. (2023), employing the Health Belief Model (HBM) and analyzing responses from 304 participants, determined that factors such as the perceived severity of threats, susceptibility to these threats, awareness, and inertia play a significant role in shaping the perceived advantages of blockchain. These perceptions positively affect consumers' willingness to transition to blockchain-based applications. Despite the significant obstacle presented by consumers' comfort with traditional banking methods, raising awareness about the privacy protections offered by blockchain can encourage adoption, particularly among those with pronounced privacy concerns.

Liang et al. (2021) expanded on the fit-viability model (FVM) by exploring factors that affect managerial intentions to adopt blockchain technology, through an empirical study involving 242 managers predominantly from the medical and financial sectors. Utilizing the Fit-Viability and Task-Technology Fit models, alongside the Unified Theory of Acceptance and Use of Technology (UTAUT), they employed a Partial Least Squares (PLS) model to evaluate managers' intentions toward blockchain adoption. Their findings indicate that both functional and symbolic benefits positively influence managers' perceptions of task-technology fit. Moreover, they highlighted viability as a critical factor in the decision to implement blockchain technology. Ruangkanjanases et al. (2023) demonstrated the impact of essential factors like government regulations, social influence, perceived security, and blockchain's functional benefits on trust and satisfaction within relationship quality, which in turn affects the intention to adopt blockchain. This conclusion was drawn from analyzing data from 460 survey respondents using SmartPLS 3, highlighting the crucial role of social influence and the practical benefits of blockchain in improving relationship quality and thus fostering a stronger inclination towards blockchain adoption. Javeed and Akram (2024) conducted empirical research within China's corporate sector, examining the organizational factors that promote the use of blockchain technology to advance the circular economy. They developed a theoretical framework showing how blockchain technology supports the enhancement of circular economy practices at the corporate level. Their findings highlight the crucial roles of organizational agility, institutional factors, strategic factors, and green knowledge management in reinforcing the link between blockchain technology and the circular economy. Moreover, they provide recommendations for policymakers on enhancing the circular economy by integrating blockchain technology.

The study by Waqar et al. (2024) focused on the challenges impacting the adoption of blockchain technology in small construction projects in Malaysia and found that the main areas for improvement in applying blockchain to small-scale building projects are related to economic and planning issues. In a study assessing how technology readiness impacts the acceptance of mobile payment services in Brazil, the research focused on the interaction between common technology acceptance constructs, like perceived usefulness and ease of use, and those specific to financial services, such as trust and perceived quality. This study, drawing on Parasuraman's concept of technology readiness from 2000, demonstrated that trust, perceived usefulness, and the perceived quality of mobile payment services directly affect the acceptance of mobile payments (Caldeira et al., 2021).

3. Research model

The main point of this study is to understand the factors driving the adoption and use of blockchain technology, considering both the existing literature and the adoption theory. Based on the research background and the work of Zhang and Zhou (2020), who highlighted a gap regarding security and trust in blockchain systems ("*The related work about security and trust issues is summarized. The open issues are discussed, and future work is proposed. Because blockchains are highly distributed, some security and trust mechanisms are greatly needed.*" (Zhang & Zhou, 2020, p. 798)), we include two constructs: Security and Trust. The constructs are identified in Table 1.

Table 1. Constructs' definition

Construct	Concept	Author
Performance Expectancy	*"The degree to which an individual believes that using the system will help him or her to attain gains in job performance."*	(Venkatesh et al., 2003, p. 447)
Effort Expectancy	*"The degree of ease associated with the use of the system."*	(Venkatesh et al., 2003, p. 450)
Personal Technology Acceptance	Person's propensity to embrace and use new technologies for accomplishing goals in home life or work.	(Wong et al., 2020)
Social Influence	*"The degree to which an individual perceives that important others believe he or she should use the new system."*	(Venkatesh et al., 2003, p. 451)
Security	The level where information is protected from security threats, leakage, and infringement.	(Chang et al., 2022)
Trust Transparency	*"The belief that blockchain technology and its services are safe, error-free, and transact transparently."*	(Chang et al., 2022, p. 4)
Environmental Concern	*"Represents the attribute of a person's compassion, worries, likes, and dislikes about the environment."*	(Hsu et al., 2014, p. 670)
Behavioral Intention	Behavioral intention to adopt a technology describes the individual's subjective likelihood that he or she will use or purchase that specific technology in the future.	(Venkatesh et al., 2003)
Use Behavior	Actual use of the technology.	(Tan et al., 2018)

The following hypotheses were developed after considering the research objectives based on the UTAUT model for examining technological adoption, and the existing literature. According to Venkatesh et al. (2003), performance expectancy is "*the degree to which an individual believes that using the system will help him or her achieve gains in job performance*." This concept integrates the five preceding theories' elements: relative advantage, perceived utility, work fit, result expectations, and extrinsic motivation. Some studies highlight performance expectancy as one of the most important constructs regarding the use of technology (e.g., (Alraja, 2015; Benbasat & Barki, 2007)).

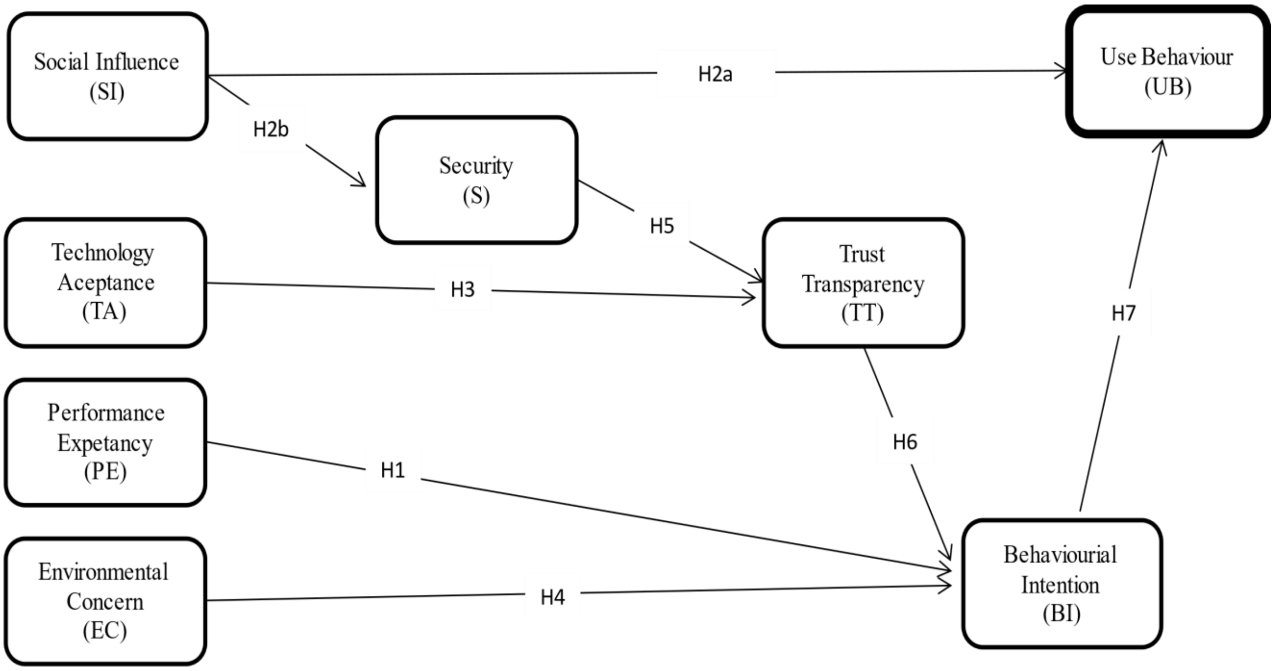

Fig. 1. Blockchain adoption research model

Based on the research by Venkatesh et al. (2003), this study posits that individuals are likely to adopt blockchain technology if they anticipate beneficial outcomes. Performance expectancy has a considerable influence on behavioral intention (Nazim et al., 2021) and plays a pivotal role in user adoption (Zhao et al., 2016). Key predictors for bankers' intention to utilize blockchain in banking transactions include facilitating conditions, performance expectancy, and initial trust, with initial trust also playing a crucial mediating role in the prediction of the intention to use blockchain (Cheng, 2020; Jena, 2022). Additionally, the transparency of blockchain trust impacts both performance and effort expectancy (Chang et al., 2022), while the relationship between perceived ease of use, behavioral intent, and actual usage is affected by the system's complexity. Consequently, performance expectancy is anticipated to positively influence behavioral intention (BI) (Fedorko et al., 2021). Based on the previous investigations, the following hypothesis is proposed:

H1: Performance Expectancy (PE) positively influences Behavioral Intention (BI).

