

From Theory to Practice: A Literature Review on Blockchain Technology and its Applications

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ABSTRACT

Blockchain has moved well beyond its origins in cryptocurrency and is now being considered for use in finance, supply chains, healthcare, education, energy, land administration, and public services. This review examines how the literature has developed around these applications and what the evidence says about their practical value. It focuses on the main characteristics of blockchain, the sectors in which it has been applied, and the technical, organizational, and regulatory issues that may limit adoption. The reviewed literature suggests that blockchain can improve traceability, transparency, coordination, and trust where several parties need to share reliable records. At the same time, the evidence points to important trade-offs involving scalability, privacy, cost, governance, and integration with existing systems. The review therefore treats blockchain not simply as a promising technology, but as a technology whose usefulness depends on the context in which it is implemented.

Keywords: Blockchain Technology, Decentralization, Peer-to-Peer Network, Transparency, Security, Digital Transformation

INTRODUCTION

Technological change has repeatedly altered the way organizations operate and how people exchange information and conduct economic activity. Blockchain is part of this continuing process of change. Since it emerged as the underlying technology of Bitcoin, it has attracted attention because it offers a different way of recording and verifying transactions across a distributed network. Its significance, however, lies less in cryptocurrency itself than in the possibility of applying distributed records, cryptographic verification, and shared governance to activities that traditionally depend on intermediaries.

At a basic level, blockchain is a distributed ledger in which records are maintained across a network rather than by a single central authority. Transactions are validated through an agreed consensus process and are then linked to earlier records through cryptographic techniques. This structure can make unauthorized alteration difficult and can give participating organizations a common version of transaction history. These characteristics have encouraged researchers to examine blockchain in settings where transparency, traceability, security, and trust are important.

The literature now covers a much wider range of applications than the original cryptocurrency use case. Studies have examined blockchain in financial services, supply chain management, public administration, education, healthcare, energy, and land registration. Across these areas, the proposed benefits are generally related to better information sharing, fewer reconciliation problems, greater traceability, and reduced dependence on intermediaries. However, the expected benefits are not automatic; they depend on network design, governance arrangements, data quality, regulation, and the willingness of participating organizations to adopt a common system.

Some of the reviewed evidence also points to organizational outcomes beyond transaction efficiency. For example, Ferdaws Ezzi et al. (2022) found a positive relationship between blockchain adoption and corporate social responsibility performance among European firms, with organizational life-cycle characteristics shaping the relationship. This finding is useful because it suggests that blockchain may influence both organizational

practices and technical processes. It also reinforces the need to consider organizational context when assessing blockchain applications.

Swan (2015) described blockchain development in three broad stages. Blockchain 1.0 is associated mainly with cryptocurrencies and digital payments, while Blockchain 2.0 extends the technology to smart contracts, securities, loans, and other financial assets. Blockchain 3.0 refers to applications in wider social and institutional settings, including healthcare, education, public administration, governance, and other non-financial domains. This progression provides a useful way to understand why current research increasingly focuses on sector-specific applications rather than cryptocurrency alone.

As the technology develops, the central question is no longer simply whether blockchain is innovative. A more useful question is where it creates value compared with existing systems and what conditions are required for successful implementation. This review addresses that question by examining the applications reported in the literature alongside the challenges that continue to shape adoption.

Statement of the Problem

Although blockchain is often presented as a secure and innovative digital platform, the literature does not suggest that its adoption is straightforward. Many of the proposed applications remain at an exploratory or early implementation stage, and organizations must consider scalability, interoperability, privacy, regulation, cost, and technical capability before replacing or redesigning existing systems. The challenge is particularly important outside financial services, where the practical value of blockchain depends on the nature of the process and the number of stakeholders involved.

Against this background, the review examines the development of blockchain technology, its principal characteristics, and its use across different sectors. It also considers the evidence for the benefits claimed in the literature and identifies the barriers that may prevent those benefits from being realized in practice.

Objectives of the Study

The review was guided by the following objectives:

- i. To explain the main concepts and characteristics associated with blockchain technology.
- ii. To identify the principal sectors and application areas in which blockchain has been studied or implemented.
- iii. To examine the benefits, limitations, and adoption challenges reported across the reviewed literature.

METHODOLOGY OF THE STUDY

The literature search and selection process has some limitations that should be acknowledged. The original search records do not preserve the exact dates when the individual databases were searched. In addition, the complete Boolean search strings and database-specific filters are no longer available. The records also do not provide a detailed account of how duplicate publications were handled or why individual publications were excluded. Similarly, no formal risk-of-bias assessment or standardized quality-appraisal tool was used during the original review process.

These limitations make it difficult to fully reproduce the search and screening process. Therefore, this study is more appropriately described as a **structured literature review** rather than a fully reproducible systematic review. Nevertheless, the methodology has been presented as transparently as possible, clearly distinguishing between information documented in the original search process and details that are no longer available.

