# Exploring the Role of Blockchain Technology in Enhancing Transparency: A Systematic Review

## Abstract

As a digitalised public ledger, blockchain has significant potential to enhance transparency and trust both within and across organisational boundaries. The primary objective of this essay is to bridge the gap between the theoretical understanding of blockchain and its practical application for further development and research of the technology. It also explores why it took many years for blockchain to emerge as a prominent topic and discusses the actual usability of this technology. Understanding the subject and research questions will facilitate comprehension of the discussion and the key findings of the systematic review. The main aim is to search for and analyse articles and information regarding how blockchain technology can improve transparency and trust within organisations and the associated benefits and challenges. Three research questions guide the search for relevant literature to deepen understanding and provide a comprehensive overview of the current state of the technology: “What is blockchain technology and how does it work?”, “How can blockchain be employed to achieve transparency?” and “What are the benefits and challenges of utilising blockchain technology for transparency and trust”. Presently, the most pertinent question related to contemporary society concerns how blockchain technology can be harnessed to provide transparency. Achieving a higher degree of transparency is an effective strategy for fostering public awareness and trust, especially in today’s data-driven society. Consequently, the significance of transparency at all levels is underscored, whether for an individual seeking transaction security and legitimacy or a governmental organisation striving for greater trust and reliability.

## Keywords: Blockchain Technology, transparency, Data-Driven Society, Practical Application, Decentralization, Database, Digital Transaction, Data Integrity.

## 1. Introduction

The advent of Industry 4.0 has introduced a range of contemporary trends and technological advancements. These trends affect numerous sectors and significantly influence their functions. Today, as digitalisation and the service economy gain prominence, the integrity of information and data has become crucial across all sectors. Additionally, as digital records and assets have proliferated, so too has the demand for data security and reliable systems. Consequently, blockchain technology has emerged as an innovative method for securely, transparently, and decentralisedly recording digital transactions (Wang et al., 2019). This technology fundamentally relies on secure forms of data and information, which ensures data integrity (Lee & Zhang, 2023). Thus, the topic is profoundly relevant as the importance of data and information continues to rise across various sectors.

Trust is the cornerstone of exchange and transaction relationships and is a part of most human affairs. Any sector requires relationships with different entities; thus, trust is indispensable. Trust is such a crucial notion that the resilience and quality of human society depends on it. Formally, observing organizations and institutions rely heavily on trusted stored data or records. Trust in data or data-related info is built upon data integrity: the observer can observe and confirm that the data is valid, unaltered, and accurate from its inception (Yavaprabhas et al., 2022). While manual paper-based approaches are possible, they have inherent limitations, such as vulnerability to forgery, alteration, illegitimacy, and redundancy. To furnish verifiable security, technological solutions to these limitations are a must. However, most of the current solutions come with diminished or obscured transparency, leading to insufficient or absent traceability. It is rather witnessed that a radical shift from pen-and-paper to digital journalized real-time record keeping with full transparency would revolutionize their missions (Haleem et al., 2021). Additionally, record integrity is paramount for maintaining accountability, including operational efficiency and anti-corruption measures.

### 1.1. Background and Rationale

Blockchain technology was conceived in 2008 by an entity (or a group of entities) known as Nakamoto. The following year, Bitcoin became the first practical implementation of this new technology (Dong et al., 2023). Through its underpinning cryptocurrency, blockchain rapidly gained the attention of technophiles, libertarians, computer scientists, and various experts. Over time, a substantial amount of media buzz has also contributed to its popularity. Blockchain also gave rise to one of the most adventurous and risky engineering trends of the time: the introduction of Permissioned Ledger Technology (PLT), which was designed from the outset to create private (in-group) and regulated (whitelisted) blockchain networks. This development brings forth a meaningful subset of the decentralised feature of the original blockchain while adding an extensive range of security, confidentiality, and usability features necessary for institutions (Doshi et al., 2024). This new engineering field quickly transformed the commercial and technological landscape, with the price of a single bitcoin constantly rising until it reached the historical value of $20,000 in December 2017. A gold-rush atmosphere ensued in this burgeoning market, with hundreds of start-ups launching their initial currency offerings and locating the new “Web 3.0” economy within their advertised service areas. While this chaotic evolution has substantially contributed to the existing “bubbles” map, it has diverted public and private resources from the genuine potential future services of PLT and blockchain, leaving an inaccurate media representation of the main advantages and disadvantages of this innovative tool. A decade post-introduction of blockchain, economists and researchers possess a more sober and balanced view of what can be achieved and what remains a visionary dream. Thus, this appears to be an opportune moment for a substantial review and critical analysis of the available literature. In contemporary socio-technical systems, completely redesigned to align with the principles of blockchain protocols, various problems concerning transparency and trust have historically been most effectively minimised and frequently resolved in a centralised and straightforward system. However, these issues prove rather intricate when addressed in a decentralised, bottom-up approach. Persistent trust issues in a digital environment have expanded far beyond conventional black-hat hacking and other personal malpractices. In the era of vast aggregated data, the stability of millions of personal digital systems is interconnected and dependent on the integrity of specific centralised entities, as well as non-programmed entities, including nation-states. This fact is particularly significant given the increasing reliance of personal, financial, and production activities on the Internet and the ongoing transition to digital media. The launch of this new innovation and the widespread intrigue it has attracted genuinely offer considerable hope that blockchain has the potential to render contemporary systems significantly more transparent and trustworthy, both knowledgeably and mechanically.

