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Article

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Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration

Provided in Cooperation with:

Faculty of Economics and Administration, University of Pardubice

Suggested Citation: Freimuth, Airi (2024) : Stakeholders' blockchain engagement: An interdependence theory's principle of interaction's framework, Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration, ISSN 1804-8048, University of Pardubice, Pardubice, Vol. 32, Iss. 2, pp. 1-13, <https://doi.org/10.46585/sp32022089>

This Version is available at:

<https://hdl.handle.net/10419/334831>

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Stakeholders' Blockchain Engagement: An Interdependence Theory's Principle of Interaction's Framework

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Abstract

This study investigates the intersection of blockchain technology, stakeholder engagement, and business sustainability, focusing on customers and employees. By introducing the novel concept of stakeholders' blockchain engagement and integrating Interdependence theory's principle of interaction facets, the research provides a new framework for understanding how blockchain technology shapes stakeholder interactions and contributes to business sustainability. The study highlights how blockchain's engagement antecedents—decentralization, privacy/anonymity, immutability, traceability, and transparency—influence stakeholder engagement. The findings suggest that these antecedents enhance trust and transparency, leading to improved customer loyalty and employee satisfaction. For customers, blockchain-based platforms offer increased transparency and control, enhancing engagement through direct peer-to-peer interactions. Employees benefit from decentralized decision-making processes and transparent organizational structures, fostering autonomy and job satisfaction. By conceptualizing stakeholders' blockchain engagement, this research offers a comprehensive lens through which to examine the impact of blockchain on business practices and stakeholder relationships, contributing to long-term business sustainability by fostering stronger relationships and promoting ethical practices.

Keywords

Stakeholder Engagement, Blockchain Technology, Stakeholders' Blockchain Engagement, Sustainable Business Models
Interdependence Theory's Principle of Interaction

JEL Classification

O33, M14, Q56, M31, L86

Introduction

The incorporation of blockchain technology into digital (for example, social media) networks has been heralded as a transformative force, for example, by enhancing user engagement, privacy, data control, and equity or by raising firm sustainability (Saraswat et al., 2023), thus facilitating stakeholder transactions. Blockchain can be useful to eliminate boundaries between stakeholders or to enable safe, secure, or private transactions (Peres et al., 2023) and to boost the sustainability of firms (Mulligan et al., 2024). Göksal and Solarte Vasquez (2024) further emphasize that blockchain technology can enhance trustworthy intelligence systems, which aligns with the growing need for reliable and transparent stakeholder interactions. Overall, digital networks using blockchain (for example, DTube) have transformed the way that organizations communicate with their stakeholders, share information and engage with one another. The proliferation of digital networks has generated a global user base of over 5 billion individuals, with the average user engaging with 6.7 social platforms per month (We Are Social & Meltwater, 2024). However, data privacy concerns are prevalent, with over 31% of internet users aged 16-64 expressing apprehension about data misuse and 24% of Internet users are using virtual private networks to enhance safety in digital networks (We Are Social & Meltwater, 2024). Given these queries, a need exists for further investigation in this area (Barati & Yankson, 2022; Neto et al., 2021).

To address these issues, blockchain technology has been advocated. By operating a decentralized network without the need for intermediaries, blockchain has been dubbed the "Trust Protocol" (Lacity, 2020). Specifically, blockchain technology has been heralded as a key mechanism to build and raise trust between stakeholders (Hollebeek et al., 2019), in turn boosting their positive engagement with both the technology and the firm's products or brands while simultaneously promoting sustainable business practices. In this process, the importance of trust cannot be overstated (Holmes, 2004; Van Lange & Balliet, 2015), including between the firm and its representatives on the one hand, and its customers on the other (Hollebeek et al., 2023). For example, Morgan & Hunt (1994) commitment-trust theory of relationship marketing proposes trust as a key ingredient for successful customer/firm relationships. By creating more secure, trusted digital interactions (thus reducing or minimizing issues like data breaches), blockchain-based digital networks are conducive to bolstering stakeholder engagement (Choi et al., 2020).

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However, despite the promise of blockchain-based platforms, a notable gap in the literature exists. Specifically, little remains known regarding how blockchain technology builds different stakeholders' engagement and trust, as therefore explored in this paper. The development of understanding of these issues is important, given the high cost associated with blockchain adoption (Černý et al., 2021), which should be outweighed by its benefits (Sun et al., 2022). While several studies have investigated blockchain's capacity to build specific stakeholders' (for example, users') engagement (Choi et al., 2020; Hannan et al., 2023; Jang & Han, 2022; Stallone et al., 2021) there is a lack of comprehensive understanding of how blockchain engagement transpires for different stakeholders (Hollebeek et al., 2023; Zutshi et al., 2021), requiring further research. Addressing this issue, this study explores how a specific blockchain application drives the engagement of the firm stakeholders of customers and employees. To do so, this study introduces a blockchain engagement framework based on interdependence theory's principle of interaction facets: comparison level, comparison level for alternatives, and perceived rewards and costs (outcomes) (Van Lange & Balliet, 2015). This framework shows how blockchain technology stimulates stakeholders' interactional motives and interdependence, which can, in turn, be leveraged to foster more sustainable business practices. This connection to sustainability is demonstrated by how blockchain fosters interdependencies among stakeholders, encouraging collaborative efforts towards sustainable practices and ethical decision-making in business contexts. Recent studies demonstrate that blockchain enhances corporate social responsibility (CSR) and business ethics, which are crucial for promoting social sustainability through improved stakeholder engagement and transparency (Mulligan et al., 2024). Overall, the framework proposes important blockchain engagement antecedents and blockchain engagement in the sustainable business context, highlighting how these factors contribute to business sustainability.