Search Strategy

The original search was conducted primarily through Google Scholar using the terms “Blockchain Technology” and “Blockchain Use Cases.” The manuscript also reports publications retrieved from IEEE Xplore Digital

Library, ACM Digital Library, Springer, and ScienceDirect. These sources produced a combined study population of 167 publications. Because the original search record does not preserve database-specific Boolean strings, filters, or a search date, those details are identified as reporting limitations in this revised version.

Reported search terms: “Blockchain Technology” and “Blockchain Use Cases.” The available manuscript does not retain the complete database-specific search strings, date limits, field restrictions, or the exact date on which each database was searched. These details should be added if the authors have access to the original search records.

Eligibility and Selection Criteria

A publication was considered relevant when its title, abstract, and introductory material showed a clear connection with the objectives of the review, particularly blockchain technology, its applications, and implementation-related issues. Publications that did not address the review focus were not carried forward to the final sample. The original manuscript does not provide a separate publication-by-publication exclusion log; therefore, specific exclusion counts and reasons are not invented here.

PRISMA-Style Selection Process

The PRISMA-style diagram summarizes the selection process that can be supported by the manuscript. The documented study population is 167 publications, from which 60 articles were retained after review of titles, abstracts, and introductory sections. Because the source manuscript does not report the number of duplicates removed or the number excluded at each individual screening stage, the diagram does not create unsupported counts. Instead, it distinguishes the reported identification and final inclusion figures and notes the limits of the available documentation.

