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Governing with the Chain: Blockchain's Transformative Potential in Digital Governance

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Abstract

This scoping review aims to comprehensively map and synthesize the existing evidence on the applications, challenges, and future directions of blockchain technology in digital governance. The review identified several potential applications and benefits of blockchain for transforming the public sector, including enhanced transparency, efficiency, and trust; streamlined operations; and its application in e-governance functions such as digital identity management, voting systems, and public records management. Key challenges to implementation were noted, including technical limitations, legal and regulatory hurdles, and the complexities of execution. The review also emphasized future directions and research gaps, highlighting the importance of blockchain governance, addressing implementation challenges, understanding broader societal impacts, and conducting further research related to data. To facilitate the responsible and effective integration of blockchain technology into digital governance, the review recommended that policymakers prioritize the development of clear and adaptable legal frameworks, promote collaboration and knowledge sharing, and invest in education and capacity building. Practitioners should emphasize user-centric design, phased implementation, interoperability, and data quality and security. Researchers are encouraged to conduct rigorous empirical studies, foster interdisciplinary collaboration, explore long-term sustainability, and address ethical considerations.

Introduction

Governments around the world are increasingly exploring the potential of blockchain technology to enhance the efficiency, transparency, and security of their digital governance systems (Datta, 2019). As a decentralized, distributed, and immutable ledger, blockchain holds the promise of revolutionizing the way public services are delivered, data is managed, and citizen engagement is fostered. This scoping review aims to examine the existing literature on the transformative potential of blockchain in the realm of digital governance, identifying key areas of impact, challenges, and future research directions.

Blockchain technology is fundamentally reshaping the traditional paradigm of governance where centralized authorities have historically held the reins of power and control. The distributed nature of blockchain, which eliminates the need for intermediaries, offers an opportunity to decentralize decision-making, increase transparency, and foster greater citizen participation in governance

processes (Zwitter & Hazenberg, 2020). As blockchain-based solutions emerge, they have the potential to streamline bureaucratic processes, reduce corruption, and improve the overall efficiency of public service delivery (Afonin, 2021).

Research has highlighted the advantages of blockchain in developing economies, where secure, immutable, and transparent records are often lacking due to unstable or inefficient institutions (Sydow et al., 2020). Blockchain's decentralized architecture can help address these challenges, empowering citizens and fostering greater trust in government.

Objective of the Study:

1. To map the various ways that blockchain is being used in the public sector

2. To assess the legal and technical challenges to adoption seriously

3. To propose a framework that strikes a balance between the "thesis" (benefits) and the "antithesis" (risks).

4. To document or propose future directions for the application of blockchain technology to digital governance.

Research Questions:

This scoping review aimed to comprehensively map and synthesize the available evidence on the applications, challenges, and future directions of blockchain technology within the realm of digital governance. It seeks to answer the following research questions:

RQ#1: What are the identified applications and positive effects of blockchain technology within digital governance?

RQ#2: What are the key challenges associated with implementing blockchain technology in digital governance?

RQ#3: What are the documented or proposed future directions for blockchain technology's use in digital governance?

Hypotheses:

1. *H1:* Blockchain significantly enhances transparency and reduces corruption in e-governance functions.

2. *H2:* The success of blockchain in digital governance is contingent upon existing technological infrastructure and regulatory maturity.

3. *H3:* The transition to blockchain-based governance introduces new tensions between data transparency and individual privacy.

Research Methods

Protocol:

This scoping review adopted a predetermined research protocol to ensure a methodical and transparent review process (Tricco, et al., 2018). The protocol directed all phases of the investigation from crafting research inquiries to interpreting the results. Any essential divergences from the original plan were meticulously recorded, bolstering the transparency and rigor of the review. Additionally, the review adhered to the PRISMA-ScR guidelines, a standard for comprehensive reporting in scoping reviews (Lee & Gambiza, 2022). Aligning with a structured protocol and established guidelines reinforces the reliability and validity of the review's conclusions.

