Enhancing Trust and Security in Peer-to-Peer Transactions through Blockchain Technology: A Comprehensive Exploration

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***Abstract**. In today's digital landscape, peer-to-peer (P2P) transactions have gained significant traction across various sectors, ranging from travel necessities to energy sharing. However, the inherent challenges of trust and security have remained formidable obstacles to widespread adoption. This paper presents a comprehensive exploration of how blockchain technology can address these challenges and enhance trust and security in P2P transactions. By providing a decentralized and immutable ledger, blockchain offers a transparent and tamper-resistant platform for recording transactions. Through a review of existing literature, this paper analyses the potential benefits of blockchain in P2P transactions. It examines various consensus mechanisms, smart contract implementations and privacy-preserving techniques to evaluate their effectiveness in ensuring trust and security. By synthesizing insights from both theoretical frameworks and practical implementations, this paper offers valuable guidance for researchers, practitioners and policymakers seeking to leverage blockchain technology to enhance trust and security in P2P transactions.*

***Keywords.** Sharing economy, blockchain technology, peer-to-peer transactions, trust, security*

1 Introduction

A sharing economy (SE) is defined as a system, often mediated by online platforms, that enables access to underutilized physical assets in a short period (Petruzzi et al., 2021). The latest concept of SE, caused by the digitization of all spheres of life, reflects changes technically and technologically in production and consumption (Lyaskovskaya & Khudyakova, 2021). While definitions may differ, the essence of the SE revolves around acquiring resource access rather than ownership (Markman et al., 2021). This involves facilitated exchanges through digital platforms and a community-driven dimension, grounded in the establishment of novel social bonds and shared goals (Baumber et al., 2019).

Moreover, blockchain (BC) is a distributed ledger of electronic transactions (Golosova & Romanovs, 2018; Guo & Yu, 2022). The first indications of the BC solution definition date back to the late 80s and early 90s of the last century (Palop Gisbert, 2022). Work (Diffie & Hellman, 1976) focuses on the use of the concept of a distributed ledger. However, the most known work in this field was written by an author (or group of authors) with the pseudonym Satoshi Nakamoto (Yaga, et al., 2018; Monrat et al., 2019; Rajasekaran et al., 2022) titled "Bitcoin: A Peer-To-Peer Electronic Money System," marking a turning point in BC and cryptocurrency evolution, particularly Bitcoin, which emerged in 2009 and currently holds a value of around $60,000 (CoinMarketCap, 2024).

This paper covers both the theoretical background of the SE and BC and related work on the application of BC systems to address the shortcomings of the SE, which is the ultimate goal of this research. After reviewing the relevant literature and related work, the main part of the paper provides an excerpted table of existing and active companies and platforms implementing BC in the field of SE. Ultimately, the conclusion outlines the next steps in researching the given topic.

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2 Theoretical Background

2.1 Definition and Origins of the Sharing Economy

SE represents one of the fastest-growing business models today. However, the philosophy underpinning the SE, which posits that access to resources and assets will become more significant than ownership itself, is far from being a novel concept (Sainaghi et al., 2019). In comparison to the business aspect and the increasing interest in engaging in the SE, the SE remains relatively contemporary from an academic viewpoint (Agarwal & Steinmetz, 2019). The term SE is often associated with the pioneering work of Marcos Fairson, a sociology professor at Texas State University and Joan Spans, a sociology professor at the University of Illinois, who introduced it in 1978 (Zhu & Liu, 2020). The emergence of the Internet and digital technologies in economic transactions has facilitated a more comprehensive unveiling and interpretation of this concept (Lyaskovskaya & Khudyakova, 2021). The historical evolution of the SE term arises from retrospective analysis and research studies specifically focused on SE. The development of the SE has been categorized into three distinct stages, as identified by Lyaskovskaya & Khudyakova (2021). The initial stage is defined by the introduction of the term collaborative consumption (SE) and is associated with the 20th century (Lyaskovskaya & Khudyakova, 2021). Identified as the origin phase, the second stage covers the period from 2002 to 2015, during which researchers examined, gathered and synthesized new findings concerning economic practices in collaborative consumption, establishing the foundational principles in terminology, theory and methodology, thereby giving rise to the SE concept as a distinct entity (Lyaskovskaya & Khudyakova, 2021). It is widely recognized that from 2016 onward, the third phase denotes a period of extensive development for SE as an emerging business model in the digital economy, intertwined with sustainable consumption (Lyaskovskaya & Khudyakova, 2021).