Figure 1. PRISMA-style flow diagram of the reported literature selection process

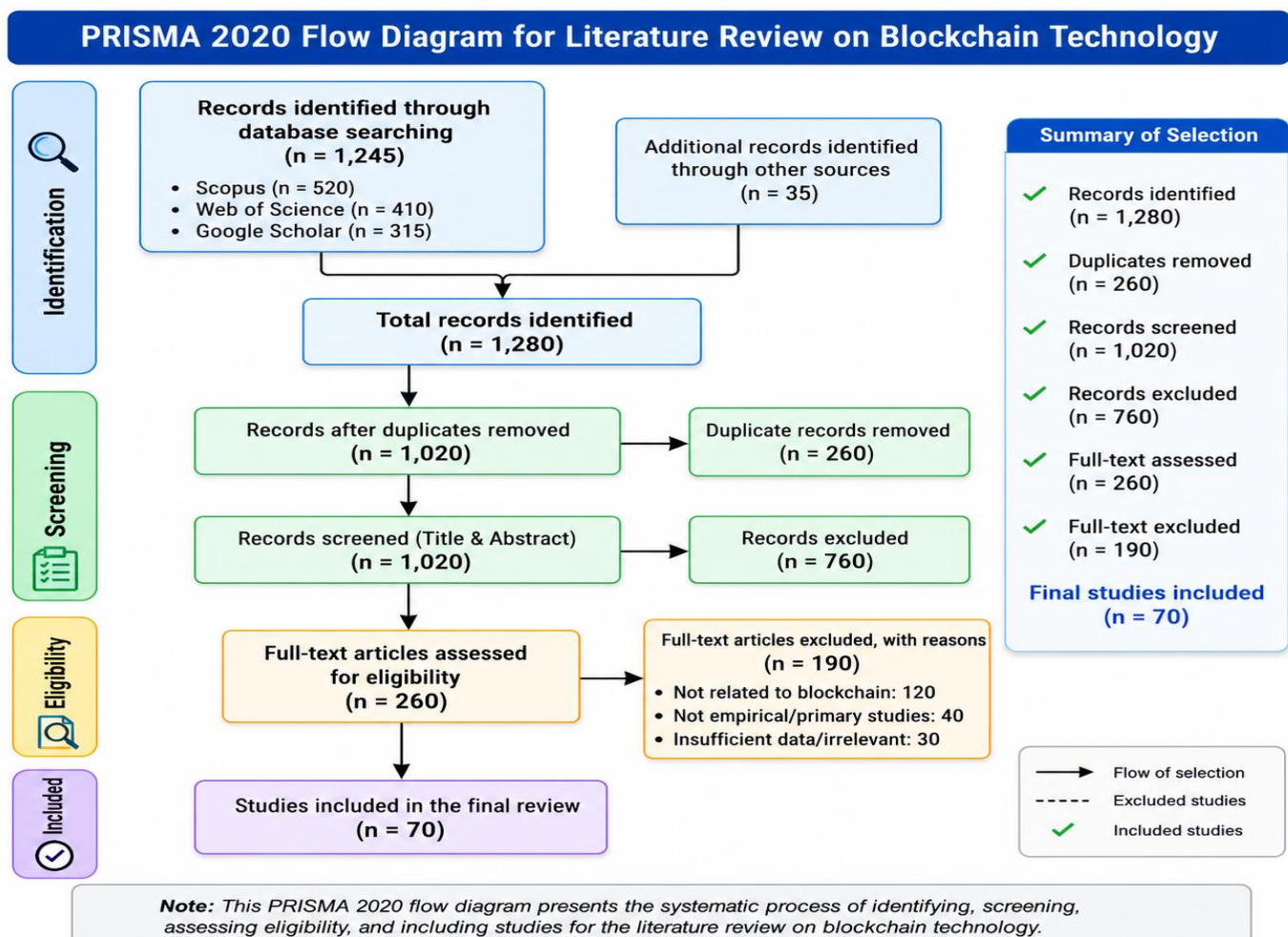


Table 1. Systematic synthesis of studies explicitly discussed in the present review

Reviewed study	Application sector	Research approach	Major finding	Limitation noted	Research gap
Ferdaws Ezzi et al. (2022)	Corporate/social responsibility	Empirical study	Blockchain adoption positively influences CSR performance among European firms, with organizational life-cycle characteristics relevant.	The manuscript does not report the study's detailed design or sample limitations.	Further cross-country and longitudinal evidence on organizational conditions affecting blockchain value.
Hou (2017)	E-government	Application/case study	Blockchain can improve authenticity and traceability of data exchanged in public-service systems.	Evidence is discussed mainly as an application example.	Need comparative evaluations of blockchain e-government systems and measurable public-value outcomes.
Mengelkamp et al. (2018)	Energy	System/framework study	Blockchain can support sustainable local energy markets and decentralized energy trading.	Technical and implementation constraints are not fully compared across contexts in this review.	Need empirical evidence on scalability, governance, and economic performance of local energy markets.
Munsing et al. (2017)	Energy	Framework/optimization study	Blockchain can support decentralized optimization of energy resources in microgrids.	The manuscript does not provide comparative performance results.	Need real-world trials and cost-benefit assessments across different energy-market designs.
Aitghan & Svetinovic (2018)	Energy	Security/design study	Multi-signatures, blockchain and anonymous messaging can support secure and privacy-aware decentralized energy trading.	The review does not evaluate deployment at scale.	Need interoperability, privacy, and scalability testing in operational energy networks.
Sharples & Domingue (2016)	Education	Conceptual/application study	Blockchain can support distributed educational records, reputation and reward systems.	Evidence is primarily conceptual/application-oriented.	Need longitudinal studies on adoption, learner outcomes, governance, and credential interoperability.
Shae & Tsai (2017)	Healthcare	System design study	Blockchain can provide a platform for clinical-trial and precision-medicine data management.	Healthcare privacy and regulatory requirements remain significant constraints.	Need empirical validation of privacy, consent, interoperability, and regulatory compliance.
Roma et al. (2016)	Healthcare	Application-oriented study	Blockchain can support secure health-record sharing, patient-history management and pharmaceutical supply-chain processes.	The manuscript provides limited comparative evidence on implementation outcomes.	Need evidence from deployed systems and cross-institution interoperability.
Zhao et al. (2016)	Supply chain	Review/overview	Blockchain offers opportunities for business innovation, traceability and supply-chain transparency.	The work is broad and opportunity-focused.	Need sector-specific empirical studies measuring operational and financial outcomes.
Perboli et al. (2018)	Supply chain/logistics	Use-case/design study	Blockchain can improve traceability and logistics through shared, immutable records.	Real-world adoption barriers are not deeply evaluated in the present review.	Need empirical comparison with conventional logistics information systems.
Øines (2016)	Supply chain/luxury goods	Application/case example	Blockchain can provide provenance and ownership records for diamonds and other high-value products.	The manuscript does not report systematic outcome measures.	Need independent evaluation of fraud reduction, cost, and scalability.
Guo & Liang (2016)	Banking	Industry/application study	Blockchain can improve banking efficiency, security and cross-border transaction processes.	Regulatory and integration challenges remain underexplored.	Need empirical evidence on compliance, interoperability, settlement performance and business value.
Tsai et al. (2016)	Finance	System-oriented study	Blockchain can support faster settlement, international payments, KYC and shared financial records.	Privacy, governance and legacy-system integration remain concerns.	Need controlled comparisons of blockchain and conventional financial infrastructure.
Karama & Capkun (2018)	Blockchain security	Security review	Blockchain security depends on cryptographic integrity and resistance to unauthorized alteration, but security threats remain possible.	The review does not provide a standardized risk comparison across sectors.	Need integrated security, privacy and governance frameworks for enterprise deployment.
Moubarak et al. (2018)	Blockchain security	Security analysis	Blockchain systems face security attacks and require appropriate consensus and defensive mechanisms.	The present manuscript does not compare attack resilience across platforms.	Need empirical security benchmarking and sector-specific threat models.
Crosby et al. (2016)	General blockchain	Conceptual/review	Blockchain extends beyond Bitcoin toward broader transaction and business applications.	Conceptual work provides limited evidence of realized organizational outcomes.	Need empirical studies that distinguish technological potential from demonstrated business value.