Search Eligibility Criteria:

This review synthesizes studies published in English language from 2015 to 2025 that examine the transformative potential of blockchain in digital governance. To provide a comprehensive analysis, the review also included relevant grey literature such as government reports and policy documents. The selection and organization of the studies were guided by the "population, concept, and context" (PCC) framework, which facilitated a structured approach to analyzing the literature (See Table 1 for details on the PCC framework).

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Table 1

Eligibility Criteria

Criterion	Inclusion	Exclusion	Rationale
Population	Studies focusing on the application of blockchain technology in digital governance within the public sector (National/ Local/International).	Studies focusing on blockchain technology applications outside of the public sector or those that do not address governance implications.	To narrow scope to government-driven initiatives.
Concept	Blockchain protocols in Public Sector used for administrative functions	Studies unrelated to blockchain technology.	Ensure the review captures relevant blockchain applications.
Context	Digital governance, e-government, and regulatory technology.	Private sector applications, purely technical implementations.	Focus on public admin-istration and policy.
Language	Studies published in English language.	Studies published in languages other than English language.	To ensure accessibility and comprehensibility of research findings
Time span	Studies published between 2015 and 2025.	Studies published before 2015.	Capture recent developments in blockchain technology and its applications.
Types of sources	Peer-reviewed journal articles, conference proceedings, government reports, white papers.	Grey literature lacking academic rigor, non-academic blogs, opinion pieces.	Ensure quality and reliability of included studies.
Geographical location	Global studies, including case studies from various countries.	Studies with limited geographical scope that do not contribute to broader understanding.	To provide a comprehensive global perspective.
Database	Scopus, Web of Science, IEEE Xplore, ACM Digital Library, Google Scholar, UN, OECD, and relevant government repositories.	Databases irrelevant to the research topic.	Ensure comprehensive coverage of relevant literature.
Areas of Research	Information systems, public administration, political science, law, computer science, and related interdisciplinary fields.	Areas unrelated to blockchain and governance.	Capture diverse perspectives on blockchain in governance.

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Search Strategy:

To identify relevant studies on the applications of blockchain technology in digital governance, the researchers developed a comprehensive search strategy. They systematically searched multiple electronic databases, including Scopus, Web of Science, IEEE Xplore, ACM Digital Library, and Google Scholar, while also consulting related government websites to ensure broad coverage of the academic literature.

The search process employed a diverse range of keywords and search terms in various combinations to capture the multifaceted aspects of blockchain technology and its applications in digital governance. These keywords included terms such as "blockchain," "distributed ledger technology," "smart contracts," "digital governance," "e-government," "public administration," "e-voting," "digital identity," "supply chain governance," "regulatory technology," and "decentralized autonomous organizations. "Examples of search strings used in the databases will be:

("blockchain" OR "distributed ledger technology" OR "smart contracts") AND ("digital governance" OR "e-government" OR "public administration")

- ("blockchain" AND "e-voting")
- ("blockchain" AND "digital identity")
- ("blockchain" AND "supply chain governance")
- ("blockchain" AND "regulatory technology")
- ("smart contracts" AND "public administration")
- ("DAOs" AND "governance")

The search focuses on the most recent and significant studies published within a specific timeframe. To ensure that the research findings are accessible and comprehensible, only studies published in English language will be included. Additionally, the researchers will conduct reference list checks and citation tracking to identify any other relevant publications which will enhance the overall comprehensiveness of the search. This multi-faceted approach aims to thoroughly identify all pertinent literature on the applications of blockchain technology in digital governance, which will be integrated into the scoping review.