This study makes the following contributions to the blockchain, engagement, and sustainability literature. First, by integrating blockchain and engagement, the new concept of stakeholders' blockchain engagement is developed in this study, which can be examined from the perspective of any firm stakeholder (Hollebeek et al., 2022). This paper focuses on the specific stakeholders of customers and employees and how their blockchain-based interactions can render firms more sustainable (for example, by enabling transparent supply chain monitoring, facilitating decentralized energy trading, and promoting ethical practices through enhanced traceability), thus offering new insight into the interface of blockchain, engagement, and sustainability. Second, a conceptual framework is developed that outlines important antecedents of the chosen stakeholders' blockchain engagement, with this engagement inherently expressing aspects of business sustainability. The paper therefore facilitates understanding of key factors that drive blockchain engagement and its main antecedents, thus improving managerial understanding of the concept. With the framework, a set of research propositions is developed that summarize the proposed theoretical relationships. These propositions contribute to the literature by offering actionable insight to guide future research and practice in the evolving landscape of blockchain-enabled digital networks, with a particular focus on how blockchain engagement naturally aligns with and promotes business sustainability.

The paper unfolds by first reviewing literature on blockchain technology and its characteristics that serve as antecedents to blockchain engagement. Subsequently, it explores the concept of stakeholders' blockchain engagement. The study then progresses to conceptual development, presenting stakeholder's blockchain engagement propositions based on a 3x2 matrix derived from the interdependence theory's principle of interaction facets, which considers alternative level, comparison level for alternatives, and perceived rewards and outcomes. The paper concludes with implications and directions for future research, offering a comprehensive framework with propositions for understanding blockchain's role in enhancing stakeholder engagement and business sustainability.

Literature Review

Blockchain technology was developed in the context of the Bitcoin cryptocurrency platform, with its principles and rules outlined in Nakamoto's (2008) seminal white paper. Nakamoto's (2008) conception of blockchain is referred to as an open-source or permissionless blockchain system that grants stakeholders the ability to perform open read and write operations for the purposes of ensuring transparency, security, and immutability of transactions, fostering trust and collaboration within the network, and enabling decentralization by allowing direct participation without a central authority (Cao et al., 2023), with public blockchains typically being considered most secure. Wahyudi et al. (2023) suggest that collaboration can serve as a crucial channel for accessing external knowledge and resources, contributing to more effective innovation processes. However, authors including Viriyasitavat & Hoonsopon (2019) broadened the definition of blockchain beyond cryptocurrency alone, referring to it as a technology that ensures data immutability and integrity across distributed nodes in peer-to-peer networks. The following blockchain characteristics are identified, as also summarized in Table 1.

First, blockchain technology functions as a decentralized peer-to-peer network that eliminates the need for intermediaries, allowing stakeholders to directly and securely transfer value to one another (Kshetri, 2017; Lacity, 2022; Göksal & Solarte Vasquez, 2024). When a transaction occurs, it is grouped with others into a block. Miners verify these transactions using complex algorithms. Once validated, the block is appended to the chain, linked to the prior block via a unique cryptographic hash. This creates an immutable record of transactions. Each new block refers back to the previous block's hash, ensuring integrity and continuity of the chain. Data is compartmentalized into blocks forming a linked chain (Nakamoto, 2008; Peres et al., 2023).

Second, given its ability to facilitate safe, secure interactions and transactions, blockchain has been argued to foster stakeholder trust (Kim et al., 2023; Wan et al., 2022). The trustworthiness of the system stems from its characteristics (such as transparency, immutability, and decentralization, which ensure that all transactions are visible, unalterable, and not controlled by a single entity). Ferreira da Silva & Moro (2021) highlight that the main security research areas of blockchain technology—namely privacy, traceability, and security—are instrumental in fostering stakeholder trust and transparency. Similarly, Pal et al. (2021) suggest that transparent internal and external business dealings can enhance trust in the business community. This linkage to sustainability is evident as blockchain technology can promote sustainable practices by ensuring transparent and accountable supply chains, reducing fraud, and enabling efficient resource tracking (Parmentola et al., 2021; Yadav et al., 2023). The technology facilitates the development of peer-to-peer networks where stakeholders maintain synchronized data, where each block is time-stamped to safeguard its integrity (Ferreira et al., 2023; S. Li et al., 2022).