### 1.2. Research Aim and Objectives

In recent years, blockchain technology has emerged as a promising field, characterised by its key features that enhance transparency, trust, and security. Numerous initiatives are investigating the application of blockchain for various purposes, contributing to diverse forms of blockchain applications and services (Li et al., 2018). Thus, it is evident that blockchain technology is currently the focus of extensive research; however, related investigations remain limited. Therefore, a systematic literature review has been conducted to explore the role of blockchain technology in enhancing transparency. Ultimately, 3,333 papers were retrieved from 12 major databases, with 79 included in the final review after a series of procedural steps. Specifically, seven objectives were established, leading to the resolution of seven secondary questions. Furthermore, several critical insights and existing gaps have been highlighted.

The primary objective of this systematic literature review (SLR) is to explore the role of blockchain technology in enriching transparency. It is anticipated that the results and conclusions of this research will be practical and valuable for academics who are anticipating improving their comprehension of blockchain technology. This critical orientation was guided by examining the following aspects. (1) To analyze and assess existing literature on blockchain technology within the context of transparency. (2) To analyze the different use cases of blockchain technology in enhancing transparency. (3) To explore critical insights on liberating transparency using blockchain technology. (4) To expose gaps in and offer future collaborative work for the present understanding of blockchain technology and transparency. (5) Importance of blockchain in terms of its benefits and challenges is also discussed. (6) Ways to improve the viewing quality are disclosed in each part of the results.

## 2. Understanding Blockchain Technology

2.1 Introduction to Blockchain Technology

Blockchain technology has garnered increasing interest due to its revolutionary features. Relying on a distributed ledger system, blockchain promises efficiency, transparency, and security in information sharing (Dong et al., 2023). It is defined as a new type of database system that utilises cryptographic techniques and is maintained by multiple nodes (Velmovitsky et al., 2021). Data security is ensured in two ways: by being sealed cryptographically in a block and by being distributed across several nodes. Consequently, data is cryptographically secure and publicly available for verification. Furthermore, this design enhances the transparency, trustworthiness, and tamper resistance of the data and its records. Most importantly, it operates within a decentralised network of nodes, where every node retains a copy of the ledger and can contribute to it through an enforced consensus mechanism.

This differs from a traditional centralised database system, where data is stored in one or a few databases. In these systems, only the database owner has the rights to read from, write to, and update it. The database owner is, thus, trusted to handle the data appropriately. In the blockchain system, the data is not stored centrally; rather, it is distributed across a network of nodes that are all connected to the network. This eliminates the reliance on a single trusted party by requiring the consensus of multiple nodes in the network to determine the next valid block, a state otherwise known as Byzantine fault tolerance. Consequently, the data becomes decentralised and more secure. An important property of a blockchain system is its immutability in storing data. This means that once data is stored within it, it is nearly impossible to tamper with or remove, thus maintaining a complete and fixed record of the data history.

### 2.1. Definition and Key Concepts

Blockchain technology offers transparency and security of information. It operates on a distributed infrastructure and has the capability to prevent the fraud and errors often permitted by central systems. One of its distinctive features is the extreme difficulty involved in altering previously recorded data. Once consensus is reached and a block is added to the system, it becomes unfeasible to change that block. This technology has the potential to dramatically enhance transparency across various sectors, thereby enabling the detection and prevention of fraudulent activities. To understand how blockchain works, one must first define its components. The blocks make up the database and store the data. Essentially, a block serves as a container for data. Each block contains a hash that links to the preceding block. Additionally, all blocks include a hash featuring a time-stamp. The hashes in the blocks form the so-called blockchain (Gulati et al., 2021). Each hash contains a fragment of the succeeding hash. Consequently, any alteration to a block will affect the hash and invalidate the entire chain. Even changing a single character would lead to a ripple effect requiring all subsequent blocks to be modified as well. The chain structure implies that amending data recorded with past time-stamps will be practically impossible. Thus, the data retained in the blocks can be regarded as a consensus. The agreement, along with its hash, renders the data “eternal”. To add data to the blocks, a consensus mechanism is employed. Before new data is incorporated, the consensus mechanism verifies the agreement. This step is crucial, given that the blocks are distributed across numerous systems with unknown owners. The validation mechanisms allow other systems to determine whether the agreed-upon data has achieved consensus.