The data extraction process is guided by the research questions and key themes identified through the literature review on blockchain technology in digital governance. Before the formal analysis begins, preliminary searches will help the researchers develop a structured approach for data extraction, focusing on three core areas:

1. Data from the reviewed documents related to the application and positive effect of blockchain technology in digital governance: This includes extracting information on the specific governance areas addressed (e.g., e-voting, digital identity), the blockchain technology used (e.g., public, private), the stakeholders involved (e.g., government agencies, citizens, NGOs), the reported benefits and limitations of the application, and the overall impact on governance outcomes.

2. Data from reviewed publications regarding the challenges and barriers encountered in implementing blockchain technology in digital governance: This involves extracting information on specific challenges faced (e.g., scalability, regulatory uncertainty, lack of technical expertise), the factors contributing to these challenges, and the strategies proposed to address them.

3. Data on future directions and research gaps: This includes extracting information on emerging trends (e.g., interoperability, AI integration, DAOs), proposed future research directions, and identified gaps in the existing literature.

The researchers conducted a thorough double-check of all extracted data to ensure its accuracy and consistency. The data will then be systematically organized and categorized into relevant thematic clusters, which will be detailed in the Results section. This meticulous data extraction process will guarantee that the review includes comprehensive and pertinent information from the studies analyzed.

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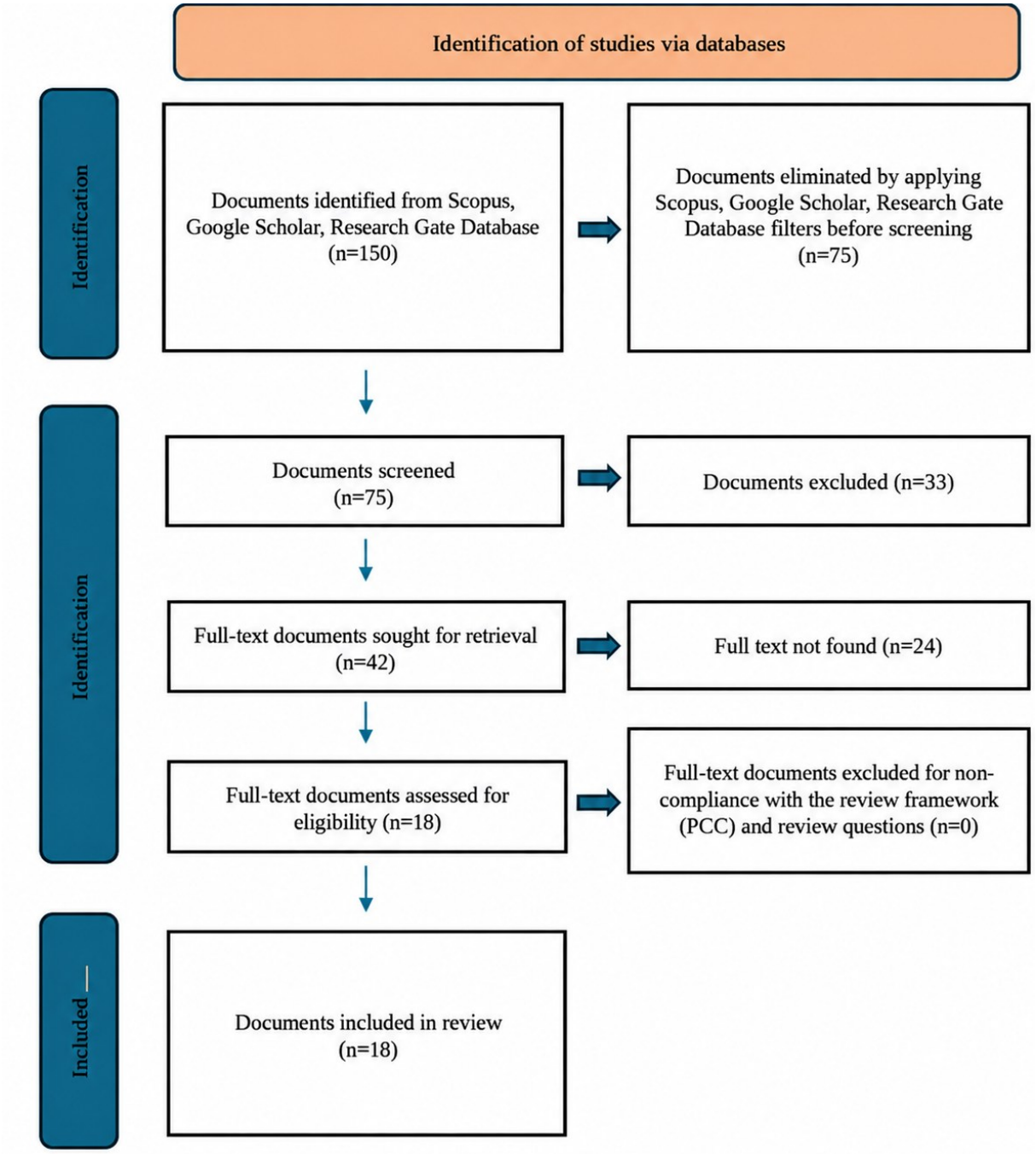
Results