Third, blockchain applications may use different algorithms. The most widely recognized algorithms include Proof-of-Work (PoW), as exemplified by Bitcoin, which necessitates mining to finalize transactions. Other methods, such as Proof-of-Stake (PoS) and Proof of Capacity (PoC), distribute power differently within the network based on stake ownership and storage capacity, respectively (Arooj et al., 2022). Proof-of-Work requires miners to solve complex mathematical puzzles, consuming significant computational power and energy to validate transactions and add blocks (Zheng et al., 2018). Proof-of-Stake selects validators based on the amount of cryptocurrency they hold and are willing to "stake," reducing energy consumption and potentially improving scalability (Saleh, 2021). Proof of Capacity allows participants to use their available hard drive space to store solutions to cryptographic puzzles, making it more accessible and energy-efficient compared to PoW (W. Wang et al., 2019)

Fourth, blockchain technology can be implemented to improve privacy, and data transparency and sustainability (Javaid et al., 2021). Blockchain systems are commonly known to be unhackable, making them immutable and secure (Reyna et al., 2018; Zhou et al., 2020). In other words, blockchain data is transparent, which helps reduce corruption (Wang et al., 2022).

Table 1. Antecedents of stakeholders' blockchain engagement.

Antecedents of stakeholders' blockchain engagement	Description	Source
Decentralization	Distributed networks, no central units. Enhances security of the systems.	Viriyasitavat & Hoonsopon, 2019; Reyna et al. 2018; Kshetri 2017; Kshetri 2018; Javaid et al. 2021; Zhou et al. 2020; Pal et al. 2021; Wang et al. 2022; Yli-Huumo et al. 2016; Zheng et al. 2018; Xiaoqi Li et al., 2020.
Privacy/Anonymity	Does not have to reveal the real identities. Username system. Data is secured by hashing (encryption).	Kshetri 2017; Kshetri 2018; Javaid et al. 2021; Pal et al. 2021; Yli-Huumo et al. 2016; Zheng et al. 2018.
Immutability	Tamper-proof system. Data can be modified only within the white paper rules. For example all the stakeholders have to agree to modify data.	Viriyasitavat & Hoonsopon, 2019; Reyna et al. 2018; Kshetri 2017; Zhou et al. 2020, Kshetri 2018; Javaid et al. 2021; Pal et al. 2021; Wang et al. 2022; Xiaoming Li & Liang, 2022.
Traceability	Timestamp system to check the origins of goods/information/services etc.	Reyna et al. 2018; Javaid et al. 2021; Elapolu et al., 2024, Kim et al., 2023.
Transparency	Information/transactions can be available for every stakeholder group.	Reyna et al. 2018; Javaid et al. 2021; Zhou et al. 2020; Yli-Huumo et al. 2016, Wang et al., 2022.

Fifth, nodes play an important role in blockchain platforms (Howell et al., 2023) that act as non-human stakeholders, although there could be a human behind each node. Nodes are networks of computers (Javaid et al., 2021) that validate the system. Based on the rights applied to nodes, blockchain systems can be private (predefined nodes), public (open to public, anyone can join), or permissioned (semi-closed, main nodes are selected, other nodes depend on access control; Viriyasitavat & Hoonsopon, 2019; Wen et al., 2023). Nodes are anonymous to obtain and preserve security (Yli-Huumo et al., 2016). In private, permissioned blockchain systems stakeholder trust can be reduced as the nodes are predefined or selected. In (open) blockchain systems, data is immutable. As stakeholders aim to preserve their privacy they are willing to share truthful information in blockchain systems (Xiaoming Li & Liang, 2022). In blockchain systems, data is transparent and traceable. Traceability is important as it improves stakeholders' trust and interactions (Elapolu et al., 2024). In blockchain digital networks, traceability helps reduce or eliminate ad fraud (Kim et al., 2023) and domain spoofing, which is a type of cyber-attack where an attacker impersonates a legitimate domain to deceive users into believing they are interacting with a trustworthy website or email, often to steal sensitive information or distribute malware (Zheng et al., 2018).

In pursuit of a deeper understanding of blockchain's nature, these characteristics are outlined below. Echoing Treiblmaier & Sillaber (2021), this paper explores the antecedents of stakeholders' blockchain engagement. Blockchain engagement can be viewed from different layers (such as the application layer, protocol layer, and interaction layer, each addressing different aspects of blockchain functionality and user interaction) (Zheng et al., 2018). Our work therefore extends that of Zutshi et al. (2021), which addresses stakeholders' blockchain engagement with the digital architecture from a trust-building perspective, which is an interaction layer (this means focusing on how blockchain facilitates secure and transparent interactions among stakeholders, thereby building trust) (Pal et al., 2021; Sansone et al., 2023).

Stakeholders' blockchain engagement refers to a stakeholder's (for example, cognitive, emotional, and behavioral) resource investment in their interactions with a blockchain-based system (Hollebeek et al., 2022; Saberi et al., 2019), revealing engagement's interactive nature (Hollebeek et al., 2019). Second, in the blockchain context, stakeholders' blockchain engagement can be positive or negative (Hollebeek & Chen, 2014). For example, while a perceived positive transaction may trigger positive engagement, issues like data breaches (i.e., when unauthorized parties access or use personal information) may raise negative engagement (for example, users spreading negative word of mouth about blockchain systems or platforms) and stress (Foecking et al., 2021; Hollebeek et al., 2023; Labrecque et al., 2021; Viglia et al., 2023). As such, these issues are likely to shape stakeholders' blockchain engagement outcomes. Therefore, by eliminating third parties or middlemen (Xiaoqi Li et al., 2020), decentralized blockchain systems facilitate system security and trustworthiness. Third, engagement is a multidimensional concept comprising cognitive, emotional, and behavioral facets (Hollebeek et al., 2014). The cognitive dimension involves brand-related thought processing and focus, reflecting how deeply customers think about and process information related to the brand (Brodie et al., 2011). The emotional dimension includes feelings and emotional bonds towards the brand, indicating the level of emotional attachment and affection customers have (Brodie et al., 2013). The behavioral dimension encompasses actions like sharing, learning, and endorsing the brand, showing the extent of customers' active participation and advocacy (van Doorn et al., 2010). Together, these dimensions reflect the comprehensive nature of customer engagement, highlighting its interactive and multifaceted character (L. Hollebeek, 2011).