Venkatesh et al. (2003) defined social influence as "the degree to which an individual perceives that important others believe he or she should use the new system". This concept encompasses social factors, subjective norms, and the concept of image. Despite various theories using different labels, all constructs that generate social influence share the underlying belief that an individual's actions are shaped by their perceptions of how others view them due to their technology usage. Numerous studies highlight the significance of social influence in adopting new technologies, indicating that an individual's social surroundings can be crucial in determining their willingness to use technology (Mazman et al., 2009). The influence of social factors from key groups, such as management and departmental teams, on the use of information systems was examined, revealing that managers exert the greatest influence on individuals' adoption of information systems, while the IT department has the least impact (Eckhardt et al., 2009). Furthermore, in the context of cybersecurity, the need for social influence to effect a change in security behaviors was identified (Das et al., 2014). Social catalysts such as peer interactions, demonstrations, and security presentations were found to either enhance awareness about security tools and threats, encourage better self-protection measures, or increase understanding of effective protection strategies. Particularly, having friends across various social circles who use a security feature significantly motivates the adoption (Das et al., 2015). These findings suggest that social influence can significantly enhance the adoption and security perceptions of blockchain technology.

H2a: Social influence (SI) positively influences blockchain technology's use behavior (UB).

H2b: Social influence (SI) positively influences security (S) to use blockchain technology.

Personal technology acceptance is the propensity to adopt and exploit new technology to achieve personal or professional goals (Wong et al., 2020). Technology acceptance variables have been integrated in many recent studies in various contexts that consistently demonstrated and encouraged the integration of technology readiness in models (Sebastián et al., 2022; Khazaei, 2020; Wong et al., 2020). Limited understanding and knowledge of the Internet result in diminished trust levels (Thatcher et al., 2011) is aligned with a statement that is consistent with observations that trust, perceived usefulness, and the quality of mobile payment services directly impact the acceptance of mobile payments (Caldeira et al., 2021). The moderating roles of transparency and trust are significant in how information quality and the nature of the channel influence intentions (Venkatesh et al., 2016). Moreover, an individual's attitude toward new technology shapes their view of innovations in financial services (Dimitriadis & Kyrezis, 2010), with those more familiar with technology generally placing greater trust in it (Caldeira et al., 2021). Drawing on these insights, the following hypothesis is proposed:

H3: Personal technology acceptance (TA) positively influences trust transparency (TT).

Today’s world faces unique, interconnected environmental challenges in areas including climate change, clean water, ocean health, and biodiversity (United Nations, 2024). Environmental concerns represent the attribute of a person’s compassion, worries, likes, and dislikes about the environment (Hsu et al., 2014). Stern et al. (1995) and Turaga et al. (2010) demonstrated that ecological paradigm and awareness of consequences measure generalized beliefs about the nature of human-environment interactions, called "folk ecology", as a set of beliefs that may be influenced by social structure and values, that influence attitudes, beliefs, and behavioral intentions.

In Europe, sustainable consumption behavior can be associated with environmental concern, which is influenced by increased levels of environmental knowledge and environmental risk perception, suggesting that environmental concern strongly influences behavioral intention (Aseri & Ansari, 2023; Saari et al., 2021). Rejeb & Rejeb (2020) identified and classified blockchains according to the triple bottom line framework, namely the economic, social, and environmental dimensions of sustainability. The major challenge is the feeling that the public and environmentalists have regarding bitcoin mining, a blockchain technology that they see as a major energy consumer and CO^2 emitter (Badea & Mungiu-Pupǎzan, 2021). This is aligned with the initial expectations of Environmental concern's impact on behavioral intention. At the business level, a study is being done on potential applications for this technology to improve environmental management and preservation efforts (Polas et al., 2022), even calling it a “game changer for green innovation.” Despite the emergence of environmentally friendly projects and concepts within the blockchain space, their integration remains embryonic with minimal tangible impact. Prior research supports the notion that consumers' environmental concerns positively affect their behavioral intentions to engage with such technologies (Hartmann & Apaolaza-Ibáñez, 2012). Thus, the following hypothesis is formed:

H4: Environmental concern (EC) has a negative influence on Behavioral Intention (BI).

Security is characterized as a risk that presents a situation, condition, or event capable of inflicting economic damage on data or network resources through destruction, disclosure, alteration of data, denial of service, and/or instances of fraud, waste, and abuse (Kalakota & Whinston, 1997). Is also a crucial dimension where information is protected against risks, leaks, and violations (Chang et al., 2022). It is a significant theme in blockchain technology research, with 14 out of 41 (33%) papers focusing on security issues and constraints (Yli-Huumo et al., 2016). Although blockchain technology is still in the early stages of development, it relies on experts in security and cryptography to advance it to new levels of innovation and application (Garg et al., 2021; Patrício & Ferreira, 2020). Regarding the behavioral perspective, Mishra and Dhillon

(2006) and Lebek et al. (2013) achieved the need for human-centered security strategies, emphasizing internal control assessment, security policy implementation, individual values, beliefs, and security training as consistent themes that need to be observed. To answer the question "How does blockchain technology guarantee transparency, trust, and sustainability in the context of Agenda 2030?", a study analyzed the implementation of blockchain technology - projected to provide transparency and trust, and its linkages with business sustainability (Gomez-Trujillo et al., 2021). Various studies have shown that an increased sense of security leads to increased trust (Ray et al., 2011), which can have a positive effect on purchase decisions (Prasetyo, 2018). Security is a crucial element that affects one's intention to adopt new technology or to influence one's level of trust (Lim et al., 2019). Trust was used as a moderating factor between security and behavioral intention (Suh & Han, 2003). It was characterized by the perceived quality of information, manifesting through a tripartite structure of perceived information disclosure, clarity, and accuracy. This concept of transparency stands apart from similar constructs like informational justice and is adept at forecasting the perceived trustworthiness of a source, including aspects such as competence, benevolence, and integrity (Schnackenberg et al., 2021). The secure and trust-free blockchain-based transaction can potentially change many existing trust-based transaction systems (Beck et al., 2016). Blockchain technology has a significant and positive impact on the Transaction Security System, which has a significant and positive impact on User Experience (Hsu et al., 2014). Based on this theory, the following hypothesis is formed:

H5: Security (S) has a positive influence on Trust Transparency (TT).

In this and earlier research, trust transparency was defined based on the assumption that blockchain technology and its services are secure, error-free, and transact transparently (Chang et al., 2022), and was observed in various studies (Dagher et al., 2018; Francisco & Swanson, 2018; Khazaei, 2020). From the social psychologist's perspective, trust is characterized in terms of the expectation and willingness of the trusting party to engage in a transaction (Nwaiwu et al., 2020). In the field of technology, flexibility, ease, and benefits that users see in the technology to their activities, appear to be the foundation of initial trust, highlighting that for new or less tech-savvy consumers, early trust is critical for embracing new technologies such as blockchain (Jena, 2022). This suggests that trust has a favorable and strong predictive effect across its different components, particularly transparency and user data ownership (Wong et al., 2020), that impacts behavioral intention. In other words, a lack of faith in IT may induce consumers to quit using or investigating technology due to concerns about its performance or reliability (Thatcher et al., 2011), so trust could be the most important antecedent of behavioral intentions (Roca et al., 2009). The findings align with literature reviews indicating that blockchain technology facilitates the cryptographic and transparent creation and management of contracts, transactions, and records. This transparency in trust generation plays a pivotal role in shaping behavioral intentions. The following hypothesis is developed:

H6: Trust (TT) positively influences Behavioral Intention (BI)