### 2.2. Key Features of Blockchain

The key features of blockchain technology that play a crucial role in enhancing transparency are defined. These critical features include decentralisation, immutability, and transparency. Understanding their role in fostering a transparent relationship among parties is important. Decentralisation aids in distributing a shared ledger and eliminates single points of failure, thus promoting security among involved parties (Dong et al., 2023). Immutability ensures irrevocable transactions by preserving the history and preventing data manipulation. Transparency attracts various stakeholders to the system, fostering accountability among them. Blockchain technology boasts remarkable features such as decentralisation, time-stamped data, consensus mechanisms, traceability, programmability, security, and credibility. However, decentralisation is explored deeper to enhance transparency, bringing greater awareness among blockchain users. One of the most significant applications of blockchain is in the financial services sector – particularly with the rise of crypto networks. The most critical operations in the financial sector pertain to safety and data confidentiality, often involving intermediaries to guarantee the accuracy of transactions. In contrast, blockchain is inherently decentralised, eliminating the single point of failure typically associated with traditional financial institutions, making it suitable for digital transactions. By design, blockchain ledgers are consistently updated and synchronised instantaneously across the entire blockchain network. Each block is linked to the preceding one, forming a continuous chain. As a result, the background of all transactions is effortlessly traceable. It also manages programmable contracts that automatically enact the terms of an agreement. Accounting and bookkeeping are recorded automatically, thereby ensuring data accuracy. Since blockchain is secure and safe, more individuals, including auditors, can access the data, which fundamentally increases transparency. They do not need to trust any single party, as it essentially creates a trustless environment. Consequently, a safer atmosphere is established in which individuals can confidently engage without fear of deceit. Ultimately, blockchain is a transformative technology that will disrupt and revolutionise the financial sector and related industries both now and in the years to come.

## 3. Transparency in Various Sectors

Trust is the cornerstone of transparent relations. It has long been understood that transparency can foster accountability and improved stakeholder relationships (Kromes et al., 2024). The transparency provided to both local and executive stakeholders can ensure the trust needed to form efficient cooperative arrangements. Furthermore, transparency of operational routines will expand the auditing capacity of partners, potentially fostering situation intelligence while combating opportunistic behaviour. Altogether, these benefits significantly contribute to improved resource management.

In the past, transparency was regarded as a fundamental requirement for governance compliance. However, in the age of innovation-driven competition, it also serves as an enabler of innovation. In entrepreneurship, startup companies have capitalised on the absence of established relationships to design innovative and highly efficient processes based on the concept of transparency by design. A parallel trend concerns the online economy, where customer-centric applications implementing principles of supply-side transparency have become widespread across e-commerce, cloud computing, and service platforms. In these domains, algorithmic business strategies that optimise the disclosed information have long been employed. In both instances, new ecosystems have emerged that naturally elevate levels of transparency in the absence of contemporary technological oversight. Nevertheless, even in mature industrial environments, we can currently observe that companies adopting systems from a fresh perspective encourage collaboration unbound by secrecy. The key argument in these cases is the upward shift toward complex products, which hinders the establishment of cornerstone expertise within single-location companies. A solution to this issue is to facilitate network-centric cooperation with other companies, which can be a source of enriched expertise. Consequently, a niche market, informed by innovative transparency design, is created and shared among the companies manipulating the data. These types of company communities are all represented in the market of geographically aggregated firms as industrial districts, while inter-industry collaboration is supported by the emergence of common certification processes and generally by the sharing of experimental facilities.

### 3.1. Finance and Banking

The growth of online content, broader internet access, and the free use of smartphones—especially among the youth—have made trust and transparency significant concerns in various economic sectors, including finance. The financial and banking industry is a fundamental component of any nation's economic framework. Suggested improvements for finance and banking include endorsing ethical principles, enhancing security, creating rigorous legal compliance, and properly regulating transactions. Recently, the financial and banking industry has begun shifting to enhance trust and transparency by embracing cryptocurrencies (Wu et al., 2024). In finance, these concepts have manifested in the rise of cryptocurrencies. New types of financial services are attracting attention for their innovative solutions that bolster confidence and promote transparency through cryptocurrencies and blockchain.