Korsakienė and Raišienė's (2022) emphasize that stakeholder engagement is a key factor in organizational sustainability efforts. Their findings show how firms of all sizes can use stakeholder involvement to tackle sustainability challenges. This view complements blockchain research, indicating that distributed ledger technologies offer organizations tools to improve transparency and stakeholder participation in sustainability initiatives. Implementing blockchain solutions may help companies overcome traditional obstacles to stakeholder engagement.

Conceptual Development

Interdependence theory posits that stakeholders are interdependent with one another, including in the blockchain context. This study focuses on the specific stakeholders of customers and employees. This research adopts interdependence theory's principle of interaction (Kelley et al., 2003). The principle of interaction posits that interactions are a function of multiple stakeholders and the situation in which they interact (Hollebeek et al., 2023; Van Lange & Balliet, 2015). Blockchain technology's characteristics produce situations that are blockchain engagement antecedents.

The principle of interaction suggests that stakeholders' blockchain engagement occurs as a function of stakeholders' comparison level (CL), comparison level for alternatives (CL-alt), and outcomes- perceived costs and rewards (Van Lange & Balliet, 2015). In the blockchain context, this framework helps explain how the technology shapes stakeholder engagement by creating environments that influence these comparison levels and perceptions. Expanding on Hollebeek et al.'s (2024) research on content creators' and viewers' interdependent journeys, this understanding can be extended to blockchain systems. Just as content creators and viewers develop interdependent relationships through engagement, blockchain stakeholders (such as customers and employees) form interdependencies through their interactions with the blockchain system and each other. These interdependencies are characterized by mutual influence and shared outcomes, where the actions of one stakeholder group can significantly impact the experiences and decisions of another.

By adopting interdependence theory's Principle of Interaction, five key characteristics of blockchain technology (Table 1, antecedents of stakeholders' blockchain engagement) are deduced as antecedents to stakeholders' blockchain engagement: (i) decentralization, (ii) privacy/anonymity, (iii) immutability, (iv) traceability, and (v) transparency. These characteristics influence the situation or context in which stakeholders interact, with positive outcomes potentially contributing to enhanced business sustainability. Taking an interdependence theory-informed (Principle of Interaction) perspective of stakeholders' blockchain engagement, Fig.1 is developed. A related set of propositions that summarize the theoretical associations depicted in the framework is also developed, incorporating business sustainability as a key outcome influenced by blockchain engagement.

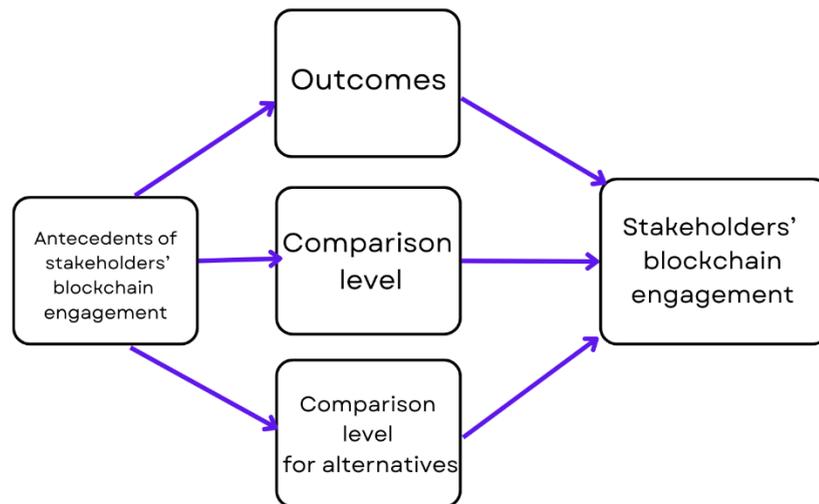


Fig. 1: Stakeholders' Blockchain Engagement 's Proposition Model from an Interdependence Theory-Informed Interaction Perspective

The study focuses on two main stakeholder groups: (a) customers and (b) employees. Each of these stakeholders is expected to be significantly influenced by the antecedents of the comparison level, comparison level for alternatives, and perceived costs/rewards, as detailed in Table 2.