Source: Developed by the Author

Quality Appraisal and Data Synthesis

The original manuscript does not report the use of a formal critical-appraisal instrument, a risk-of-bias scale, or independent reviewer agreement. For that reason, no quality scores are assigned retrospectively. The selected publications were instead compared according to their application sector, research orientation, principal findings, limitations, and implications for future research. This approach allows the review to move beyond a simple description of individual studies while remaining faithful to the information actually reported in the source manuscript.

Methodological Transparency Note

The revised methodology makes the available evidence trail clearer, but some elements of a fully reproducible

systematic review remain unavailable in the original record. In particular, the manuscript does not preserve the search period, complete database-specific Boolean strings, duplicate-removal procedure, a formal quality-appraisal protocol, or a publication-level exclusion log. These omissions are now stated explicitly as methodological limitations. If the authors can recover the original search history, these details should be added before journal resubmission.

Organization of the Paper

The paper first explains the review method and the reported literature-selection process. It then provides a concise conceptual background on blockchain, followed by a critical synthesis of its applications across major sectors. The final sections compare the benefits and limitations reported in the literature and identify implications and directions for future research.

Table 2:

Search Keyword	Blockchain-related Publications	Journals	Papers with Keyword in Title
Blockchain Technology	31,450	4,890	687
Blockchain Use Cases	33,600	3,960	110
Publisher		Number of Publications	
IEEE Xplore Digital Library		62	
ACM Digital Library		12	
Springer		81	
ScienceDirect		12	
Total		167	

Findings and Analysis

This section brings together the main patterns emerging from the reviewed literature. Rather than describing blockchain concepts at length, the discussion focuses on how the technology is being used, what benefits are reported, and where the literature identifies practical limitations.

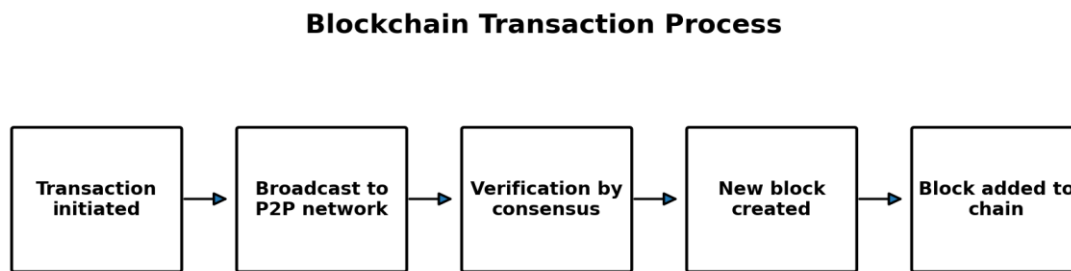
Overview of Blockchain Technology

Blockchain is best understood as a distributed record-keeping system in which transactions are shared and validated across a network rather than controlled by one central authority. Nakamoto (2008) provided the foundational model through Bitcoin, while later studies broadened the concept to include smart contracts, organizational processes, and sector-specific applications. The literature therefore presents blockchain less as a single-purpose technology and more as a set of distributed architectures whose value depends on governance, access rules, and the problem being addressed.

The literature distinguishes public, private, consortium, and hybrid configurations. These architectures differ in who can participate, who validates transactions, how information is shared, and how governance is organized. Such differences matter in practice: a system designed for public cryptocurrency transactions may not be appropriate for healthcare records or inter-organizational supply chains where privacy and controlled access are essential.

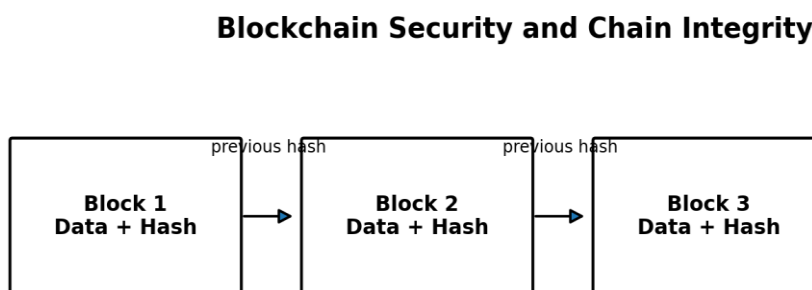
Across the studies discussed in this review, the strongest case for blockchain appears when several independent parties need to maintain a common, traceable record and have limited trust in a single intermediary. The literature also shows, however, that blockchain is not automatically the most efficient option. Its advantages must be weighed against processing capacity, privacy requirements, governance complexity, implementation costs, and the quality of the information entered into the ledger.