Search and Selection Results:

The final search was conducted on April 20, 2025. Initially, a total of 150 records were identified from the selected databases and government websites. After applying filters for language, subject area, and publication period, the number of records was reduced to 75. Titles and abstracts were then evaluated for relevance, leading to the exclusion of 33 records that did not align with the research questions. Full texts were retrieved for the remaining 42 records, and following a detailed assessment, an additional 24 records were deemed ineligible. This process resulted in a final sample of 18 studies included in the scoping review. The search and selection procedure are illustrated in the PRISMA flow diagram (Figure 1).

Figure 1

Selection of Publications for Review (PRISMA-ScR Flow Diagram)



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Documents Ultimately Included in the Review:

The review yielded 11 review articles, 1 case study, 1 working paper, 4 research articles and 1 document from website, thus, meeting the objective and eligibility criteria (Table 2).

Table 2

Documents included in the review

Reference	Publication Title
REVIEW ARTICLES	
1. (Tan et al., 2021)	Blockchain governance in the public sector: A conceptual framework for public management (PA)
2. (Laatikainen et al., 2023)	A system-based view of blockchain governance (IT)
3. (Ibrahimy et al., 2023)	Blockchain-based governance models supporting corruption-transparency: A systematic literature review (IT)
4. (Blockchain for digital government – the ASEAN way, 2021)	Blockchain for digital government – the ASEAN way (PA)
5. (Yadavalli, 2024)	The Role of Blockchain Technology in E-Governance – A study on Transforming Governance (IT)
6. (Feizal et al., 2024)	A Systematic Literature Review on Blockchain for Implementation of Data Governance Framework (IT)
7. (Hakimi et al., 2024)	Integrating Blockchain Technology for Secure E-Government Services: Opportunities and Challenges (SOCIAL SCIENCE)
8. (Lykidis et al., 2021)	The Use of Blockchain Technology in e-Government Services (IT)
9. (Zhang, et al., 2022)	A Systematic Review of Blockchain Technology for Government Information Sharing (IT)
10. (Batubara et al., 2018)	Challenges of blockchain technology adoption for e-government: a systematic literature review (PA)
11. (Andaya et al., 2025)	Digital governance in the Philippines: a scoping review of current challenges and opportunities (PA)
CASE STUDY	
12. (Assiri, 2022)	Design and Implementation of a Secure and Efficient E-Governance Model Using Blockchain for a Developed Country (IT)
WORKING PAPER	
13. (Berryhill et al., 2018)	Blockchains Unchained: Blockchain Technology and its Use in the Public Sector (PA)
RESEARCH ARTICLE	
14. (Kowalczyk & Napiceck, 2023)	E-governance and blockchain technology in local government (PA)
15. (Mansour et al., 2023)	A Survey on Blockchain in E-Government Services: Status and Challenges (IT)
16. (El Khatib et al., 2022)	The Role of Blockchain in E-Governance and Decision-Making in Project and Program Management (IT)
17. (Anil Kolhe & Mandge, 2024)	Blockchain Technology in E-Governance (IT)
DOCUMENT/S FROM WEBSITE	
18. (Ocampo, 2024)	The Philippines is introducing blockchain to secure government transactions (PA)