Results

Customers' Comparison Level and Blockchain Engagement

Decentralization and transparency are crucial antecedents that significantly influence customers' comparison levels (CL). Decentralization allows customers to engage directly with each other without intermediaries, fostering a sense of control and trust. Transparency ensures that all transactions are visible and verifiable, further enhancing trust and engagement. According to Treiblmaier and Sillaber (2021), decentralized platforms provide a higher level of transparency and control, which aligns with customers' increasing expectations for direct and secure interactions. This positive engagement is likely to result in greater customer satisfaction and loyalty (Hollebeek & Chen, 2014). From a firm sustainability perspective, increased customer engagement through decentralized, transparent blockchain platforms can lead to more sustainable business practices. As customers demand more transparency and control, businesses that adopt blockchain technology can build stronger relationships with their customers, leading to long-term loyalty and reduced customer churn (D. Tapscott & Tapscott, 2016). This alignment with customer expectations can also enhance the firm's reputation and competitive advantage, contributing to overall business sustainability. Hollebeek et al. (2014) emphasize that customer engagement is a multidimensional construct encompassing cognitive, emotional, and behavioral dimensions. The decentralized nature of blockchain enhances these dimensions by providing customers with more control and transparency. This observation aligns with the findings of Kujala et al. (2022), who highlight the importance of transparency and accountability in building trust and engagement. Moreover, increased transparency and control in blockchain transactions is expected to generate higher levels of customer trust and loyalty, as noted by Hollebeek et al. (2019). This trust is crucial for sustainable business practices, as it fosters long-term relationships and reduces the likelihood of customer churn. By leveraging blockchain technology, businesses can create a more engaging and trustworthy environment for customers, contributing to the development of sustainable business models that prioritize stakeholder engagement and long-term value creation. Origin Protocol, a decentralized platform, allows users to create and manage marketplaces without intermediaries, providing transparency and control over transactions, which aligns with customer expectations for direct peer-to-peer interactions.

Proposition P1a: Customers will expect higher levels of transparency and control in blockchain-based transactions, leading to increased engagement with decentralized platforms that offer direct peer-to-peer interactions. Antecedents: decentralization, transparency.

Customers' Comparison Level for Alternatives and Blockchain Engagement

Privacy/anonymity and immutability are critical antecedents that influence customers' comparison levels for alternatives (CL-alt). Blockchain platforms offer superior privacy and security features compared to traditional centralized services, making them more attractive to customers. The immutability of blockchain ensures that transaction records cannot be altered, enhancing trust and reliability. Saberi et al. (2019) note that the enhanced privacy and security of blockchain platforms can lead to increased customer engagement as they perceive these platforms as safer alternatives. From a business sustainability perspective, adopting blockchain technology to

enhance privacy and security can attract more customers and build long-term trust. Firms that prioritize data privacy and security are likely to gain a competitive edge, as customers increasingly value these attributes in digital interactions (Biswas & Gupta, 2019). This can lead to sustained customer loyalty and a stronger market position, contributing to the overall sustainability of the business. Hollebeek et al. (2019) emphasize the importance of trust in fostering customer engagement. By leveraging blockchain's privacy and immutability features, businesses can create a more secure and trustworthy environment for customers. This trust is crucial for sustainable business practices, as it fosters long-term relationships and reduces the likelihood of customer churn. Moreover, as Kumar and Pansari (2016) argue, customer engagement is a key driver of firm performance and competitive advantage. By prioritizing data privacy and security through blockchain, businesses can gain a competitive edge and build a loyal customer base. For example, Brave Browser uses blockchain to offer enhanced privacy features, attracting users who are concerned about data security compared to traditional browsers (Brave Software, 2024). This alignment with customer expectations can enhance the firm's reputation and contribute to long-term business sustainability.

Proposition P2a: Customers will perceive traditional centralized services as less attractive compared to blockchain alternatives, increasing their engagement with decentralized platforms that offer enhanced privacy and security. Antecedents: privacy/anonymity, immutability.

Customers' Outcomes (Costs/Rewards) and Blockchain Engagement

Traceability and transparency are key antecedents that influence customers' perceptions of costs and rewards. Blockchain platforms that offer reduced transaction costs and transparent, tokenized reward systems can significantly enhance customer engagement. Lacity (2020) suggests that the ability to trace transactions and rewards in real-time increases customer trust and satisfaction, leading to higher engagement and loyalty. From a business sustainability perspective, offering reduced transaction costs and enhanced reward systems can attract and retain customers, leading to increased sales and revenue. Transparent reward systems can also build long-term trust and loyalty, contributing to the sustainability of the business by fostering a stable customer base and reducing marketing and customer acquisition costs. Hollebeek et al. (2014) emphasize the importance of both tangible and intangible benefits in customer engagement. By leveraging blockchain to provide transparent and traceable reward systems, businesses can enhance the overall customer experience. This alignment with customer expectations can lead to sustained engagement and loyalty, as noted by Brodie et al. (2011). Moreover, as Pansari and Kumar (2017) argue that customer engagement value is a key driver of firm performance. By offering reduced costs and enhanced rewards through blockchain, businesses can create a more engaging and trustworthy environment for customers. This contributes to long-term business sustainability by fostering a loyal customer base and enhancing overall firm performance. Chiliz, a blockchain-based platform, offers tokenized rewards for sports fans, reducing transaction costs and enhancing customer engagement through loyalty programs (Chiliz.com, 2024).

Proposition P3a: Customers will engage more with blockchain platforms that offer reduced transaction costs and enhanced reward systems, such as tokenized loyalty programs, leading to increased participation and repeat transactions. Antecedents: Traceability, Transparency.