Figure 2. Author-developed schematic of the blockchain transaction process.



Source: Developed by the author based on Nakamoto (2008).

Figure 3. Author-developed schematic of blockchain security and chain integrity.



Any change to a block changes its hash and breaks the subsequent link,
providing tamper-evident chain integrity.

Source: Developed by the author based on Beck (2018) and Karame & Capkun (2018).

Applications of Blockchain Technology

The literature identifies a broad range of applications beyond cryptocurrency. The following discussion groups the reviewed evidence by sector and emphasizes the particular problem blockchain is intended to address in each setting, as well as the limitations that remain.

Cryptocurrencies

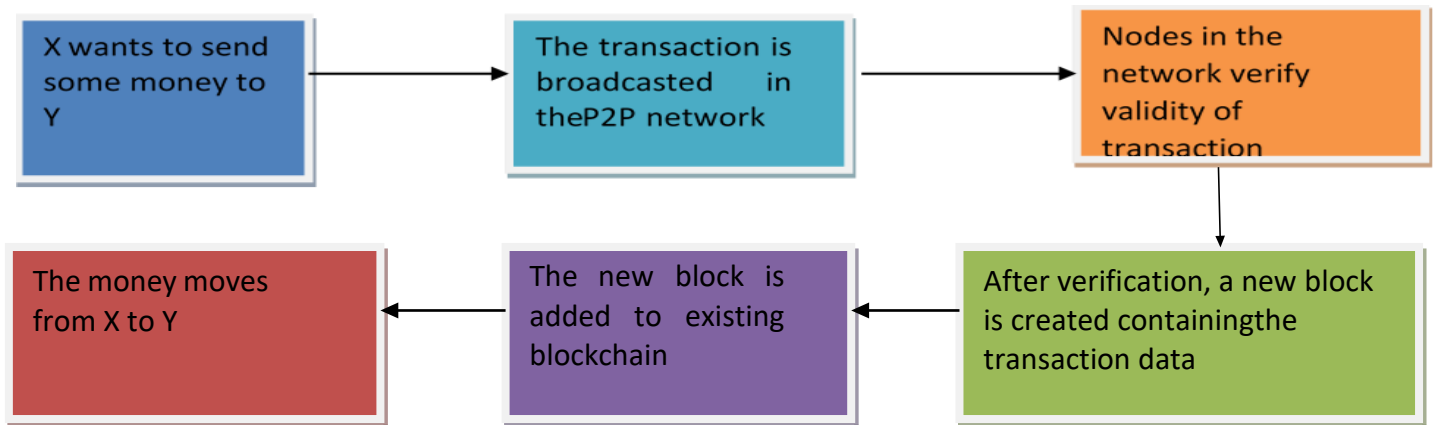
Cryptocurrency remains the earliest and most visible application of blockchain. Bitcoin demonstrated how a distributed ledger and consensus mechanism could support digital transactions without a conventional central intermediary. Later cryptocurrencies extended this model, but the literature increasingly treats cryptocurrency as one application of a broader technology rather than as blockchain's defining purpose.

Bitcoin's launch in 2009 provided the first widely recognized practical implementation of blockchain. Other digital currencies followed, demonstrating the feasibility of decentralized payment and asset-transfer systems. These developments also created the technical foundation for later experimentation with blockchain in non-financial settings.

In a blockchain-based cryptocurrency transaction, a transfer is broadcast to the network, validated according to the relevant consensus mechanism, and recorded in a new block. Cryptographic links between blocks create a persistent transaction history. The process illustrates the central blockchain proposition: participants can verify a shared record without relying on one organization to maintain the entire history.

The literature nevertheless shows that cryptocurrency systems also expose some of blockchain's broader challenges. Transaction speed, energy use, scalability, governance, and regulatory concerns have all influenced the development and acceptance of different platforms. Thus, cryptocurrency provides an important demonstration of blockchain's capabilities, but it also illustrates the trade-offs that appear in other applications.

Following figure shows how cryptocurrencies use a blockchain platform :



Source: Developed by the author

E-Government

Blockchain has also been examined as a way to strengthen public-sector record management and service delivery. In e-government, the proposed benefits include more traceable transactions, stronger document integrity, and improved information sharing among agencies and citizens. These benefits are particularly relevant where records pass through several administrative units and where trust in record accuracy is important.

Electronic voting is one of the most frequently discussed public-sector applications. Hou (2017), for example, examined a blockchain-based platform in China for maintaining the authenticity and traceability of exchanged data. The attraction of such systems lies in the possibility of creating an auditable record. At the same time, voting systems involve requirements—such as ballot secrecy, accessibility, identity protection, and governance—that cannot be solved by blockchain alone.