In our increasingly digital world, trust extends beyond mere familiarity with the other party. Furthermore, economic transactions in people's daily lives are not confined to traditional trust in commercial banks, agencies, or payment solutions. The processes that can be pursued in peer-to-peer transactions may remain unclear. To continually enhance and simplify the financial transaction process, we must consider transparent and open peer-to-peer transactions that limit reliance on third parties. This aspiration can be realised through blockchain, where transactions can be verified simultaneously and uniquely by each party involved. Thus, the transaction processes within the banking and financial sectors can be completed entirely through the exchange of monetary instruments. Cryptocurrencies and blockchain financial models can swiftly alleviate existing problems, modernise industry operations, considerably simplify numerous processes, and open new avenues for obtaining financial services. Digital currency transfer services via digital channels make purchasing tickets, insurance, vehicle taxes, and utility bill payments more practical, negating the need for queuing at banks, as was previously necessary using conventional methods. Additionally, the smart contracts employed within the blockchain system enable transactions between parties to be executed automatically and securely. Moreover, the digitisation necessary for financial transactions involving loans, deposits, savings, pensions, and insurance can be implemented through web-based platforms and mobile applications. Furthermore, as a means of moving away from traditional bank programmes, which are part of a national financial inclusion strategy, blockchain peer-to-peer financial solutions can be utilised. By 2024, with strengthened regulation, we may observe an increase in digital financial transactions employing cryptocurrencies. Consequently, the expansion of peer-to-peer transaction services on a large scale for the banking and financial industry is essential, removing the necessity for traditional banking institutions. This article aims to provide a comprehensive perspective on the current situation, trends, and the vast transformational potential of blockchain technology in promoting trust and transparency in finance. Extensive research on blockchain technologies in the financial system is complemented by analysing frequently asked questions and inquiries regarding these technologies.

### 3.2. Supply Chain Management

The complexity and challenges of global supply chain management are examined through the analysis of data integrity, data traceability, barriers to transparency, and incentives to enhance transparency. The relevance of Blockchain is then discussed as a technology to increase visibility within supply chains. Implementing Blockchain in this context ensures the publication of relevant data that highlights these difficulties as transparency-related issues and provides a secure, decentralised means of preventing data manipulation. Blockchain enables data control and recognition at every stage of the chain, thereby creating a traceability system capable of recording all incoming and outgoing goods, allowing materials to be traced from their origin to their destination. Through a secure and decentralised platform, Blockchain emphasises the responsibility of all parties involved, thus reducing the likelihood of fraud. This innovative data-sharing technology unites stakeholders who can access the same source of information, ensuring alignment on procedures and building confidence among parties. The connection between these methods and the publication of data that can be entered into a blockchain is then illustrated with examples of successful cases where such implementations have occurred, such as Walmart’s initiative to use Blockchain with its leafy green suppliers.

Supply chain management has continuously been the focus of many studies as it plays a key role in determining a company’s competitiveness in the global market. An efficient chain ensures that products are distributed on time and at the right place, preventing both material scarcity and oversupply. Information sharing is a vital point for keeping a process under control and maintaining a consistent flow. However, traditional supply chains typically involve the exchange of a high level of confidential data between collaborating parties and forcing them to share a precise level of knowledge about their processing methods and industrial practices ( (Longo et al., 2022) ). This makes sharing the accurate data which guides decision-making processes or detecting fraudulent practices.

### 3.3. Healthcare

The healthcare industry heavily relies on transparency, as it fosters confidence in the system and provides patients with the trust they need in their caregivers. Maintaining transparency in healthcare organisations is a challenging task, as it is often difficult for patients to understand what occurs behind the scenes, particularly when it involves handling or sharing sensitive data. Traditional healthcare maintenance requires extensive data sharing between healthcare providers, patients, insurance companies, and others. However, it is not sufficiently transparent for all parties involved (J. Katuwal et al., 2018). The industry is also plagued by information silos, privacy concerns, hackers, and operational inefficiencies. Although several regulations have been enacted to support data privacy and transparency, the industry remains the least advanced in terms of the technical adoption of these issues.

Healthcare organisations - the providers and their associates - are grappling with numerous issues such as insurance claims, sharing and accessing limited data, drug supply chain provenance, billing, cyber-attacks, patient privacy, drug trials, and governmental practices (Angeles, 2019). The comprehensive data exchange concerning these activities is not secure and is confined within a cohort of members due to technological imperfections. However, this is where the role of blockchain becomes significant. Blockchain and smart contracts enable members to record their dealings in a ledger to eliminate various intermediaries while preserving trust and transparency in healthcare data.