Behavioral Intention (BI) reflects the likelihood of an individual adopting a specific technology. This concept has been extensively explored by social scientists, focusing on the intention to engage in prospective behavior. In the foundational UTAUT model, BI is shown to positively impact actual technology use. The correlation between behavioral intention and the use of technology is reinforced by various technology adoption models integrated within the UTAUT framework. The correlation between behavioral intention and the use of technology is reinforced by various technology adoption models integrated within the UTAUT framework (Khazaei, 2020). Based on these insights, the subsequent hypothesis is proposed:

H7: Behavioral intention (BI) positively influences use behavior (UB)

4. Method

This study seeks to identify the determinants influencing the acceptance and adoption of blockchain technology. It is based on the foundational constructs of the UTAUT (Venkatesh et al., 2003), with modifications incorporating insights from additional research (Alatiqi, 2022; Hsu et al., 2014; Nwaiwu et al., 2020). A thorough literature review facilitated the development of a user acceptance model, including examining supplementary variables. We collected data using quantitative and deductive methods with an empirical focus to better comprehend reality and society's perspective (Bryman, 2016). The initial target individuals were formed by personnel of Portuguese companies that require technology for daily operations. We distributed the questionnaire using the survey platform Qualtrics. The initial questions gathered individuals' employment function, as well as their company-based operation in Portugal, and whether their company required this technology for its activity.

The questionnaire had three sections. The first section introduced the researchers, the university, the study's purpose, anonymity, and voluntariness, as well as a summary of how blockchain technology is used, this helped respondents to contextualize. The following section included demographic questions, allowing segmentation of the target audience and the comparison of various genders, ages, and occupations. The third section included the model constructs. All variables were measured with a seven-point scale ("1 – Strongly Disagree" to "7 – Strongly Agree"). The dependent variable, use behavior, was measured with three items that were adapted from the literature (Alatiqi, 2022). A sample item is "I depend on blockchain to achieve my work tasks".

The measurement items are presented in Table 2. Regarding the predictor variables, performance expectancy was measured with four items (Venkatesh et al., 2003). A sample item is "I would find blockchain technology useful in my job". Social influence was measured with four items (Venkatesh et al., 2003). An example is, "People who influence my behavior think I should use blockchain technology." The behavioral intention was measured using three items adapted from the previous study. An example is "I intend to use blockchain technology in 6 months". Personal technology acceptance was measured using three items adapted from the previous survey. A sample item is "Typically; I do not hesitate to try out new information technologies.". Trust transparency was measured with four items used in a previous study by Chang et al. (2022), "Data in blockchain technology would be handled transparently." Security was measured with four items from the previous study. An example of an item is "Using Blockchain technology would be a way to protect from external threats, such as hacking". Environmental concern was measured with four items based on a previous study by (Clincy & Shahriar, 2019). A sample item is "I find Blockchain technology to be against environment conservation".

The questionnaire was developed and distributed in both Portuguese and English language. To preserve and affirm the value and substance of the questions after translation, a native speaker of both English and Portuguese reviewed the questionnaire. We collected the participation of 198 employees from organizations that operate in Portugal, who responded voluntarily. Non-probabilistic, practical, and deliberate sampling was employed. Email was the most common distribution method, followed by LinkedIn and personal contacts. It was observed that many respondents opened the questionnaire and answered the demographic questions, but not the defined items. This likely occurred because the technology is still relatively new, and the topic is complex (Berdik et al., 2021). As a result, when the number of new responses slowed down, the general strategy shifted towards blockchain technology to increase the percentage of respondents and acquire more knowledgeable individuals. The Orbis database of private corporations was accessed, and an e-mail was sent to every company discovered to have open activity in Portugal related to the blockchain. During data collection, responses were frequently downloaded and analyzed to determine their reliability and validity.

The sample characteristics are presented in Table 3. From December 2022 to February 2023, a total of 90 valid responses were gathered. Most respondents are male (80%) and between the ages of 30 and 49 (46%). Regarding their professional experience, the majority (60%) has ten or more years of work, 20% of the sample works in the field of information technology, and the largest sample (38%) responded with a non-optional field. Finally, 42% of them are team members.

Table 2. Measurement items

Constructs		Items		Source
BI	Behavioral Intention	BI_1	I intend to use blockchain technology in 6 months	(Venkatesh et al., 2003)
		BI_2	I predict I would use blockchain technology in 6 months	
		BI_3	I plan to use blockchain technology in 3 years	
EC	Environmental Concern	EC_1	Environmental concern has a negative influence on intention to adopt blockchain	(Hsu et al., 2014)
		EC_2	I find Blockchain technology to be against environment conservation	
		EC_3	Using Blockchain technology decreases chances of achieving Sustainable Development Goals	
PE	Performance Expectancy	PE_1	I would find the use of blockchain technology useful in my job	(Venkatesh et al., 2003)
		PE_2	Using blockchain technology enables me to accomplish tasks more quickly	
		PE_3	Using blockchain technology increases my productivity	
SI	Social Influence	SI_1	People who influence my behavior think that I should use blockchain technology	(Venkatesh et al., 2003)
		SI_2	People who are important to me think that I should use blockchain technology	
		SI_3	The senior management in the organization has supported the use of blockchain technology	
		SI_4	In general, my organization has supported the use of blockchain technology	
S	Security	S_1	Using Blockchain technology would be a way to protect from external threats, such as hacking	(Chang et al., 2022)
		S_2	Using blockchain technology would be a safe defense against risks such as information leakage	
		S_3	Using blockchain technology would be a way to protect from data forgery and alteration	
		S_4	Using blockchain technology would be useful to secure personal information	
TA	Personal technology acceptance	TA_1	In general, I am not hesitant to try out new information technologies	(Wong et al., 2020)
		TA_2	I look forward to changes at work	
TT	Trust Transparency	TT_1	Blockchain technology is trustworthy	(Chang et al., 2022)
		TT_2	Blockchain technology services are trustworthy	
		TT_3	Data in blockchain technology would be saved securely	
		TT_4	Data in blockchain technology would be handled transparently	
UB	Use behavior	UB_1	I depend on blockchain to achieve my work tasks	(Tan et al., 2018)
		UB_2	I have used the Blockchain technology a lot in the past 4 weeks	
		UB_3	I create my own analyses using the Blockchain technology	

Table 3. Sample characterization

Sample (n=90)	No.	%		No.	%
Gender			Job Role		
Male	72	80%	Team Member	38	42%
Female	18	20%	Supervisor/Leader	9	10%
			Director	10	11%
Age			Manager	15	17%
<18	0	0%	Other	18	20%
18-29	23	21%			
30-49	41	46%	Years of Experience		
50+	26	29%	<2	17	19%
			3-9	18	20%
Business Unit			10+	54	60%
IT	18	20%			
Marketing	3	3%	Company depends on IT		
Finance	14	16%	Nothing	0	0%
Sales	10	11%	Slightly	8	9%
Customer Care	5	6%	Highly	45	50%
Human Resources	6	7%	Totally	37	41%
Other	34	38%			

5. Results

The structural equation modeling (SEM) with partial least squares (PLS) method is used to test the proposed model (Costa et al., 2016; Henseler et al., 2009). PLS-SEM was used to assess a non-normally distributed sample for a model with over six components to find relevant drivers and constructs (Hair et al., 2014). The measurement model was examined to evaluate the reliability and construct validity (Costa et al., 2016). A common rule of thumb is a value greater than 0.7 (Hair et al., 2014). To evaluate the constructs, indicators for reliability and validity were measured following (Henseler et al., 2009) proposed measurement model: Cronbach's alpha, Composite reliability, Average Variance Extracted (AVE), Fornell-Larcker criterion, and Heterotrait-Monotrait (HTMT). All the measurements proposed above are identified in tables 4 and 5, following (Henseler et al., 2009), and are supported by other authors (Hair et al., 2014).

To estimate the model using a PLS-SEM analysis and to ensure that the sample size would be adequate for this purpose, given that the maximum number of arrows pointing to a construct in our research model is three, this sample size is sufficient to achieve a statistical power of 80% for detecting R^2 values of at least 0.10, with a 10% probability of error (Cohen, 1992; Hair al., 2014).