Employees' Comparison Level and Blockchain Engagement

In blockchain-enabled work environments, decentralization and transparency are crucial antecedents that affect employees' comparison levels (CL). Decentralized decision-making processes empower employees by providing them with greater autonomy and reducing hierarchical barriers. Transparency in organizational processes ensures that employees have a clear understanding of their roles and responsibilities, leading to increased trust and engagement. Godavarthi et al. (2023) highlight that decentralized work environments can enhance job satisfaction and motivation, resulting in positive engagement (Hollebeek & Chen, 2014). From a business sustainability perspective, increased employee engagement through decentralized and transparent blockchain systems can lead to higher productivity and job satisfaction. Employees who feel empowered and trusted are more likely to be committed to the organization, reducing turnover rates and fostering a positive workplace culture (Ryan & Deci, 2000). This can contribute to the long-term sustainability of the business by enhancing its human capital and reducing recruitment and training costs. Kahn (1990) emphasizes that psychological meaningfulness, safety, and availability are essential for fostering employee engagement. Decentralized and transparent blockchain systems align with these principles by providing employees with a sense of control and clarity in their roles. This alignment can lead to increased job satisfaction and organizational commitment, as noted by Saks (2006). Moreover, as Macey and Schneider (2008) argue that engaged employees are more likely to exhibit discretionary effort and organizational citizenship behaviors. This can contribute to long-term business sustainability by enhancing human capital and reducing turnover costs. IBM is developing blockchain technology to enhance transparency and empower employees by providing clear records of project contributions, fostering a culture of trust and autonomy (Varghese, 2021). Organizations that prioritize employee engagement through decentralized and transparent systems are more likely to achieve positive outcomes in terms of employee retention, productivity, and overall organizational performance.

Proposition P1b: Employees will anticipate greater autonomy and transparency in blockchain-enabled work environments, resulting in higher engagement with decentralized decision-making processes. Antecedents: decentralization, transparency.

Employees' Comparison Level for Alternatives and Blockchain Engagement

Employees' comparison level for alternatives (CL-alt) is influenced by the privacy/anonymity, immutability and decentralization offered by blockchain-based systems. These systems provide greater transparency and reduce hierarchical barriers, making them more appealing compared to conventional centralized work structures. Tapscott and Tapscott (2016) argue that the enhanced privacy and secure record-keeping of blockchain can lead to higher employee engagement by providing a more trustworthy and transparent work environment. From a business sustainability perspective, adopting blockchain technology to create more transparent and decentralized work environments can enhance employee satisfaction and retention. Employees who feel their privacy is respected and their contributions are securely recorded are more likely to remain loyal to the organization (Lee & Edmondson, 2017). This can reduce turnover rates and associated costs, contributing to the long-term sustainability of the business. Schaufeli et al. (2002) identify vigor and dedication as key components of work engagement. Blockchain's privacy and immutability features align with these components by providing employees with a secure and transparent environment. This alignment can lead to increased job satisfaction and organizational commitment, as noted by Saks and Gruman (2014). Moreover, Bailey et al. (2017) highlight the positive relationship between employee engagement and job performance. By leveraging blockchain to respect employee privacy and securely record contributions, organizations can foster loyalty and reduce turnover rates. For example, Consensys, a blockchain technology company, uses decentralized systems to reduce hierarchical barriers, creating a more transparent and engaging work environment for employees (Consensys, 2024). This contributes to long-term business sustainability by reducing costs associated with recruitment and training and enhancing overall organizational performance.

Proposition P2b: Employees will find conventional centralized work structures less appealing, leading to increased engagement with blockchain-based systems that provide greater transparency and flatter hierarchies. Antecedents: privacy/anonymity, immutability, decentralization.

Table 2. Stakeholders' Blockchain Engagement.

Principle of Interaction	Customers (a) Blockchain Engagement	Employees (b) Blockchain Engagement
Comparison Level (CL)	P1a: Customers will expect higher levels of transparency and control in blockchain-based transactions, leading to increased engagement with decentralized platforms that offer direct peer-to-peer interactions. Antecedents: Decentralization, Transparency	P1b: Employees will anticipate greater autonomy and transparency in blockchain-enabled work environments, resulting in higher engagement with decentralized decision-making processes. Antecedents: Decentralization, Transparency
Comparison Level for Alternatives (CL-alt)	P2a: Customers will perceive traditional centralized services as less attractive compared to blockchain alternatives, increasing their engagement with decentralized platforms that offer enhanced privacy and security. Antecedents: Privacy/Anonymity, Immutability	P2b: Employees will find conventional centralized work structures less appealing, leading to increased engagement with blockchain-based systems that provide greater transparency and flatter hierarchies. Antecedents: Privacy/Anonymity, Immutability
Costs/Rewards	P3a: Customers will engage more with blockchain platforms that offer reduced transaction costs and enhanced reward systems, such as tokenized loyalty programs, leading to increased participation and repeat transactions. Antecedents: Traceability, Transparency	P3b: Employees will show higher engagement with blockchain-based work environments that provide transparent compensation structures and performance-based rewards, resulting in increased productivity and job. Antecedents: Traceability, Transparency