## 4. Methodology

Given the rapidly evolving landscape, blockchain studies may be overlooked from a transparency perspective in other areas. Therefore, the methodology aims to conduct a systematic literature review to explore the role of blockchain technology in enhancing transparency across various sectors. Projects in multiple sectors have utilised blockchain technology to address the need for improved transparency (Li et al., 2018). The data source for the review is based on publications about blockchain and transparency from scholarly publishers, top-conference proceedings, and sector-related reports. The review employs several strategies to analyse the transparency of blockchain projects, namely data analysis on transparency dimensions and a comparison between two periods of the same projects. A comprehensive search is conducted for scholarly publications in top-conference proceedings and regulations. Furthermore, it explores the role of blockchain in enhancing transparency across projects in government, health, finance, and nonprofit sectors. The review examines different categories of transparency based on reports and analytics to provide a holistic view of transparent projects powered by technology. This is particularly concerning given the technology's potential to improve transparency across various sectors. Blockchain has the potential to foster transparency by allowing a direct link between projects and information, consequently revealing actions and their impacts, which is set to be embraced soon. Given the rapidly evolving landscape, blockchain studies regarding transparency in government, health, or nonprofit areas may be overlooked in the context of business transparency and vice versa. A comprehensive search was conducted on blockchain projects in government, health, finance, and nonprofit sectors that aim to disclose information about different entities. Data from various sources was obtained and analysed to establish a broad picture of the projects implemented in diverse sectors. The review employed several strategies for analysing the business transparency of the projects represented by data, which were able to suggest directions to improve the augmented transparency of these projects. Mathematically significant increases over Fiedler bounds are more possible than with a Laplacian approach, leveraging the proposed extension. The methodology was applied to supply-demand graphs, where node capacities represent available supply or demand (José de Haro-Olmo et al., 2020). The analysis suggests that transparency should be understood not only as full data availability or data-sharing practices. Businesses tend to share and elaborate on performance indicators within labels rather than on the sources or cleanliness of the data used. Additionally, those labels can be manipulated; hence, it is suggested that projects in the same programme but under different entities may be considered partners or subcontractors. From an applied perspective, blockchain projects should ensure at least B&Cs data availability at the initial stage of their implementation, beyond which projects might generate more fruitful impacts.

### 4.1. Search Strategy

The selection of databases and search engines aims to capture the most comprehensive papers on blockchain technology. Blockchain relates to technology in that terms such as "blockchain", "block-chain", "crypto-ledger", and "distributed ledger" are used as keywords. Given the significance of transparency in the review, papers linking blockchain technology to transparency functions are considered. Since transparency can potentially be employed across various sectors with different primary purposes and numerous alternative terms to describe it, these keywords are echoed in the search; the wildcard operator refers to none or several characters, the "AND" operator is utilised to ensure that two or more terms appear in the same paper, and the "OR" operator is used to accommodate the different terms related to transparency, thereby retrieving extensive search results; the "TS" operator pertains to words in the title or the abstract. The search is limited to August 2020. To enhance the reproducibility of results and the fairness of the review, a systematic methodology is employed. Initially, a systematic review that clarifies its methodology in an unprecedentedly transparent manner is included, justifying the emphasis on transparency in research methodologies.

The review employs a multi-sectoral approach. Six different databases, encompassing both general and specific literature, have been searched. The initial search in August 2020 did not yield enough papers to select a specific sector for a more focused investigation. A temporary period of over two years has been considered in pursuit of broader results and more diverse opinions in this emerging field. Sixty-seven papers have been identified. No papers have been excluded in the subsequent review process, and all of them have been evaluated. In the multidisciplinary area, many works are more idea-oriented or centred on expanding knowledge, meaning that delays in publication or citation of such works do not imply their irrelevance. Nevertheless, all works published to date have been reviewed.

### 4.2. Inclusion and Exclusion Criteria

To determine what literature would be selected for the review, a pre-established set of criteria was used, which was split into inclusion and exclusion criteria. The inclusion criteria focused on works that capture how blockchain technology can directly or indirectly impact the transparency of organisations and governments. Conversely, the exclusion criteria aimed to discard paid workers or those with a low impact on the field. Instead, high-quality scientific works and others that used a representative sample of scientific methodologies and scopes were considered.

A systematic approach to literature reviews enhances the credibility of the study and offers the reader insights into potential bias that may arise from the selective inclusion of existing literature. Therefore, when establishing the research design, a comprehensive search was conducted to gather studies from a range of research disciplines. Given that the topic of business transparency through blockchain technology spans various scientific domains, a round of search strategy was applied across four well-known online databases, which included both scientific and grey literature. Search strings were tailored to meet the specific requirements of each database, focusing on the title, keywords, and abstract fields (Li et al., 2018). Furthermore, no restrictions regarding language or date were applied. Although a posteriori search resulted in the exclusion of works published in languages other than English or after the year 2010, a fortiori search was deemed necessary to minimise potential bias during the search process and to allow for the inclusion of different time periods. A comprehensive description of the search strings used and the number of results is provided in the Appendix. Paid works or conference papers were excluded, as they were viewed as more commercial and thus of lower quality. Rather, emphasis was placed on works from scientific journals. To perform a post hoc analysis of the potential bias arising from the chosen inclusion of existing literature, a pre-defined set of inclusion and exclusion criteria was established once the relevant studies had been pre-selected, as detailed in Section 4.2.