Table 4. Model measurements

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
BI	0.884	0.889	0.928	0.812
EC	0.897	0.973	0.934	0.825
PE	0.945	0.949	0.964	0.900
S	0.910	0.913	0.937	0.787
SI	0.913	0.924	0.938	0.793
TA	0.768	0.793	0.895	0.810
TT	0.936	0.937	0.955	0.840
UB	0.864	0.865	0.917	0.788

Table 5. Fornell–Larcker criterion and AVE squared root, and Heterotrait-Monotrait (HTMT)

	BI	EC	PE	S	SI	TA	TT	UB	BI	EC	PE	S	SI	TA	TT	UB
BI	**0.901**															
EC	-0.322	**0.908**							**0.341**							
PE	0.584	-0.182	**0.949**						0.633	**0.209**						
S	0.517	-0.073	0.547	**0.887**					0.576	0.094	**0.591**					
SI	0.476	-0.122	0.560	0.375	**0.890**				0.518	0.128	0.590	**0.395**				
TA	0.342	-0.054	0.238	0.238	0.119	**0.815**			0.434	0.096	0.243	0.268	**0.145**			
TT	0.624	-0.135	0.534	0.820	0.397	0.374	**0.917**		0.687	0.146	0.567	0.884	0.427	**0.428**		
UB	0.576	-0.132	0.491	0.406	0.563	0.186	0.376	**0.888**	0.649	0.155	0.542	0.458	0.635	0.221	**0.418**	

To ensure that there is no multicollinearity, which threatens the model experimental design, the variance inflation factor (V.I.F.) was examined for all constructs before the structural model evaluation (Costa et al., 2016). After validating exterior model estimates, bootstrapping assessed structural model quality. Bootstrapping uses the sample as a population representation to evaluate the sampling distribution's shape, spread, and bias. The structural model's route significance was determined using 5000 subsamples. The validity of the structural model ensured the structural paths were assessed to measure the research hypotheses. Looking at Fig. 2, we observe that all hypotheses were supported. SI ($\beta = 0.375$, $p < 0.001$) explains S variation by 14.1%. S ($\beta = 0.774$, $p < 0.001$) and T.A. ($\beta = 0.171$, $p = 0.05$) explain 69.9% of TT variation. TT ($\beta = 0.425$, $p < 0.001$), PE ($\beta = 0.319$, $p < 0.05$), and EC ($\beta = -0.207$, $p < 0.05$) explain 51.8% of BI variation. 44.0% of UB variation is explained by BI ($\beta = 0.398$, $p < 0.001$) and SI ($\beta = 0.374$, $p < 0.001$). All paths are statistically significant, at $p < 0.05$** or $p < 0.001$***, and all hypotheses are supported (Hair et al., 2014).

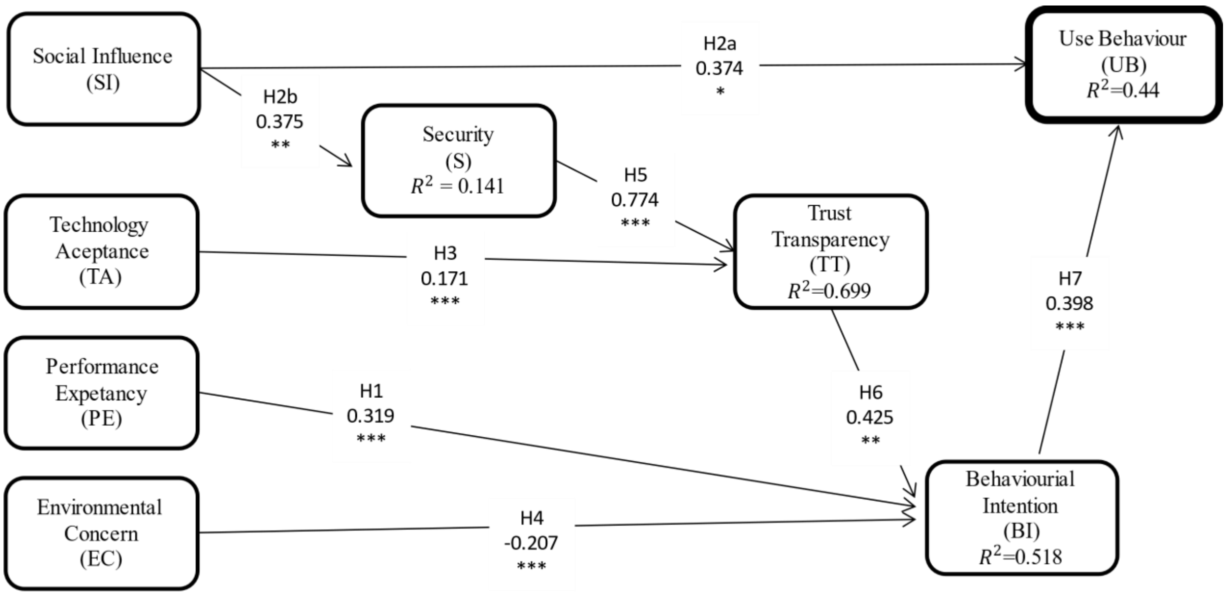

Fig. 2. Structural Blockchain adoption model results
Path *significant at p < 0.05; ** significant at p < 0.010; *** significant at p < 0.001.

As observed in Table 6, the presented model supports all trajectories with at least a moderate predictive impact. Checking the threshold values from previous studies (Chang et al., 2022; Alshurafat et al., 2023), we observe that hypotheses H3 and H4 have a moderate predictive impact, whereas hypotheses H1, H2, H5, H6, and H7 have a large effect.

Table 6. Hypothesis test

Hypothesis	Independent Variable		Dependent Variable	Standard deviation	β̂	T Value	P Value
H1	PE	->	BI	0.08	0.319	4.997	0.000
H2a	SI	->	UB	0.083	0.374	2.267	0.023
H2b	SI	->	S	0.1	0.375	3.409	0.001
H3	TA	->	TT	0.066	0.171	11.745	0.000
H4	EC	->	BI	0.091	-0.207	3.751	0.000
H5	S	->	TT	0.066	0.774	4.477	0.000
H6	TT	->	BI	0.095	0.425	2.574	0.006
H7	BI	->	UB	0.08	0.398	4.456	0.000

6. Discussion

The research aims to demystify the dynamics behind employees' attitudes toward blockchain adoption by integrating the UTAUT model with additional variables that are particularly relevant to the blockchain context as Trust Transparency (TT), Security (S), Environmental Concern (EC), and Personal Technology Acceptance (TA).

We hypothesized that Performance Expectancy (PE) would positively influence Behavioral Intention (BI) to use blockchain technology H1. Our findings, showing PE ($\beta = 0.319$, $p < 0.001$), support this hypothesis and align with Venkatesh et al.'s UTAUT model (Venkatesh et al., 2003), also corroborating with several studies that underscore the importance of PE in technology adoption (Alraja, 2015; Benbasat & Barki, 2007). The positive correlation between PE and BI is consistent with the literature, emphasizing that individuals' belief in the job performance benefits of a system is a compelling factor in their decision to adopt it (Zhao et al., 2016).

SI significantly impacts UB and S, with ($\beta = 0.374$, $p < 0.05$) and ($\beta = 0.375$, $p < 0.01$), respectively, affirming H2a and H2b. This echoes Venkatesh et al.'s (2003) assertion on the pivotal role of social networks in shaping technology usage and security perceptions, highlighting the integral role of subjective norms and social dynamics within organizational and personal spheres in technology adoption (Eckhardt et al., 2009; Mazman et al., 2009). The relation between SI and S is particularly interesting, accounting for 14.1% of S variance, suggesting that the normative pressure and social dynamics within an organization can contribute to a secure technology environment, a notion also found in cybersecurity behavior change literature (Das et al., 2014; Das et al., 2015). These findings highlight the dual role of social factors in not only boosting blockchain adoption but also in enhancing its security posture, suggesting the need to leverage positive social endorsements, and understanding organizational dynamics for effective blockchain implementation.