Employees' Outcomes (Costs/Rewards) and Blockchain Engagement

In addition to other blockchain engagement antecedents, employees' perceptions of costs and rewards are strongly influenced by the traceability and transparency of blockchain-based work environments. Transparent compensation structures and performance-based rewards can enhance employee motivation and engagement. Tapscott and Tapscott (2017) argue that blockchain's ability to provide verifiable and transparent records of performance and compensation leads to higher job satisfaction and productivity. From a business sustainability perspective, transparent and performance-based reward systems can enhance employee engagement and productivity, leading to better organizational performance. Employees who feel compensated and recognized for their contributions are more likely to remain with the organization, reducing turnover rates and associated costs. This contributes to the long-term sustainability of the business by fostering a motivated and stable workforce. Bakker and Demerouti's (2008) job demands-resources model emphasize the importance of job resources in fostering engagement. Blockchain's traceability and transparency features align with this framework by providing employees with clear and fair compensation structures. This alignment can lead to increased job satisfaction and organizational commitment, as noted by Schaufeli and Bakker (2004). Moreover, as Schaufeli et al. (2009) highlight, engaged employees are more

likely to exhibit positive organizational outcomes. By leveraging blockchain to ensure fair compensation and recognition, organizations can foster a motivated and stable workforce. For example, Buffer, a social media management company, uses blockchain to ensure transparent compensation and performance-based rewards, boosting employee motivation and satisfaction (Buffer, 2024). This contributes to long-term business sustainability by improving organizational performance and reducing costs associated with employee turnover.

Proposition P3b: *Employees will show higher engagement with blockchain-based work environments that provide transparent compensation structures and performance-based rewards, resulting in increased productivity and job satisfaction. Antecedents: traceability, transparency.*

Discussion

The conceptual framework developed in this study illuminates the relationships between blockchain technology, stakeholder engagement, and business sustainability. By examining these relationships through the lens of interdependence theory's principle of interaction, novel insights are gained into how blockchain's key characteristics influence stakeholder engagement and, consequently, business sustainability.

The findings reveal that blockchain's impact on stakeholder engagement is multifaceted and context dependent. For customers, the decentralization and transparency offered by blockchain platforms not only enhance trust and control but also reshape expectations for digital interactions. As Treiblmaier and Sillaber (2021) note, decentralized platforms provide a higher level of transparency and control, aligning with customers' increasing expectations for direct and secure interactions. This shift in customer expectations may drive businesses to adopt more transparent and accountable practices across their operations, extending beyond blockchain-specific applications.

For employees, the implications of blockchain-enabled work environments are equally profound. Godavarthi et al. (2023) highlight that decentralized work environments can enhance job satisfaction and motivation, resulting in positive engagement. The decentralized and transparent nature of these systems challenges traditional hierarchical structures, potentially leading to more adaptive organizational models. This transformation may necessitate a reevaluation of leadership styles and performance management systems to align with the increased autonomy and transparency afforded by blockchain technology. Blockchain platforms can provide a decentralized space for collaboration and idea-sharing, potentially amplifying the innovative behavior observed in diverse workplaces. By combining effective diversity management with blockchain technology, organizations may create an even more fertile ground for innovation.

While blockchain technology offers new avenues for stakeholder engagement, it's important to consider how it interacts with existing organizational practices and culture. Huseynova and Matošková (2022) highlight the importance of sustainable Human Resource Management (HRM) practices and organizational culture in building a strong employer brand. Their findings on the mediating role of organizational culture (specifically engagement and productivity) in the relationship between sustainable HRM practices and employer branding can be extended to the blockchain context. As organizations implement blockchain solutions, companies should consider how these technologies align with and potentially enhance their sustainable HRM practices. Blockchain's transparency and traceability features could support sustainable HRM by enabling more fair and transparent performance management and reward systems.

The integration of blockchain technology in business systems, as explored by Göksal and Solarte Vasquez (2024), offers significant potential for enhancing stakeholder engagement through improved transparency, accountability, and human-centredness in digital interactions. The decentralized nature of blockchain could further amplify the benefits of transparency and trust in stakeholder interactions, potentially leading to more robust and sustainable business practices. The importance of partnerships and open innovation in driving technological advancements, as highlighted by Wahyudi et al. (2023), aligns closely with the potential of blockchain technology to facilitate collaborative processes. By leveraging blockchain's capabilities for secure data sharing and trust-building, companies can create an environment that fosters open innovation and strengthens partnerships, potentially leading to more user-driven innovations and improved marketing performance.

The study's propositions regarding comparison levels for alternatives (CL-alt) and perceived costs/rewards offer a understanding of how blockchain technology might reshape stakeholder perceptions and behaviors. Saberi et al. (2019) note that the enhanced privacy and security of blockchain platforms can lead to increased customer engagement as they perceive these platforms as safer alternatives. These insights suggest that the adoption of blockchain technology could lead to a fundamental shift in how stakeholders evaluate and engage with organizations.

From a sustainability perspective, the findings indicate that blockchain's potential to enhance stakeholder engagement could contribute to more resilient and sustainable business models. As Tapscott and Tapscott (2016) argue that businesses that adopt blockchain technology can build stronger relationships with their customers, leading to long-term loyalty and reduced customer churn. Moreover, the transparency and traceability offered by blockchain could facilitate more effective implementation and monitoring of sustainability initiatives, potentially leading to more authentic and impactful corporate social responsibility efforts.