Bibliometric Characteristics of the Research Field:

The current review analyzed 18 documents based on several categories: annual distribution, document types, authors, and publication journals. Of these publications, 10 (55.55%) were classified under Information Technology. The remaining 8 documents (44.44%) were associated with another domain: Social Sciences/Public Administration.

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Hypothetical Thematic Clusters:

During the preliminary research phase, the researchers identified potential thematic areas which they later refined and explored further while evaluating studies and gathering data. After several revisions, the researchers finalized three thematic clusters for this scoping review: (1) Applications of Blockchain Technology in Digital Governance, (2) Challenges and Barriers to Blockchain Implementation in Digital Governance, and (3) Future Directions and Research Gaps. These clusters comprehensively address the key aspects of blockchain technology in digital governance, aligning with the three research questions guiding the review. They encapsulate the primary findings from the included studies, providing a structured framework for analyzing and synthesizing the literature.

Table 3

Hypothetical Thematic Clusters

Thematic Clusters	Cluster Descriptions
Cluster One: Applications of Blockchain Technology in Digital Governance	Explores the applications of blockchain technology in digital governance, including specific use cases and their outcomes.
Cluster Two: Challenges and Barriers to Blockchain Implementation in Digital Governance	Analyzes the key challenges and barriers to implementing blockchain technology in digital governance, including technical limitations, regulatory issues, and social considerations.
Cluster Three: Future Directions and Research Gaps	Examines the documented or proposed future directions for the use of blockchain technology in digital governance. It includes emerging trends, potential areas for further research, and identified gaps in the existing literature.

Table 4

Mapping the publications to the cluster

SN	*Authors and Year*	*Cluster 1 / Applications of Blockchain Technology in Digital Governance*	*Cluster 2 / Challenges and Barriers to Blockchain Implementation in Digital Governance*	*Cluster 3 / Future Directions and Research Gaps*
1	(Andaya et al., 2025)	✓		
2	(Anil Kolhe & Mandge, 2024)	✓	✓	✓
3	(Assiri, 2022)	✓		✓
4	(Batubara et al., 2018)		✓	✓
5	(Berryhill et al., 2018)	✓	✓	
6	(Blockchain for digital government – the ASEAN way, 2021)	✓	✓	
7	(El Khatib et al., 2022)		✓	✓
8	(Feizal et al., 2024)	✓		✓
9	(Hakimi et al., 2024)	✓	✓	✓
10	(Kowalczyk & Napiecek, 2023)			✓
11	(Ibrahimy et al., 2023)	✓	✓	✓
12	(Laatikainen et al., 2023)			✓
13	(Lykidis et al., 2021)			✓
14	(Mansour et al., 2023)	✓	✓	✓
15	(Ocampo, 2024)			✓
16	(Tan, Mahula, & Crompvoets, 2021)			✓
17	(Yadavalli, 2024)	✓	✓	
18	(Zhang, et al., 2022)	✓	✓	✓
Total		**11**	**10**	**14**

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Cluster One: Applications of Blockchain Technology in Digital Governance:

The research emphasizes various applications and positive impacts of blockchain technology in enhancing digital governance, illustrating its potential to transform traditional systems.

Applications in E-Governance

Anil Kolhe & Mandge (2024) discovered that blockchain technology can enhance e-governance through various applications, including voting systems, public records management, identity management, procurement procedures, and regulatory compliance.

The versatility of blockchain technology is clearly illustrated by its extensive applications in e-governance. It can secure voting systems, manage public records, streamline procurement processes, and ensure regulatory compliance. Overall, blockchain has the potential to revolutionize how governments provide services and engage with citizens.