The relationship between TA and TT is confirmed with ($\beta = 0.171$, $p < 0.001$), supporting H3. This finding is in line with studies that integrate technology acceptance variables and technology readiness, suggesting that an individual's predisposition to adopt new technologies for personal or professional goals can positively influence their trust in the system, especially in the context of emerging technologies (García et al., 2022; Khazaei, 2020; Wong et al., 2020). By highlighting the positive correlation between TA and TT, our study contributes to the understanding of how personal inclination towards technology can shape perceptions of trustworthiness in blockchain technology, suggesting that fostering technological openness is key to enhancing trust and transparency in blockchain implementations.

Environmental Concern (EC) revealed a negative influence on BI, evidenced by ($\beta = -0.207$, $p < 0.001$), thus confirming H4. This finding aligns with the existing debate on blockchain's environmental implications, specifically its substantial energy consumption, as highlighted in some studies (Badea & Mungiu-Pupăzan, 2021; Rejeb & Rejeb, 2020). The results emphasize the critical need for environmentally sustainable blockchain innovations, suggesting that the technology's adoption is heavily influenced by ecological considerations. This insight encourages a shift towards the development of blockchain solutions that not only advance technological frontiers but also prioritize environmental stewardship, echoing the urgent call for sustainable practices within the blockchain domain.

Security (S) arises as a strong predictor of TT, with ($\beta = 0.774$, $p < 0.001$), validating H5. This relationship underscores the fundamental link between security measures and the development of trust in blockchain technologies. The strong correlation between S and TT suggests that perceptions of security significantly influence the perceived transparency and integrity of blockchain systems. Consistent with existing literature (Hsu et al., 2014; Lim et al., 2019; Ray et al., 2011), our study highlights the importance of security in promoting trust among users, indicating that enhanced security protocols contribute to a more transparent and trustworthy blockchain environment. This insight is critical for blockchain development, emphasizing that advancing security features is not just about protecting data but also about enhancing the system's transparency, which in turn, reinforces user trust and experience.

Our study reveals TT as the primary influencer of BI towards blockchain, indicated by ($\beta = 0.425$, $p < 0.001$), aligning with H6 and reflecting insights from prior research (Chang et al., 2022; Dagher et al., 2018; Francisco & Swanson, 2018; Khazaei, 2020). This highlights the importance of trust, cultivated through both the security and clarity of blockchain operations, for potential adopters. Trust is a crucial gatekeeper for technology acceptance, highlighting the imperative for blockchain infrastructures to be transparent and secure. Further exploration shows that TT is significantly shaped by S and TA, with ($\beta = 0.774$, $p < 0.001$) and ($\beta = 0.171$, $p < 0.001$), respectively. These factors together explain 69.9% of the variance in TT, showcasing a complex interaction where the perceived security of the technology and an individual's readiness to engage with innovations profoundly influence trust. This relationship between security, personal technology acceptance, and trust transparency, informed by studies on trust's foundational role in technology adoption (Roca et al., 2009; Jena, 2022; Thatcher et al., 2011; Wong et al., 2020), reinforces the critical need for secure, user-friendly blockchain systems that align with user expectations and readiness, thereby supporting adoption intentions.

We also confirm that BI significantly influences UB, supported by ($\beta = 0.398$, $p < 0.001$), following hypothesis H7. This affirms the UTAUT model's assertion (Venkatesh et al., 2003), regarding the direct positive impact of BI on technology usage. The analysis demonstrates that BI, alongside SI, accounts for 44% of the variance in UB, with BI being the stronger predictor. This relationship is grounded in the broader framework of technology adoption theories within the UTAUT model (Khazaei, 2020), where the intention to use technology is a critical precursor to actual usage. The study further elucidates the dynamics influencing BI, identifying TT, PE, and EC as key factors. TT and PE positively contribute to BI, while EC shows a negative correlation, together explaining 51.8% of BI's variation. This interaction highlights the importance of trust and performance expectancy in developing an intention to adopt technology while also acknowledging the potential restriction effect of environmental concerns.

These findings, aligning with previous research (Caldeira et al., 2021; Mazman et al., 2009; Wong et al., 2020), highlight the complexity of technology adoption processes. They emphasize that an individual's intention to use technology, and ultimately their actual use behavior, is shaped by a convergence of factors, including the perceived benefits of the technology, trust in its security and transparency, and considerations of its environmental impact.

7. Conclusion

This study, supported by a literature review and an empirical investigation, constructed a predictive model to explain the factors influencing blockchain adoption, integrating technological, social, environmental, trust, security, and performance expectancy variables. Findings show that Behavioral Intention (BI) to adopt blockchain technology is significantly influenced by Social Influence (SI), Performance Expectancy (PE), Environmental Concern (EC), Security (S), and Trust Transparency (TT). The analysis integrates essential aspects such as technology, society, the environment, trust, and security, identifying Trust Transparency (TT) as a critical determinant, heavily influenced by security perceptions. Findings also show a complex interaction among these factors, offering a detailed outline for understanding the dynamics of blockchain adoption and providing insights for its practical and effective application.

The theoretical implications of this work extend the blockchain domain's knowledge base, dissecting the multifaceted drivers of its adoption. By highlighting the vital importance of trust and security within the theoretical discourse on technology acceptance, our study significantly contributes to the conceptual expansion of models like UTAUT in the context of blockchain. It lays the foundational groundwork for future theoretical explorations into the unique attributes of blockchain technology and their alignment with established and emerging technology adoption theories.

The practical implications of this work present a strategic guide for organizations and policymakers by pinpointing essential adoption factors. It underscores addressing key issues, trust, security, and environmental sustainability to foster an environment conducive to the widespread acceptance and utilization of blockchain technology. This research thus acts as a navigational tool for entities aiming to implement blockchain, highlighting the pathways toward successful integration and the enhancement of user trust and system sustainability.

This study's insights are limited because the empirical data was collected solely from respondents in Portugal, which may reduce generalizability to other regions due to cultural, economic, and regulatory differences. The sample's characteristics and industry focus might not fully capture the broader dynamics of blockchain adoption. Additionally, the evolving nature of blockchain technology and regulations could impact the long-term relevance of some findings.

Future research should expand the geographical scope of data collection to include diverse regions and countries, allowing for the examination of cultural, economic, and regulatory influences on blockchain adoption. Cross-industry comparisons should also be explored to account for sector-specific variations in adoption dynamics. Additionally, future studies should explore organizational factors influencing blockchain adoption, distinguishing between individual and systemic influences. Investigating blockchain's specific use cases across various sectors could expose distinct motivations driving adoption, providing deeper insights into its applicability and effectiveness. Moreover, assessing the broader ecosystem, including regulatory frameworks and the availability of blockchain expertise, is crucial for a comprehensive understanding of the adoption landscape.

References

Abreu, P. W., Aparicio, M., & Costa, C. J. (2018). Blockchain technology in the auditing environment. In 2018 13th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1–6). IEEE. https://doi.org/10.23919/CISTI.2018.8399460

Alatiqi, A. (2022). Antecedents of business intelligence system use: A study investigating Kuwait's telecom and banking industries (Doctoral dissertation). Brunel University London. http://bura.brunel.ac.uk/handle/2438/24556

Al-Jaroodi, J., & Mohamed, N. (2019). Blockchain in industries: A survey. IEEE Access, 7, 36500–36515. https://doi.org/10.1109/ACCESS.2019.2903554

ALraja, M. N. (2015). User acceptance of information technology: A field study of an e-mail system adoption from the individual students' perspective. Mediterranean Journal of Social Sciences, 6(6S1), 19.