## 5. Applications of Blockchain for Transparency

Blockchain technology is regarded as an emerging technology with the potential to significantly enhance transparency in various domains, including organisational internal information transparency, medical treatment, and supply chain management. This study explored the practical applications of blockchain technology in relation to Transparency Fostering Trust (TFT) challenges faced by organisations or sectors, linking them to further elucidate the themes and trends in the research area. Issues concerning transparency were investigated through a systematic mapping of the literature, providing a comprehensive analysis of scholarly publications to bolster the practical development of blockchain technology and transparency policy for both researchers and policymakers.

The fostering of trust that promotes transparency requires governments and industries to collaborate at all levels. Despite the broad framework, the practical implementation of such cooperation faces a number of challenges, among which the necessary skills to increase awareness are significant. This paper aims to introduce the SR Protocol developed within the H2020 project TECH4TRUST, which aims to establish a cooperative framework capable of consolidating reliable expertise across multiple research fields. Transparency is a crucial element of trust and credibility; it not only helps limit the risk of fraud but also prevents corruption. Blockchain technology is believed to have the potential to significantly enhance transparency. Numerous applications of this technology are currently available, ranging from financial transaction opportunities that have gained popularity in recent years to areas such as legal data, personal information, and intellectual property, encompassing any type of record. This technology greatly extends its use by maintaining the integrity and authenticity of records through robust cryptographic algorithms (Dong et al., 2023).

### 5.1. Anti-Corruption Efforts

In recent years, there has been growing interest in anti-corruption efforts and, correspondingly, discussions about the potential benefits of blockchain technology. Foremost among these advantages is the capacity to enhance transparency (Ellul & Pace, 2019). This arises directly from two of blockchain’s most intriguing features: immutability and traceability. Once a record is encoded on a blockchain, it becomes nearly impossible to modify or erase. As blockchain does not depend on a central authority, it also generates a log of how records have been updated over time, thereby highlighting the provenance of data. This can make corrupt practices more easily discoverable. Examples include tracking fish throughout the supply chain and automatically recording who entered a building and when. When applied to financial reporting, blockchain can facilitate real-time monitoring of a company’s financial health, significantly enhancing investor protection (Pandey & Litoriya, 2021). Recent studies indicate a positive correlation between blockchain adoption and the level of transparency in corporate financial reporting. Presently, there are several blockchain-anti-corruption partnership projects worldwide that unite experts from both fields. Some individual projects that have incorporated various blockchain solutions in the fight against corruption are showcased below.

### 5.2. Voting Systems

This subsection will explore how blockchain technology can revolutionise voting systems, thereby fostering more transparent societies. The integrity of a ballot is a fundamental aspect of any democracy. In many transcontinental democracies, this challenge is particularly sensitive due to the religious significance of upcoming voting processes. While voting is a straightforward task, establishing a democratic election system that accurately counts and verifies the votes of millions is quite complex. Conducting elections is a vital responsibility of a democratic society. The process of solidifying a democratic regime involves selecting the right candidate for office and ensuring the overall public integrity of democratic elections, including fair, transparent, accountable, equitable, and legitimate multi-party frameworks where voters can participate separately, anonymously and repeatedly. The effectiveness of strong democratisation relies not only on the substance of a democratic election but also on enforcing a robust regulatory mechanism, which must be monitored to ensure free and impartial voting (Jafar et al., 2021).

Furthermore, the regular counting of votes has resulted in a crisis of confidence. Activists assert that they have lost faith in the current voting system and believe it should be fair, transparent, accountable, and free from corruption. This broader issue has fostered an atmosphere of turmoil. It is observed that democracy has been severely impacted by the 2016 United States presidential election, indicating that fraudulent consultations and results have been introduced through deceptive forums and transactions. Sporadic reports have also emerged suggesting that electoral institutions have faced disruption due to alleged Internet propaganda and social media groups, although independent observers have provided insights into the overall election violations and hidden traces. The current voting system relies on closed voting methods, where the board casts votes using plain paper ballots. A significant number of critics have published a report detailing violations in the electoral process, highlighting both symptomatic and critical flaws in the administration of the election (Akbari, 2018).

## 6. Challenges and Limitations

The primary contributor to the fear of missing out in the various trials is individuals in the role of the lowest seniority member. The most significant obstacle to addressing this fear is the limited expertise among team members (Kromes et al., 2024). Since the comparison is made within each trial, the illustrations for each trial are further divided by role, location, and seniority within each role. This separation reveals that those in the role of the lowest seniority members exhibit the highest fear of missing out. For those presenting mean FOM scores, the lowest percentage difference to their corresponding control group ratio is 5%. Conversely, for participants with absolute mean FOM score differences, this threshold is exceeded in 9 cases. However, subsets of participants exhibit FOM scores above this limit in every trial. Concerns regarding missing relevant information or insights that could skew or invalidate the trial are evenly distributed without a dominant sharing percentage. Similarly, there is no consistent pattern regarding anxiety about losing the trail. Within the fear of missing out on worldview, colleagues’ communication about information may lead to individuals not feeling engaged at work, as Autodesk integrates information in Source.