Enhanced Transparency and Efficiency

Ibrahimy et al. (2023) emphasize that blockchain provides enhanced transparency, efficiency, and reliability in the public sector. It streamlines processes and ensures secure record-keeping.

Zhang et al. (2022) further argue that blockchain can address issues related to inconsistent technical standards and inadequate transparency in existing digital systems, promoting improved data sharing and collaboration.

These findings suggest that blockchain technology has the potential to significantly enhance the operational framework of the public sector by introducing more streamlined bureaucratic processes and ensuring the integrity and reliability of data records. The technology's capacity to improve data sharing and collaboration among government agencies and stakeholders effectively tackles a fundamental challenge in traditional governance, where information silos often result in inefficiencies and a lack of accountability.

Promotion of Trust and Reduction of Corruption

Ibrahimy et al. (2023) argue that blockchain technologies are effective in combating corruption and improving transparency by preventing manipulation of systems and increasing traceability. Similarly, Assiri (2022) emphasizes that blockchain enhances participant confidence and fosters trust due to its inherent characteristics.

The studies reviewed indicate that blockchain technology has significant potential to promote trust and reduce corruption within the public sector. By preventing system manipulation and enhancing traceability, blockchain not only makes government operations more transparent but also increases accountability. This increased transparency and accountability, in turn, fosters greater confidence among citizens and stakeholders, which is essential for effective governance.

Streamlining Government Operations

Berryhill et al. (2018) discuss various applications of blockchain technology, including facilitating fund transfers, managing land titles, tracking assets, and automating payments. Anil Kolhe & Mandge (2024) confirm that blockchain can enhance the efficiency, security, and transparency of government operations.

The literature demonstrates that blockchain technology can streamline a wide range of government functions from financial transactions and land management to asset tracking and payment automation. This streamlining can result in increased efficiency, improved security, and greater transparency in government operations, making them more responsive and accountable to the needs of citizens.

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Digital Identity Management

Berryhill et al. (2018) suggest that blockchains can be used to establish digital identities for citizens and manage identity-related information. Hakimi et al. (2024) emphasize the technology's potential to provide a secure and decentralized way to enhance the reliability of e-government services while reducing identity fraud.

Blockchain technology presents a promising solution for managing digital identities, addressing a significant challenge faced by traditional e-governance systems. By offering a secure and decentralized platform, blockchain can improve the reliability of government services, minimize the risk of identity fraud, and empower citizens to have greater control over their personal information.

Data Governance

Feizal et al. (2024) emphasize that blockchain technology can create a transparent, open, safe, and reliable environment for data governance, effectively preventing data falsification and fraud.

The use of blockchain in data governance provides a strong mechanism for ensuring data integrity, transparency, and security. Its capability to prevent data tampering and fraud, along with its ability to establish a trustworthy environment, makes it an invaluable tool for governments aiming to enhance the management and oversight of public data.

Cluster 2: Challenges and Barriers to Blockchain Implementation in Digital Governance:

The studies reviewed highlight several challenges and barriers that obstruct the widespread adoption of blockchain technology in digital governance.

Technical Limitations

Zhang et al. (2022) and Yadavalli (2024) highlight scalability issues, noting that blockchain's capacity may be insufficient for the large volumes of data generated by government operations.

Ibrahimy et al. (2023), along with Hakimi et al. (2024), identify interoperability challenges between different blockchain systems and existing governmental systems as a significant obstacle.

Ocampo (2024) also confirms that integrating blockchain technology with government services presents challenges, particularly regarding compatibility with existing systems.

Overall, these studies indicate that substantial data volumes in government and the compatibility of blockchain with current systems represent significant challenges. Scalability limitations may cause blockchain systems to struggle with the high volume of transactions and data while interoperability issues impede the smooth integration of blockchain with legacy systems.