Alshurafat, H., Al-Mawali, H., & Al Shbail, M. O. (2023). The influence of technostress on the intention to use blockchain technology: The perspectives of Jordanian auditors. Development and Learning in Organizations, 37(3), 24–27. https://doi.org/10.1108/DLO-06-2022-0103

Aparicio, J. T., Romao, M., & Costa, C. J. (2022). Predicting Bitcoin prices: The effect of interest rate, search on the internet, and energy prices. 2022 17th Iberian Conference on Information Systems and Technologies (CISTI), 1–5. https://doi.org/10.23919/CISTI54924.2022.9820085

Aseri, M., & Ansari, Z. A. (2023). Purchase behaviour of green footwear in Saudi Arabia using theory of planned behaviour. Sustainability, 15(6), Article 6. https://doi.org/10.3390/su15065045

Badea, L., & Mungiu-Pupăzan, M. C. (2021). The economic and environmental impact of Bitcoin. IEEE Access, 9,48091–48104. https://doi.org/10.1109/ACCESS.2021.3068636

Bae, Y.-S., Park, Y., Kim, T., Ko, T., Kim, M.-S., Lee, E., Kim, H.-C., & Yoon, H.-J. (2021). Development and pilot-test of blockchain-based MyHealthData platform. Applied Sciences, 11(17), Article 17. https://doi.org/10.3390/app11178209

Beck, R., Stenum Czepluch, J., Lollike, N., & Malone, S. (2016). Blockchain – The gateway to trust-free cryptographic transactions: 24th European Conference on Information Systems. Proceedings of the Twenty-Fourth European Conference on Information Systems (ECIS), İstanbul, Turkey, 1–14.

Benbasat, I., & Barki, H. (2007). Quo vadis TAM? Journal of the Association for Information Systems, 8(4), 211–218. https://doi.org/10.17705/1jais.00122

Berdik, D., Otoum, S., Schmidt, N., Porter, D., & Jararweh, Y. (2021). A survey on blockchain for information systems management and security. Information Processing & Management, 58(1), 102397. https://doi.org/10.1016/j.ipm.2020.102397

Bernardino, C., Costa, C. J., & Aparício, M. (2022). Digital evolution: Blockchain field research. 2022 17th Iberian Conference on Information Systems and Technologies (CISTI), 1–6. https://doi.org/10.23919/CISTI54924.2022.9820035

Bruneau, T. C., & Matei, F. C. (2012). The Routledge handbook of civil-military relations. Routledge.

Bryman, A. (2016). Social research methods (5th ed.). Oxford University Press.

Buterin, V. (2013). Ethereum white paper. GitHub. https://github.com/ethereum/wiki/wiki/White-Paper

Caldeira, T. A., Ferreira, J. B., Freitas, A., & Falcão, R. P. de Q. (2021). Adoption of mobile payments in Brazil: Technology readiness, trust, and perceived quality. BBR. Brazilian Business Review, 18, 415–432. https://doi.org/10.15728/bbr.2021.18.4.4

Carlos Roca, J., José García, J., & José de la Vega, J. (2009). The importance of perceived trust, security, and privacy in online trading systems. Information Management & Computer Security, 17(2), 96–113. https://doi.org/10.1108/09685220910963983

Casino, F., Dasaklis, T. K., & Patsakis, C. (2019). A systematic literature review of blockchain-based applications: Current status, classification, and open issues. Telematics and Informatics, 36, 55–81. https://doi.org/10.1016/j.tele.2018.11.006

Chalmers, D., Fisch, C., Matthews, R., Quinn, W., & Recker, J. (2022). Beyond the bubble: Will NFTs and digital proof of ownership empower creative industry entrepreneurs? Journal of Business Venturing Insights, 17, e00309. https://doi.org/10.1016/j.jbvi.2022.e00309

Chang, M., Walimuni, A. C., Kim, M., & Lim, H. (2022). Acceptance of tourism blockchain based on UTAUT and connectivism theory. Technology in Society, 71, 102027. https://doi.org/10.1016/j.techsoc.2022.102027

Cheng, R. (2020). UTAUT implementation of cryptocurrency-based Islamic financing instrument. International Journal of Academic Research in Business and Social Sciences, 10, 2222–6990. https://doi.org/10.6007/IJARBSS/v10-i9/7880

Christidis, K., & Devetsikiotis, M. (2016). Blockchains and smart contracts for the Internet of Things. IEEE Access, 4, 2292–2303. https://doi.org/10.1109/ACCESS.2016.2566339

Clincy, V., & Shahriar, H. (2019). Blockchain development platform comparison. In 2019 IEEE 43rd Annual Computer Software and Applications Conference (COMPSAC (pp. 922–923). IEEE. https://doi.org/10.1109/COMPSAC.2019.00142

Cohen, J. (1992). Statistical power analysis. Current Directions in Psychological Science, 1(3), 98–101.

Cong, Y., Du, H., & Vasarhelyi, M. A. (2018). Technological disruption in accounting and auditing. Journal of Emerging Technologies in Accounting, 15(2), 1–10. https://doi.org/10.2308/jeta-10640

Costa, C. J., Ferreira, E., Bento, F., & Aparicio, M. (2016). Enterprise resource planning adoption and satisfaction determinants. Computers in Human Behavior, 63, 659–671. https://doi.org/10.1016/j.chb.2016.05.090

Dagher, G. G., Mohler, J., Milojkovic, M., & Marella, P. B. (2018). Ancile: Privacy-preserving framework for access control and interoperability of electronic health records using blockchain technology. Sustainable Cities and Society, 39, 283–297. https://doi.org/10.1016/j.scs.2018.02.014

Dam, H., Phan, D., Vu, D., & Nguyen, L. (2020). The determinants of customer’s intention to use international payment services by applying blockchain. Uncertain Supply Chain Management, 8(3), 439–456.

Das, S., Kim, T. H.-J., Dabbish, L. A., & Hong, J. I. (2014). The effect of social influence on security sensitivity. In Proceedings of the 10th USENIX Conference on Usable Privacy and Security (SOUPS), 143–157. https://www.usenix.org/conference/soups2014/proceedings/presentation/das

Das, S., Kramer, A. D. I., Dabbish, L. A., & Hong, J. I. (2015). The role of social influence in security feature adoption. Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing, 1416–1426. https://doi.org/10.1145/2675133.2675225

Dhillon, V., Metcalf, D., & Hooper, M. (2021a). Behold the dreamers. In V. Dhillon, D. Metcalf, & M. Hooper (Eds.), Blockchain enabled applications: Understand the blockchain ecosystem and how to make it work for you (pp. 1–8). Apress. https://doi.org/10.1007/978-1-4842-6534-5_1

Dhillon, V., Metcalf, D., & Hooper, M. (2021b). Unpacking Ethereum. In V. Dhillon, D. Metcalf, & M. Hooper (Eds.), Blockchain enabled applications: Understand the blockchain ecosystem and how to make it work for you (pp. 37–72). Apress. https://doi.org/10.1007/978-1-4842-6534-5_4

Dhingra, S., Raut, R., Naik, K., & Muduli, K. (2024). Blockchain technology applications in healthcare supply chains – A review. IEEE Access, 12, 11230–11257. https://doi.org/10.1109/ACCESS.2023.3348813

Dimitriadis, S., & Kyrezis, N. (2010). Linking trust to use intention for technology-enabled bank channels: The role of trusting intentions. Psychology & Marketing, 27(8), 799–820. https://doi.org/10.1002/mar.20358

Eckhardt, A., Laumer, S., & Weitzel, T. (2009). Who influences whom? Analyzing workplace referents' social influence on IT adoption and non-adoption. Journal of Information Technology, 24(1), 11–24. https://doi.org/10.1057/jit.2008.31

Hair Jr, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. European Business Review, 26(2), 106–121. https://doi.org/10.1108/EBR-10-2013-0128

Fedorko, I., Bačik, R., & Gavurova, B. (2021). Effort expectancy and social influence factors as main determinants of performance expectancy using electronic banking. Banks and Bank Systems, 16(2), 27–37. https://doi.org/10.21511/bbs.16(2).2021.03

Francisco, K., & Swanson, D. (2018). The supply chain has no clothes: Technology adoption of blockchain for supply chain transparency. Logistics, 2(1), Article 1. https://doi.org/10.3390/logistics2010002

Gan, Q., & Lau, R. Y. K. (2024). Trust in a 'trust-free' system: Blockchain acceptance in the banking and finance sector. Technological Forecasting and Social Change, 199, 123050. https://doi.org/10.1016/j.techfore.2023.123050

García de Blanes Sebastián, M., Sarmiento Guede, J. R., & Antonovica, A. (2022). Application and extension of the UTAUT2 model for determining behavioral intention factors in use of the artificial intelligence virtual assistants. Frontiers in Psychology, 13 https://www.frontiersin.org/articles/10.3389/fpsyg.2022.993935

Garg, R., Bhatia, R., Chhikara, R., & Kataria, A. (2021). Sensory marketing – A review and research agenda. Academy of Marketing Studies Journal, 25.