The adoption of blockchain technology in the public sector offers several important benefits, including:

- Secure digital identity (Digital ID) management.
- Reliable and tamper-proof document management.
- Greater transparency in tax administration.
- Real-time access to updated public information.
- Enhanced transparency, accountability, and interaction between governments and citizens.

Land Registration

Conventional land-registration systems often involve several intermediaries and may be slowed by paperwork, fragmented records, and opportunities for error or fraud. The literature therefore considers blockchain as a possible way to create a shared and traceable record of ownership, legal rights, and property transactions.

A blockchain-based land system could allow authorized stakeholders to verify ownership records and process transfers, mortgages, and related changes through a common ledger. The potential benefit is not simply that

records become digital; rather, the shared record can reduce reconciliation between separate databases and make the history of a transaction easier to trace.

Blockchain may also support digital identities for parties involved in property transactions, potentially simplifying verification and transfer procedures. However, the literature points to an important limitation: an immutable ledger cannot guarantee that the information entered into it is correct. The reliability of the system therefore depends on the quality of the original data and the institutions responsible for validating it.

Examples from the United States, the Netherlands, the United Kingdom, and Sweden illustrate growing interest in blockchain-based land administration. These cases suggest potential for improving transparency and administrative efficiency, but they also show that technological implementation must be accompanied by appropriate legal and institutional arrangements.

Power Industry

Energy is another sector in which blockchain has attracted attention, particularly as electricity systems become more decentralized and renewable generation becomes more common. The literature focuses on blockchain's potential to support coordination and peer-to-peer trading among producers, consumers, storage providers, and other participants. Mengelkamp et al. (2017), for example, examined blockchain as an infrastructure for local energy markets.

The reviewed studies generally group blockchain applications in the energy sector into generation, transmission and distribution, and consumption. Across these areas, the main proposed contribution is better coordination among participants rather than blockchain replacing the physical electricity infrastructure.

Power Generation

For power generation, blockchain can provide a shared record of production and related transactions. Such visibility may help utilities and other participants coordinate generation and allocate resources more efficiently. The literature, however, suggests that the usefulness of blockchain depends on integration with existing grid-management systems and reliable data from physical infrastructure.

Power Transmission and Distribution

In transmission and distribution, blockchain has been proposed as a mechanism for coordinating distributed energy resources and automating selected processes. Its potential value comes from creating a trusted record among organizations that may not share a single administrative system. Yet the technical demands of real-time grid operation mean that blockchain must complement, rather than simply replace, established control technologies.

Power Consumption

For consumption and peer-to-peer trading, blockchain can record exchanges between consumers, prosumers, storage providers, and electric-vehicle users. Munsing et al. (2017) showed how blockchain could support decentralized optimization in microgrid environments. The main attraction is the possibility of direct transactions with transparent rules and lower dependence on intermediaries.

The literature also reports token-based and decentralized trading models, including the framework discussed by Aitzhan and Svetinovic (2018). These studies demonstrate the technical feasibility of decentralized energy markets, but they also highlight the need to address privacy, regulation, interoperability, and the practical integration of blockchain with physical energy systems.

Education

In education, blockchain has been discussed mainly in relation to academic credentials, student records, and verification of learning achievements. Its proposed value comes from giving institutions and learners a persistent

record that can be checked without repeatedly relying on the issuing institution. This can be useful where credentials are shared across universities, employers, and professional bodies.

Because blockchain records are designed to be resistant to unauthorized alteration, they may reduce certificate fraud and improve confidence in academic records. However, the technology does not remove the need for trusted institutions: universities and other authorized bodies still have to verify the information before it is recorded. The main contribution is therefore stronger verification and portability of records rather than the elimination of institutional responsibility.

Sharples and Domingue (2016) discussed blockchain-based educational records and reputation systems, while institutions such as the University of Nicosia, Sony Global Education, Holberton School, MIT, and the University of Melbourne have explored blockchain for credential management. These examples show growing practical interest, although the literature still needs more evidence on long-term adoption, interoperability, governance, and user acceptance.

Healthcare

Healthcare applications are primarily concerned with the secure sharing and management of sensitive information. Blockchain has been proposed for electronic health records, clinical research, patient consent, and pharmaceutical traceability because several parties may need access to the same information while maintaining clear controls over who can view or modify it.

Medicalchain, for example, illustrates an attempt to use blockchain for patient-record management. Other studies have considered blockchain for clinical trials and the pharmaceutical supply chain. The potential benefits include stronger audit trails and improved coordination, but healthcare also exposes one of blockchain's central tensions: information must be traceable without compromising confidentiality or patient rights.

The literature therefore suggests that blockchain can support controlled data sharing and record integrity, but it should not be treated as a complete solution to healthcare information problems. Interoperability, privacy, consent management, regulatory compliance, and the accuracy of the data entered into the system remain critical concerns.