As previously emphasized, with the progression of science and technology, as well as the popularity of online payments, numerous categories of products and services that can be shared have emerged in the market, making the SE an omnipresent trend in people's lives (Jiajing, 2023). In this regard, (Baumber et al., 2019) highlight that SE pertains to characteristic activities that can be categorized into four broad tiers: goods recirculation, increased utilization of durable assets, service exchange and sharing of productive resources. According to (Markman et al., 2021), sharing platforms are typified by the following traits: (1) enabling peer-to-peer transactions, wherein participants are private individuals rather than businesses or professionals; (2) supporting offline interactions among users; (3) focusing on the utilization of underutilized capacities like physical assets, resources, skills, or time, and (4) highlighting temporary access over ownership. It could be posited that the integration of the preceding insights on the SE has given rise to a redefined SE, evolving from its original bilateral transaction framework to today's three-way transaction structure, characterized by communal sharing on the platform (Zhu & Liu, 2020). As illustrated in Figure 1, a third-party platform holds a pivotal role, with shared information being present on the platform. Seekers offer the resources to acquire shared items. Throughout this procedure, the platform levies a portion of the fee for its services, as adjusted per (Zhu & Liu, 2020).

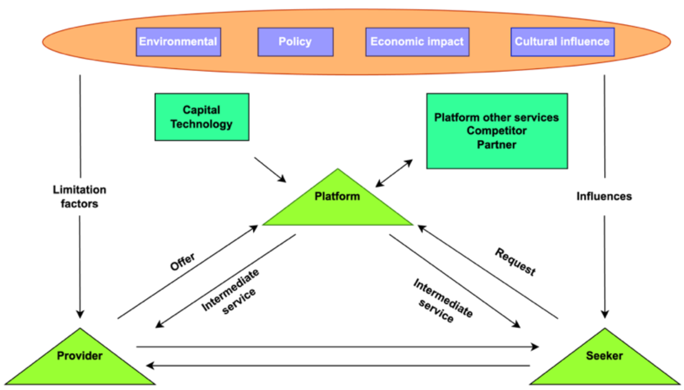

Figure 1. Overview of the Sharing Economy (Source: Zhu & Liu, 2020)

2.2 Definition and Infrastructure of the Blockchain

BC, as the name implies, is a chain of blocks, each carrying transactions or other information. While the contents of blocks can vary, they usually consist of the following: a block header containing the block number, hash of the previous block header, hash of the block data, timestamp, block size, nonce (a cryptographic nonce is an arbitrary number used only once), and block data containing other data and a list of transactions and ledger events included in the block (Yaga et al., 2018). Blocks are cryptographically linked, meaning each new block in the chain contains a cryptographic hash of the preceding one, generated automatically and cannot be altered. The more blocks in the chain, the more "resilient" the chain is (Golosova & Romanovs, 2018). Similarly, if there is a shift in any block, the entire chain will be "infected" (Khatri et al., 2021). The architecture of BC consists of applications, a decentralized ledger and a peer-to-peer network (Yaga et al., 2018). As (Yaga et al., 2018) state, the first level refers to all user-interface applications, usually wallets, whether they are web, mobile, or hardware, through which end users can execute and track their transactions. The middle level belongs to the decentralized ledger, enabling the grouping of transactions into sections that are linked to each other cryptographically (Miraz & Ali, 2018). According to Ammous (2016), mining is the process of organizing transactions into blocks and adding them to the end of the current BC. Nodes carry out different tasks based on their position within the BC network. When a node proposes, approves and mines transactions to create consensus for the BC's security, it is referred to as a miner (Yaga et al., 2018). Proof-of-work, as (Monrat et al., 2019) describe, provides security and agreement within the BC network by verifying blocks through a hash function and a nonce. However, (Sarmah, 2018) points out that its reliance on miners' incentives can lead to scalability and security concerns. Alternatively, proof-of-stake offers a more efficient solution by assigning consensus updating responsibilities based on participants' stakes, thus reducing the risk of unwanted BC forks (Sarmah, 2018). Smart contracts, first developed by Nick Szabo in the mid-1990s, verify the delivery of products and services by suppliers during transaction processes between two parties (Guustaaf et al., 2021).

3 Conducted Research

The central theme explored in this paper is how to acknowledge how leveraging the benefits of BC can mitigate the drawbacks of the SE. In this part, the shortcomings of the SE will be outlined first, followed by the advantages of BC technology. Then, concrete examples of how BC technology has been applied in the SE domain will be presented in the form of a table.