Gomez-Trujillo, A. M., Velez-Ocampo, J., & Gonzalez-Perez, M. A. (2021). Trust, transparency, and technology: Blockchain and its relevance in the context of the 2030 agenda. In S. H. Park, M. A. Gonzalez-Perez, & D. E. Floriani (Eds.), The Palgrave Handbook of Corporate Sustainability in the Digital Era (pp. 561–580). Springer International Publishing. https://doi.org/10.1007/978-3-030-42412-1_28

Han, H., Shiwakoti, R. K., Jarvis, R., Mordi, C., & Botchie, D. (2023). Accounting and auditing with blockchain technology and artificial intelligence: A literature review. International Journal of Accounting Information Systems, 48,100598. https://doi.org/10.1016/j.accinf.2022.100598

Hartmann, P., & Apaolaza-Ibáñez, V. (2012). Consumer attitude and purchase intention toward green energy brands: The roles of psychological benefits and environmental concern. Journal of Business Research, 65(9), 1254–1263. https://doi.org/10.1016/j.jbusres.2011.11.001

Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. In R. R. Sinkovics & P. N. Ghauri (Eds.), New challenges to international marketing (Vol. 20, pp. 277–319). Emerald Group Publishing Limited. https://doi.org/10.1108/S1474-7979(2009)0000020014

Hsu, C. Y., Chen, M., Chang, K. W., & Hsieh, A. Y. (2014). Adopting the extension of UTAUT model to investigate the determinants of e-book adoption. International Conference on Information Science, Electronics and Electrical Engineering.

Janze, C. (2017). Towards a decentralized information systems success model. CAPSI 2017 Proceedings. https://aisel.aisnet.org/capsi2017/5

Javeed, S. A., & Akram, U. (2024). The factors behind blockchain technology that boost the circular economy: An organizational perspective. Technological Forecasting and Social Change, 200, 123194. https://doi.org/10.1016/j.techfore.2023.123194

Jayasuriya, D. D., & Sims, A. (2022). From the abacus to enterprise resource planning: Is blockchain the next big accounting tool? Accounting, Auditing & Accountability Journal, 36(1), 24–62. https://doi.org/10.1108/AAAJ-08-2020-4718

Jena, R. K. (2022). Examining the factors affecting the adoption of blockchain technology in the banking sector: An extended UTAUT model. International Journal of Financial Studies, 10(4), Article 4. https://doi.org/10.3390/ijfs10040090

Kabir, M. R., Islam, M. A., Marniati, & Herawati. (2021). Application of blockchain for supply chain financing: Explaining the drivers using SEM. Journal of Open Innovation: Technology, Market, and Complexity, 7(3), Article 3. https://doi.org/10.3390/joitmc7030167

Kalakota, R., & Whinston, A. B. (1997). Electronic commerce: A manager's guide. Addison-Wesley Professional.

Khazaei, H. (2020). Integrating cognitive antecedents to UTAUT model to explain adoption of blockchain technology among Malaysian SMEs. JOIV: International Journal on Informatics Visualization, 4(2), 85–90. https://doi.org/10.30630/joiv.4.2.362

Lebek, B., Uffen, J., Breitner, M. H., Neumann, M., & Hohler, B. (2013). Employees' information security awareness and behavior: A literature review. 2013 46th Hawaii International Conference on System Sciences, 2978–2987. https://doi.org/10.1109/HICSS.2013.192

Liang, T.-P., Kohli, R., Huang, H.-C., & Li, Z.-L. (2021). What drives the adoption of blockchain technology? A fit-viability perspective. Journal of Management Information Systems, 38(2), 314–337. https://doi.org/10.1080/07421222.2021.1912915

Lim, S. H., Kim, D. J., Hur, Y., & Park, K. (2019). An empirical study of the impacts of perceived security and knowledge on continuous intention to use mobile fintech payment services. International Journal of Human–Computer Interaction, 35(10), 886–898. https://doi.org/10.1080/10447318.2018.1507132

Mazman, S. G., Usluel, Y. K., & Çevik, V. (2009). Social influence in the adoption process and usage of innovation: Gender differences. Procedia Social and Behavioral Sciences, 1(1), 279–283.

Mishra, S., & Dhillon, G. (2006). Information systems security governance research: A behavioral perspective. 1st Annual Symposium on Information Assurance, Academic Track of 9th Annual NYS Cyber Security Conference.

Nakamoto, S. (2017). Bitcoin: A peer-to-peer electronic cash system. 2017 Blockchain Technology and Digital Currency National Institute, A-1.

Nazim, N. F., Razis, N. M., & Hatta, M. F. M. (2021). Behavioural intention to adopt blockchain technology among bankers in Islamic financial system: Perspectives in Malaysia. Revista Românâ de Informaticâ Ş Automaticą 31(1), 11–28. https://doi.org/10.33436/v31i1y202101

Ni, L., & Irannezhad, E. (2024). Performance analysis of LogisticChain: A blockchain platform for maritime logistics. Computers in Industry, 154, 104038. https://doi.org/10.1016/j.compind.2023.104038

Nwaiwu, F., Kwarteng, M., Jibril, A., Burita, L., & Pilik, M. (2020). Impact of security and trust as factors that influence the adoption and use of digital technologies that generate, collect and transmit user data. Proceedings of the 15th International Conference on Cyber Warfare and Security (ICCWS 2020).

Patrício, L. D., & Ferreira, J. J. (2020). Blockchain security research: Theorizing through bibliographic-coupling analysis. Journal of Advances in Management Research, 18(1), 1–35. https://doi.org/10.1108/JAMR-04-2020-0051

Polas, M. R. H., Kabir, A. I., Sohel-Uz-Zaman, A. S. M., Karim, R., & Tabash, M. I. (2022). Blockchain technology as a game changer for green innovation: Green entrepreneurship as a roadmap to green economic sustainability in Peru. Journal of Open Innovation: Technology, Market, and Complexity, 8(2), 62. https://doi.org/10.3390/joitmc8020062

Prasetyo, K. A. (2018). The influence of trust, security, and service quality toward purchase decision at Lazada. Journal of Research in Management, 1(2), 18–22.

Rachad, A., Gaiz, L., Bouragba, K., & Ouzzif, M. (2024). A smart contract architecture framework for insurance industry using blockchain and business process management technology. IEEE Engineering Management Review, 1–8. https://doi.org/10.1109/EMR.2023.3348431

Raddatz, N., Coyne, J., Menard, P., & Crossler, R. E. (2023). Becoming a blockchain user: Understanding consumers' benefits realisation to use blockchain-based applications. European Journal of Information Systems, 32(2), 287–314. https://doi.org/10.1080/0960085X.2021.1944823

Ray, S., Ow, T., & Kim, S. S. (2011). Security assurance: How online service providers can influence security control perceptions and gain trust. Decision Sciences, 42(2), 391–412. https://doi.org/10.1111/j.1540-5915.2011.00316.x

Rejeb, A., & Rejeb, K. (2020). Blockchain and supply chain sustainability. LogForum, 16(3). https://doi.org/10.17270/J.LOG.2020.467

Ruangkanjanases, A., Qhal, E., Alfawaz, K., & Hariguna, T. (2023). Examining the antecedents of blockchain usage intention: An integrated research framework. Sustainability, 15, 3500. https://doi.org/10.3390/su15043500

Saari, U. A., Damberg, S., Frömbling, L., & Ringle, C. M. (2021). Sustainable consumption behavior of Europeans: The influence of environmental knowledge and risk perception on environmental concern and behavioral intention. Ecological Economics, 189, 107155. https://doi.org/10.1016/j.ecolecon.2021.107155

Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain technology and its relationships to sustainable supply chain management. International Journal of Production Research, 57(7), 2117–2135. https://doi.org/10.1080/00207543.2018.1533261

Schnackenberg, A. K., Tomlinson, E., & Coen, C. (2021). The dimensional structure of transparency: A construct validation of transparency as disclosure, clarity, and accuracy in organizations. Human Relations, 74(10), 1628–1660. https://doi.org/10.1177/0018726720933317

Sim, H. L., & Kamaruddin, K. (2023). Factors influencing intention to use blockchain technology among textile manufacturing sectors in Johor. Research in Management of Technology and Business, 4(1), Article 1.