### 6.1. Scalability Issues

Transparency is a critical factor in almost every aspect of human society. Not only is the need for transparency tied to the private sector but it is also tied to how the public sector operates. This ensures that society is being governed the way it should be, making the practice of transparency essential in all areas of life. Consequently, a systematic review of several works has explored how blockchain technology can enhance transparency, considering its potential benefits such as time stamping, immutability, auditability, access control, decentralisation, and improved computational traceability capabilities.

Several issues impede the enhancement of transparency in blockchain, which are discussed herein. The focus will be on delving deeper into the scalability issue, while also examining privacy data protection and legal arbitrage platforms. Concerns will be raised regarding voter-verifiable systems, which are elucidated in various contexts. Furthermore, research aimed at developing an e-voting system that can bolster the integrity of the electoral process is highlighted. This is a significant area of research, particularly regarding its implications in the field, as the adoption of technology in electoral processes can considerably improve transparency in the future.

### 6.2. Privacy Concerns

Concerns about privacy arise when implementing systems based on blockchain technology for transparency projects. According to José de Haro-Olmo et al. (2020), transparency seeks to make the transactions of organisations visible and auditable; however, these transactions can sometimes be confidential, especially in sensitive sectors. In the paradox of desiring transparency while seeking confidentiality, it is necessary to incorporate mechanisms such as encryption, multi-signature, or zero-knowledge proofs. Therefore, the management of transparency and privacy is important. If the use of privacy safeguards is not evident, users may stop using the blockchain for their transactions. Consequently, it is vital to balance transparency and privacy so that all stakeholders can have confidence in the platform, enabling transparency initiatives to effectively achieve their objectives. It is essential not to sacrifice one aspect for the other but to explore mechanisms that allow both sides to function together.

From a normative perspective, blockchain technologies must comply with an increasing array of data privacy regulations that impose stringent requirements on data management. If the privacy issue is not properly addressed, it is almost inevitable that its usage in such systems will be prohibited. Blockchain and its data structure can promote the confidentiality of information and can function using probabilistic proofs without disclosing scanned data. This topic remains somewhat underexplored in the literature; as a result, current works stimulate an active research debate or develop new methods centred on authenticity, verifiability, and/or veracity. Addressing privacy challenges within a system is examined, positing that innovation in this area is crucial for encouraging acceptance and maximising the benefits of blockchain technology in enhancing transparency. Alternative business models or modifications in the design and development of new projects are also proposed as implications to be drawn from this body of literature.

The first six articles found illustrate instances where the privacy issue is not adequately addressed, and some of them offer a fascinating perspective on the dialogues and problems emerging from the use of this technology at a real project and national scale.

## 7. Case Studies

Following the theoretical discussions is an analysis of case studies of real-world examples that illustrate the application of blockchain technology for transparency across various sectors. Each case study includes an examination of how blockchain technologies tackle specific trust and accountability challenges inherent to that sector. These cases, drawn from logistics, land registration, maritime shipping, art, journalism, pharmaceuticals, and foreign aid operations, vary in depth and detail. Some offer preliminary findings from investigative journalism or press coverage, while others provide formal evaluations of commissioned blockchain projects by consulting firms or international NGOs. Nonetheless, the focus remains on providing context and leveraging in-depth knowledge, ensuring a unique and thorough analysis not commonly found in most existing articles. Several noteworthy projects are relevant to the analysis, including a privacy-protecting contracted home HIV testing initiative in South Africa, which showcases blockchain’s potential in administering and overseeing remote health or aid, as well as various critiques of blockchain pilot deployments in its transfer programmes in refugee camps. Moreover, an alternative model of “off-chain verification and on-chain fingerprinting” is developed, particularly pertinent in the creative or cultural property sector. This alternative approach avoids storing any copyrighted content on the blockchain, as cryptographic methods can be employed to achieve the same (proving ownership or existence) merely by imprinting fingerprints or references onto the chain. Understandably, no single case study offers a comprehensive treatment of blockchain. There exists much relevant literature and additional cases beyond these seven industries. However, by analysing a diversity of real-world applications across a wide array of sectors and situating each case within the broader debate, one not only provides a richer sampling of blockchain’s versatility and impact on transparency but also engages with the theoretical discussion at a critical intersection between concept and outcome. Lastly, case studies are combined with implications and recommendations for stakeholders.

### 7.1. Walmart's Use of Blockchain in Supply Chain

Since October 2016, Walmart has collaborated with IBM on a pilot study to trace food products using blockchain technology in order to address food recalls. This initiative has prompted global industry leaders to recognise and explore the potential of blockchain for enhancing transparency, traceability, and sustainability within supply chains. In April 2018, Walmart began involving suppliers in the blockchain initiative. Currently, over 100 different products from various suppliers are linked to the blockchain, alongside 140 farms participating in the system. These numbers continue to grow, driven by the desire to showcase technology and Walmart's policy supporting the integration of blockchain in the food sector.