However, the successful implementation of blockchain technology for enhancing stakeholder engagement and business sustainability will likely require careful consideration of industry-specific factors and potential challenges. Organizations must navigate the complexities of integrating blockchain systems with existing processes and technologies while addressing potential resistance to change from both internal and external stakeholders.

Conclusion

This study has explored the intersection of blockchain technology, stakeholder engagement, and business sustainability, focusing on customers and employees as key stakeholders. By developing the new concept of stakeholders' blockchain engagement and proposing a conceptual framework with key antecedents, this research not only contributes significantly to the blockchain, engagement, and sustainability literature but also provides a novel lens through which to examine the impact of blockchain on business practices and stakeholder relationships (Hollebeek et al., 2022). The introduction of stakeholders' blockchain engagement as a new concept offers a unique perspective on how blockchain technology shapes stakeholder interactions and contributes to business sustainability. The findings suggest that blockchain's core characteristics—decentralization, privacy/anonymity, immutability, traceability, and transparency—have the potential to positively impact stakeholder engagement in ways that promote business sustainability.

For customers, blockchain-based platforms offer increased transparency, control, and security, leading to higher levels of trust and engagement. This can result in stronger customer relationships, increased loyalty, and reduced churn, all of which contribute to long-term business sustainability (Hollebeek et al., 2019; Kshetri, 2018; Treiblmaier & Sillaber, 2021). For employees, blockchain-enabled work environments promise greater autonomy, transparency in decision-making processes, and fairer reward systems. These factors can enhance job satisfaction, motivation, and productivity, and fostering a more positive workplace culture (Godavarthi et al., 2023). The integration of blockchain technology in organizational processes aligns with recent findings by Mulligan et al. (2024), who highlight how blockchain can enhance corporate social responsibility (CSR) and business ethics through improved stakeholder engagement and transparency. The study's framework, based on interdependence theory's principle of interaction, provides a novel approach to understanding how blockchain technology shapes stakeholder engagement. By considering the comparison level, comparison level for alternatives, and perceived costs and rewards, the framework offers a comprehensive view of the factors influencing stakeholder engagement in blockchain systems. This approach aligns with recent research by Yadav et al. (2023), who emphasize the potential of blockchain in creating more sustainable and transparent supply chains. Furthermore, this research underscores the potential of blockchain technology to address sustainability challenges faced by organizations. As highlighted by Cao et al. (2023), blockchain adoption can drive firm innovation, which is crucial for developing sustainable business practices. The transparency and traceability offered by blockchain can enable more efficient resource tracking and reduce fraud, contributing to overall business sustainability.

In conclusion, this study provides a comprehensive framework for understanding the role of blockchain technology in enhancing stakeholder engagement and promoting business sustainability. By leveraging blockchain's unique characteristics, organizations can create more transparent, secure, and engaging environments for their stakeholders, ultimately contributing to long-term business success and sustainability. As blockchain technology continues to evolve, its potential to transform stakeholder relationships and drive sustainable business practices will likely grow, opening up new avenues for research and practical applications in the field of business sustainability.

Limitations

This study recognizes several limitations regarding blockchain technology and stakeholder engagement. While focusing primarily on open source blockchain systems, it acknowledges that the dynamics of stakeholder engagement can vary significantly across different blockchain validation methods and architectures.

In addition, while this study focuses on blockchain's technical characteristics and how they affect stakeholder engagement, there is an absence of features addressing social rules and norms within these systems, often referred to as "social contracts".

Empirical testing of the proposed framework is essential, requiring future research to employ mixed methodologies.

Future Research

As blockchain technology continues to evolve, policymakers need to consider how to regulate its use while encouraging innovation. This research highlights the potential benefits of blockchain for stakeholder engagement and business sustainability, which could inform policy decisions aimed at fostering responsible blockchain adoption (Lakhani & Iansiti, 2017). The study's focus on blockchain's potential for enhancing business sustainability through improved stakeholder engagement highlights the need for interdisciplinary research. Future studies should integrate perspectives from fields such as organizational behavior, information systems, and sustainability science to develop a holistic understanding of blockchain's impact on business practices (Hollebeek et al., 2019; Kujala et al., 2022).

In addition, future research should explore the long-term implications of blockchain-enabled stakeholder engagement on organizational performance and sustainability. Mulligan et al. (2024b) highlight how blockchain technology can enhance corporate social responsibility (CSR) and business ethics through improved stakeholder engagement and

transparency. Building on this, future studies could investigate how blockchain-driven stakeholder engagement models evolve over time and their impact on firms' CSR performance and ethical decision-making.

Moreover, future research should investigate the potential challenges and unintended consequences of widespread blockchain adoption for stakeholder engagement and sustainability. Yadav et al. (2023) provide a comprehensive framework for leveraging blockchain in sustainable supply chain management, which could be extended to other areas of business operations. Future studies could explore how blockchain technology interacts with other emerging technologies (e.g., artificial intelligence, Internet of Things) to enhance stakeholder engagement and sustainability across various business functions. Cao et al. (2023) empirically demonstrate blockchain's positive impact on firm innovation, suggesting that future research could examine how blockchain-driven stakeholder engagement specifically contributes to sustainable innovation practices across different cultural and regulatory contexts. Additionally, studies should address the ethical implications of blockchain adoption, including data privacy concerns, and the potential for creating new forms of digital divides among stakeholders.

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