Although the SE has gained widespread popularity with a tendency for further growth, due to its innovative approach to resource utilization and community engagement (Hossain, 2020), like any concept, authors have observed and considered various drawbacks in the SE. The most commonly observed drawbacks are associated with trust and security (Wang et al., 2021; Jiajing, 2023). Given that individuals engage in mutual exchanges facilitated by digital platforms today, they must have a significant level of trust in both the platform itself and all participants (Köbis et al., 2021). There's also a lack of transparency about the quality of goods and services, leading to potential dissatisfaction (Jing & Sun, 2018). According to (Buhalis et al., 2020) SE platforms often face challenges with regulatory compliance, given the global and decentralized nature of their services. Furthermore, current SE platforms often charge high fees for their intermediary role, reducing earnings for service providers and increasing consumer costs (Hossain, 2020). In the end, the SE is susceptible to fraud, including fake listings and payment fraud (Mosaad et al., 2023).

According to (Budhi, 2022), immutability ensures that data on the chain cannot be modified or deleted, transparency fosters trust among network participants, censorship resistance indicates the absence of a third-party making decisions and taking actions without oversight and traceability enables tracking of changes, all of which are advantages of BC technology. This is also acknowledged by (Sarmah, 2018), who adds that BC's peer-to-peer systems aid in identifying fraudulent activities within the network and achieving distributed consensus. Moreover, BCs can continue to operate even if some nodes aren't online or under attacks of some kind (e.g. security) and numerous copies of data stored in the BC allow users to desist centralized storage of sensitive information (Sarmah, 2018).

BC technology has been widely utilized in various aspects of the SE, enhancing various services. Certainly, ridesharing has recently drawn the attention of academia (Golubović et al., 2023).

Furthermore, BC can be applied in ridesharing systems, by improving traceability, transparency and automation (Vazquez & Landa-Silva, 2021; Chang et al., 2022). Additionally, it has been proposed as a governance tool for co-working spaces, bolstering traceability and transparency (Fiorentino & Bartolucci, 2021). Furthermore, its influence on trust dynamics within the platform economy has been noted, where confidence in BC technology and its user community impacts rental intentions (Dann et al., 2020). Lastly, it has been seamlessly integrated into a protected ride-sharing decentralized applications (DApps) applying smart contracts on the Ethereum BC (Renu & Banik, 2021). An excerpt from the research results is presented in Table 1 due to the paper's length limitation.

Table 1. BC solutions in the SE domain (Source: Authors' work excerpted from the full table)

Type of SE	Short Description	Technology	Reference
Travel Necessities	Winding Tree is an open-source software family aimed at fostering innovation in the travel industry. Its flagship product, the Winding Tree Market Protocol, connects travel suppliers and buyers through BC technology, facilitating secure and transparent transactions while cutting costs by eliminating intermediaries.	Protocol Smart Contracts - Polygon zkEVM	Winding Tree (2024)
Cloud Storage	Storj, founded in 2014, is a decentralized platform for sharing cloud storage, offering users a reduction in costs by up to 80%.	Golang; STORJ Token	Storj (2024)
Labour Services	ChronoBank operates as a decentralized labour exchange platform built on BC technology. This platform enables direct hiring of freelancers and temporary workers by employers. The employment contracts are executed through smart contracts, ensuring both security and transparency. Additionally, the platform facilitates cryptocurrency payments.	Ethereum and Smart Contracts	ChronoBank (2024)
Energy Sharing	Power Ledger is a platform that facilitates peer-to-peer energy trading within microgrids. Through this platform, individuals have the ability to engage in the buying, selling and trading of renewable energy, sourced from solar panels or other means, directly with nearby residents. By leveraging BC technology, it guarantees transparent and secure transactions, along with precise monitoring of energy consumption.	Smart Contracts and a dual-token system (POWR and Sparkz)	Power Ledger (2024)

4 Conclusion and Future Directions

The objective of this research paper was to apply the benefits of BC to the shortcomings of the SE. After reviewing the literature and mapping the stated advantages and disadvantages, research on related work in this field followed, which confirmed the author's idea of addressing the drawbacks of SE through the application of BC systems. To support theory with practice, the provided table of active companies/platforms offers an overview across various spheres of the SE and the technologies used in their implementation. It is concluded that the authors' idea is realistic as there are attempts at model development in the literature as well as still working companies with real BC solutions. As a next step, it is possible to further explore both the literature databases and other companies. However, authors could also design a model that would track the success factors of developed models and companies/platforms.

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