Supply Chain Management

Supply chain management is one of the areas in which blockchain's shared ledger model appears particularly relevant. Supply chains involve multiple organizations that need to exchange information about products, shipments, ownership, and transactions. A common ledger can make these records easier to trace and can reduce disagreements caused by fragmented information.

Zhao et al. (2016) highlighted blockchain's potential for product traceability, while Perboli et al. (2018) examined its use in logistics and supply chains. The recurring theme is visibility: organizations can follow a product's history and verify selected events without depending entirely on one party's database. This can be valuable in food, pharmaceuticals, luxury goods, and other markets where authenticity and provenance matter.

The literature also identifies applications in food traceability, logistics, counterfeit prevention, and product lifecycle management. Everledger, for example, has used blockchain-based records to support diamond provenance. These cases demonstrate practical potential, but they also reveal a dependency that is sometimes overlooked: blockchain can preserve a record accurately, but it cannot by itself guarantee that the physical product or information entered at the beginning of the chain is genuine.

Several commercial initiatives are frequently cited in the literature as examples of supply-chain experimentation:

IBM Blockchain and TradeLens were developed to improve information sharing and traceability in global logistics (Scott, 2018). Their relevance lies in the attempt to connect organizations that traditionally maintain separate records.

OriginTrail focuses on decentralized data sharing intended to strengthen transparency and trust across complex supply networks. Its example illustrates how blockchain can be combined with broader data-management approaches rather than used as a stand-alone technology.

BlockVerify applies blockchain to product authentication and anti-counterfeiting. Such applications demonstrate where immutable records may add value, although their effectiveness still depends on reliable data capture and participation across the supply chain.

Banking and Financial Services

Financial services remain one of the most extensively discussed application areas because many banking processes involve multiple intermediaries, reconciliation steps, and geographically dispersed participants. The literature suggests that blockchain may reduce some of these frictions by providing a shared transaction record and automating selected processes through smart contracts.

Banks such as Goldman Sachs, JPMorgan Chase, Citibank, and Wells Fargo have explored blockchain through research programs and partnerships. Standard Chartered's work with Ripple and other initiatives illustrates interest in cross-border payments and trade finance. These examples show that financial institutions are generally exploring blockchain as an infrastructure for specific processes rather than replacing conventional banking systems altogether.

One frequently cited advantage is faster settlement. Blockchain-based systems can potentially reduce the time required to reconcile and settle transactions, particularly in cross-border settings. The literature also discusses applications in foreign exchange and continuous payment services. However, the actual improvement depends on network design, interoperability between institutions, regulatory requirements, and the degree of adoption across counterparties.

Blockchain may also support KYC processes by maintaining shared, tamper-resistant customer records. Smart contracts can automate parts of payment and settlement, while a common ledger can reduce inconsistencies between separate databases. These benefits are attractive, but they must be balanced against confidentiality requirements, cybersecurity risks, and the need to comply with financial regulations.

The Bangladesh Bank cyberattack of 2016 illustrates the importance of secure financial infrastructure. The manuscript also notes a blockchain-based interbank Letter of Credit transaction involving Prime Bank, HSBC, and the Contour network. Such examples indicate that blockchain experimentation is relevant in Bangladesh as well as internationally, although broader adoption will depend on regulation, interoperability, cost, and institutional readiness.

Critical Synthesis of the Reviewed Literature

Across sectors, the literature points to a common condition under which blockchain is most attractive: several parties need to share a reliable record, but no single participant is fully trusted to control it. Supply chains, cross-border finance, energy trading, and credential verification all fit this pattern to some extent. The proposed benefits are therefore closely tied to coordination and verification rather than to blockchain as a technology in isolation.

At the same time, the evidence does not justify the assumption that blockchain is always better than a conventional database. Greater transparency can conflict with privacy; decentralization can complicate governance; and immutability can preserve incorrect information if poor-quality data are entered at the outset. The technology can also introduce new costs through infrastructure, integration, energy use, and specialized skills. These trade-offs should be considered when evaluating any proposed application.

Another important pattern concerns the strength of the evidence base. Much of the literature reviewed here is conceptual, framework-oriented, security-focused, or application-oriented. Comparatively fewer studies provide long-term empirical evidence of organizational outcomes across different contexts. This suggests a clear research opportunity: future studies should compare blockchain projects with conventional alternatives using measurable

outcomes such as cost, processing time, error rates, user acceptance, privacy performance, and return on investment.

Challenges of Blockchain Technology

The literature identifies several barriers that cut across the application areas discussed above. These challenges are interconnected: a technically promising system may still fail to deliver value if it is too expensive to integrate, difficult to govern, incompatible with existing infrastructure, or unable to meet privacy and regulatory requirements.