Stern, P. C., Dietz, T., & Guagnano, G. A. (1995). The new ecological paradigm in social-psychological context. Environment and Behavior, 27(6), 723–743. https://doi.org/10.1177/0013916595276001

Suh, B., & Han, I. (2003). The impact of customer trust and perception of security control on the acceptance of electronic commerce. International Journal of Electronic Commerce, 7(3), 135–161.

Taherdoost, H. (2019). Importance of technology acceptance assessment for successful implementation and development of new technologies. Global Journal of Engineering Sciences, 1(3).

Tamilmani, K., Rana, N. P., Nunkoo, R., Raghavan, V., & Dwivedi, Y. K. (2022). Indian travellers' adoption of Airbnb platform. Information Systems Frontiers, 1–20.

Tan, A. W. K., Zhao, Y., & Halliday, T. (2018). A blockchain model for less container load operations in China. International Journal of Information Systems and Supply Chain Management (IJISSCM), 11(2), 39–53. https://doi.org/10.4018/IJISSCM.2018040103

Thatcher, J. B., McKnight, D. H., Baker, E. W., Arsal, R. E., & Roberts, N. H. (2011). The role of trust in postadoption IT exploration: An empirical examination of knowledge management systems. IEEE Transactions on Engineering Management, 58(1), 56–70. https://doi.org/10.1109/TEM.2009.2028320

Tsolakis, N., Niedenzu, D., Simonetto, M., Dora, M., & Kumar, M. (2021). Supply network design to address United Nations sustainable development goals: A case study of blockchain implementation in Thai fish industry. Journal of Business Research, 131, 495–519. https://doi.org/10.1016/j.jbusres.2020.08.003

Turaga, R. M. R., Howarth, R. B., & Borsuk, M. E. (2010). Pro-environmental behavior. Annals of the New York Academy of Sciences, 1185(1), 211–224. https://doi.org/10.1111/j.1749-6632.2009.05163.x

United Nations. (2024, January 16). Environment | UN Global Compact. https://unglobalcompact.org/what-is-gc/our-work/environment

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425–478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y. L., Chan, F. K. Y., & Hu, P. J. H. (2016). Managing citizens' uncertainty in e-government services: The mediating and moderating roles of transparency and trust. Information Systems Research, 27(1), 87–111. https://doi.org/10.1287/isre.2015.0612

Waqar, A., Hannan Qureshi, A., Othman, I., Saad, N., & Azab, M. (2024). Exploration of challenges to deployment of blockchain in small construction projects. Ain Shams Engineering Journal, 15(2), 102362. https://doi.org/10.1016/j.asej.2023.102362

White, B., Mahanti, A., & Passi, K. (2022). Characterizing the OpenSea NFT marketplace. Companion Proceedings of the Web Conference 2022, 488–496. https://doi.org/10.1145/3487553.3524629

Wong, L. M., Tan, G. W., Lee, V., Ooi, K., & Sohal, A. S. (2020). Unearthing the determinants of blockchain adoption in supply chain management. International Journal of Production Research, 58(7), 2100–2123. https://doi.org/10.1080/00207543.2020.1730463

Yawalkar, P. M., Paithankar, D. N., Pabale, A. R., Kolhe, R. V., & William, P. (2023). Integrated identity and auditing management using blockchain mechanism. Measurement: Sensors, 27, 100732. https://doi.org/10.1016/j.measen.2023.100732

Yli-Huumo, J., Ko, D., Choi, S., Park, S., & Smolander, K. (2016). Where is current research on blockchain technology? - A systematic review. PLOS ONE, 11(10), e0163477. https://doi.org/10.1371/journal.pone.0163477

Zhang, P., & Zhou, M. (2020). Security and trust in blockchains: Architecture, key technologies, and open issues. IEEE Transactions on Computational Social Systems, 7(3), 790–801.

Zhang, T., Jia, F., & Chen, L. (2024). Blockchain adoption in supply chains: Implications for sustainability. Production Planning & Control, 0(0), 1–24. https://doi.org/10.1080/09537287.2023.2296669

Zhao, J. L., Fan, S., & Yan, J. (2016). Overview of business innovations and research opportunities in blockchain and introduction to the special issue. Financial Innovation, 2(1), 28. https://doi.org/10.1186/s40854-016-0049-2

Biographical notes

Carlos M.P.C. Bernardino has a B.Sc. degree in aeronautical military technologies from the Air Force Academy. He obtained a Postgraduate degree in open-source software and a M.Sc. in open-source software, both from ISCTE, Portugal. He also earned a Postgraduate degree in aeronautical military sciences from the Instituto Universitario Militar, Portugal. Additionally, he completed the Blockchain: Disruptive Technology course at the MIT, USA. He is currently pursuing a Ph.D. in Management at ISEG, Portugal. He has held various roles within the Portuguese Air Force. He has been the Coordinator for Organizational Transformation at the Innovation Division, at Portuguese Air Force Headquarters. His research interests include blockchain technology, organizational transformation, and IS Theory. He has been recognized with various honors, including the Saint George's Cross Medal, the Aeronautical Merit Medal, and other commendations. ORCID 0009-0008-3967-787

Francisco Cesário holds a Master's degree in Management Sciences from Lisbon School of Economics & Management, Lisbon, Portugal, since 2023. He obtained a Bachelor in Economics from ISCTE - Instituto Universitario de Lisboa, Lisbon, Portugal, since 2002. His research interests include web3, technology and Business & Economy.

Carlos J. Costa holds a PhD in Information Sciences and Technologies in the field of IS and Databases from ISCTE, Portugal. He holds a Master's degree in Management Sciences from the same university and a degree from the Portuguese Catholic University. He is Associate Professor with Habilitation at ISEG, Portugal. He has published more than 200 publications. He has organized the Workshop on Artificial Intelligence and Management annually. His research interests include IS theory, especially in the areas of gamification, business applications of data science, and programming learning. He is a member of IEEE and ACM. He is also chair of EuroSIGDOC / ACM. He was conference and program chair of conferences sponsored by ACM and EuroSIGDOC / ACM. ORCID 0000-0002-1037-0561

Manuela Aparicio holds a PhD in Information Management from Universidade Nova de Lisboa (UNL), Portugal. She is the Associate Dean for Education at NOVA IMS, Portugal. Her work appears in journals such as Information & Management and Journal of Educational Technology & Society. Her research interests include the evaluation of information systems effectiveness, notably the implementation and use of IT in organizational IS. She is also interested in research on the success of IS. She is a member of ACM, a board member of the EuroSIGDOC/ACM chapter, and belongs to ACM Women. In the last three years she has been in the top 2% of most cited researchers globally across 22 scientific fields and 174 subfields, considering the influence and impact of academic research. She was honored with the prestigious Diana Award at the 41st ACM ICDC. ORCID 0000-0003-4261-0344

João T. Aparicio is currently pursuing a PhD in Computer Science at Instituto Superior Técnico (IST), Portugal, focusing on Network Science and Machine Learning. He holds a Master’s degree in Information Systems and Computer Engineering from the same institution. He also earned a Bachelor’s degree in Computer Engineering from ISCTE-IUL, Portugal. He is a Research Fellow at INESC-ID and LNEC, working on projects related to multimodal urban data analysis for public and logistic transportation optimization. He also serves as a Teaching Assistant at IST, where he teaches courses in computer science. His research spans a range of topics, including network science, machine learning, gamification, and the use of robotics for programming education. His current research explores the application of network data science to transportation and urban economics. ORCID 0000-0002-8047-7452