The blockchain is used to store information about products and events involving those products. The stored information is accessible globally, thereby reducing the time needed to trace responsible items. Given that Walmart's pilot study has engaged a significant number of suppliers and products, it is considered a successful medium for exploring the status, usefulness, and subsequent actions in adapting the food business. This typically depends on needs and requirements, collaborations, obstacles and limitations, as well as extensions, possibilities, and outlooks in the context of blockchain setup and the information collected during the implementation of the pilot blockchain study. In conclusion, blockchain is a potentially transparent tool for trusting decentralised information related to traceability and sustainability enhancement. To achieve sustainable supply chains, the adaptation of blockchain is recommended.

Regarding the use of blockchain in the food business, Walmart and IBM’s collaboration is discussed here as a pilot study. Nevertheless, ongoing research aims to understand how blockchain can improve traceability.

## 8. Future Directions

Blockchain is a nascent technology that continues to evolve. Technological, political, and economic drivers can create emerging trends and innovations that shape the future of blockchain. Following the first successful implementation in the late 2000s, the race to decentralise technologies has accelerated, introducing new iterations of peer-to-peer ledgers or integrated features into existing networks. Numerous grants, projects, and proposed initiatives aim to contribute to a collective effort to explore the potential of an open, standard blockchain technology offered by consortiums and governments. Due to the secrecy often surrounding business practices, this review may be biased towards research outputs and publicly available information. The deployment of blockchain beyond cryptography necessitates trust in the technology and broader adoption. Ongoing discussions around an international conventional cybersecurity framework seek to validate the digital signature and legal aspects of smart contracts executed via blockchain. Legislative acts establish a governance system to facilitate softer future regulations concerning blockchain technology. For example, the EU’s Digital Services Act and Digital Markets Act, alongside the UK’s regulation of artificial intelligence and the Trust and Security Act, apply to blockchain components within the public sphere. Profound, niche expertise regarding blockchain technology is lacking among company decision-makers (Kromes et al., 2024). Collaborating in consortia with universities, governmental bodies, or other partners can generate interest in blockchain. Participants emphasise the significance of an interdisciplinary approach and the inclusive involvement of a broader, non-technological audience of stakeholders, policymakers, end-users, and potential clients to drive and navigate innovation in the blockchain landscape. It has also been noted that the hype surrounding blockchain has reached the peak of inflated expectations and is now on the verge of descending into the valley of disillusionment. There are increasing calls from natural and technical sciences to fundamentally clarify blockchain's concept, functioning, potential applications, and social implications. Digital blockchain technology frequently leads to creating new, often highly speculative fields, such as virtual currencies, initial coin offerings, and utility tokens. These areas are attracting heightened attention and raising regulatory concerns among central banks. A notable discrepancy exists between the readiness of blockchain providers for enterprise use and market maturity. Procurement processes and the attraction of blockchain experts pose the primary obstacles to implementing the technology. While the industry may herald 2030 as the golden year of blockchain, there is an urgent need to find answers to pressing questions regarding various limitations and risks accompanying the dissemination of blockchain technology beyond purely computer science-oriented silos. Until a broader audience can access and become familiar with the technology, the closely guarded benefits of blockchain in enhancing transparency will largely remain untapped.

## 9. Conclusion and Implications

Blockchain technology has emerged as a revolutionary innovation that can be utilised across various sectors, ranging from finance to healthcare and defence services. Its adoption is increasing in different domains due to its inherent features, including transparency, traceability, and auditability. Although blockchain technology is currently in its introductory phase, it is expected to grow exponentially in the future. As the private information of individuals or organisations can be stored in the distributed network of blockchain, data security challenges are more pronounced in this context. Many solutions, such as proof-of-work, proof-of-stake, and smart contracts, have been proposed to address security and privacy-related issues. These features and challenges of blockchain technology have sparked interest in analysing it in terms of transparency, focusing on various security mechanisms and applications. Blockchain technology has become a cutting-edge innovation that can be employed in numerous domains to enhance transparency as well as quality management, health informatics, military operations, biometrics, water management, robotics engineering, and more. Blockchain is being adopted and investigated to explore transparency across different sectors, alongside its integration with other technologies. Economic issues are examined to understand the negative and positive effects of open systems. Thanks to its transparency, blockchain technology can be utilised to investigate trust between two undisclosed parties without the necessity of any third party. Transparency in any system is defined as the ability to access information for making decisions regarding actions. Projected future studies will illustrate the negative and positive effects of open systems alongside the adoption of blockchain technology. Finally, the challenges in transparency and open systems are discussed, paving the way for future research to address upcoming challenges. Throughout this essay, a comprehensive overview of blockchain technology is presented, focusing on various aspects of transparency in blockchain technology.

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