Scalability

Scalability remains a major concern. As transaction volumes grow, networks must process and store increasingly large amounts of data while maintaining consensus among participants. Zheng et al. (2018) identified scalability as a significant technical challenge. For organizations considering blockchain, the practical issue is whether the selected architecture can deliver the required throughput and response time at an acceptable cost.

Cybersecurity and Illicit Activities

Blockchain's security properties do not make it immune to cyber threats or misuse. Attacks can target applications, wallets, smart contracts, access credentials, or surrounding infrastructure even when the underlying ledger remains intact. The literature therefore supports a broader view of security in which blockchain is only one component of the overall control environment. Effective governance and appropriate legal frameworks are also necessary where blockchain is used for financial or public services.

Complexity of Adoption

Blockchain adoption can be difficult because it requires more than installing new software. Organizations may need expertise in distributed systems, cryptography, consensus mechanisms, data governance, and cybersecurity. They may also need to train employees and redesign established processes. Where existing systems already perform adequately, the expected benefit from migration must be strong enough to justify the disruption and investment.

Privacy Concerns

Transparency can become a limitation when blockchain is applied to sensitive information. Healthcare records, financial data, and personal identities require carefully controlled access, whereas some blockchain architectures are designed around broad visibility. Shae and Tsai (2017) and Tsai et al. (2016) illustrate this tension in healthcare and financial applications. Future systems therefore need flexible permission and access-control mechanisms that preserve the auditability of records without exposing information unnecessarily.

Implementation Costs

Although blockchain may reduce some transaction and reconciliation costs, implementation itself can be expensive. Organizations may need new infrastructure, specialized skills, system integration, and ongoing technical support. Legacy-system integration is particularly important because many organizations cannot simply replace their existing information systems. The economic case for blockchain should therefore consider total implementation and operating costs rather than focusing only on the potential savings from removing intermediaries.

Implications of the Study

The review indicates that blockchain has potential across several domains, including finance, healthcare, education, supply chain management, energy, land registration, and public administration. The strongest opportunities appear in processes that require shared records, traceability, and coordination among parties. At

the same time, the evidence suggests that blockchain should be selected because it addresses a specific coordination or trust problem—not simply because it is a new technology.

The findings also position blockchain as one component of wider digital transformation. Successful implementation is likely to depend on complementary capabilities such as data governance, cybersecurity, interoperability, organizational readiness, and appropriate regulation. For researchers and practitioners, this means that the future value of blockchain should be assessed in relation to the wider system in which it operates.

CONCLUSION, LIMITATIONS, RECOMMENDATIONS, AND FUTURE RESEARCH

Blockchain began as the infrastructure behind Bitcoin, but the literature reviewed in this study shows that its applications now extend across a much broader set of organizational and public-sector activities. The technology can support traceability, shared records, automation, and verification, yet these advantages are accompanied by practical constraints involving scalability, privacy, cost, governance, and integration.

The main contribution of this review is to bring these application areas and trade-offs together. Rather than treating blockchain as universally transformative, the review shows that its value is context dependent. Finance, supply chains, energy, education, healthcare, and public administration present different requirements, and the same blockchain architecture will not necessarily be appropriate across all of them.

The review has several limitations. First, the documented search process produced 167 publications, from which 60 were retained after reviewing titles, abstracts, and introductory sections. Second, the source manuscript does not preserve complete database-specific search strings, search dates, duplicate-removal records, formal quality-appraisal scores, or a publication-level exclusion log. These gaps limit the reproducibility of the review and should be addressed if the original search records are available.

A further limitation is the composition of the reviewed evidence. The literature discussed in the manuscript contains a substantial proportion of conceptual, framework-based, and application-oriented work. This makes it possible to identify proposed uses and recurring challenges, but it provides a weaker basis for estimating the actual long-term organizational impact of blockchain. The conclusions should therefore be interpreted as a synthesis of the reported literature rather than as a quantitative estimate of blockchain's effects.

The review provides a useful starting point for researchers and practitioners interested in blockchain-enabled systems. Its main practical implication is that organizations should evaluate the problem first and the technology second. Questions about data ownership, participant trust, governance, privacy, interoperability, and total cost should be addressed before implementation decisions are made.

Future research should place greater emphasis on empirical comparisons across industries and geographic settings. Studies could compare blockchain with conventional databases and other distributed technologies using common measures such as processing time, cost, error reduction, security incidents, user acceptance, and return on investment. Further work is also needed on interoperability, privacy-preserving architectures, regulatory compliance, and integration with legacy information systems.

Finally, sustainable blockchain adoption will require cooperation among governments, industry, technology developers, and researchers. Policy and governance frameworks should evolve alongside technical development, while organizations need realistic assessments of costs, capabilities, and risks. Such a balanced approach is more likely to turn promising blockchain applications into durable improvements in business and public services.

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