Legal and Regulatory Challenges

According to Ibrahimy et al. (2023), there is a significant lack of legal and regulatory support for blockchain technology. Meanwhile, Hakimi et al. (2024) highlight the necessity of "reframing" regulatory frameworks to better fit the technology. Additionally, a report titled "Blockchain for Digital Government – The ASEAN Way" (2021) notes that policymakers often lack awareness of blockchain's potential.

These issues—the absence of clear legal and regulatory frameworks along with a lack of awareness among policymakers—are major obstacles to the adoption of blockchain technology in digital governance. Current legal frameworks frequently fail to address the unique characteristics of blockchain, making it essential to undertake a comprehensive overhaul to ensure compliance and foster responsible innovation.

Implementation Challenges

Hakimi et al. (2024) emphasize the necessity for government spending on specialized knowledge and infrastructure. The report "Blockchain for

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Digital Government – The ASEAN Way" (2021) highlights that a lack of skilled labor and high initial costs are significant obstacles to implementation. According to Anil Kolhe & Mandge (2024), the adoption of blockchain in e-governance encounters several challenges, including regulatory concerns, interoperability issues, scalability limitations, and privacy risks.

Implementing blockchain technology within a government framework is a complex and resource-intensive process. It requires substantial financial investment, specialized expertise, and a strong infrastructure. The shortage of skilled personnel and the high upfront costs associated with data integration and system development represent considerable barriers for governments aiming to adopt blockchain solutions.

Governance Model Challenges

Mansour et al. (2023) indicate that governance models, storage criteria, and access control are the primary challenges we need to address.

Establishing effective governance models, defining appropriate storage criteria, and implementing robust access controls are essential challenges to tackle when using blockchain as the infrastructure for developing government models. These factors are critical for ensuring accountability, security, and trust in blockchain-based governance systems.

Awareness and Application Challenges

El Khatib et al. (2022) highlight several major challenges in the deployment of blockchain technology. These challenges include identifying the appropriate applications for blockchain across various fields, a lack of awareness about blockchain and its use in program management, and the difficulty in selecting governance models that accommodate the needs of all stakeholders involved.

The limited understanding of blockchain technology and its potential applications, along with the challenge of choosing suitable governance frameworks, poses a significant obstacle to its implementation across different sectors. To facilitate successful adoption, it is crucial to address these issues through education, training, and the creation of clear guidelines.

Cluster 3: Future Directions and Research Gaps:

The literature identifies several future directions and research gaps that require further exploration.

Blockchain Governance Research

Tan et al. (2021) emphasize the need for studies that examine the relationship between trust in the public sector and decentralized governance models. Laatikainen et al. (2023) propose investigating how contextual factors influence the effectiveness of various governance structures. There is an increasing acknowledgment of the importance of researching blockchain governance, particularly regarding the connection between trust in the public sector and the adoption of decentralized models. Future studies should also focus on how contextual elements—such as cultural, economic, and political environments—affect the effectiveness of blockchain-based governance systems.

Addressing Implementation Challenges

Batubara et al. (2018) suggest that organizations should focus on their approach to blockchain development and accurately assess the technology's suitability for specific applications. Hakimi et al. (2024) emphasize the importance of government investment in research and development (R&D), collaboration between academia and industry, and public awareness programs.

Future research should prioritize tackling the practical challenges of implementing blockchain technology. This includes how organizations can effectively develop the technology and determine

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its suitability for specific applications, particularly in e-government systems. Additionally, there should be a stronger emphasis on fostering collaboration between academia and industry, as well as on the role of government investment in research and development to facilitate the adoption of blockchain technology.

Data and Technology Research

Feizal et al. (2024) suggest that future research should focus on developing energy-efficient consensus mechanisms, enhancing data privacy techniques, and integrating artificial intelligence and machine learning with blockchain technology. Lykidis et al. (2021) highlight that most studies tend to emphasize security issues rather than the preservation of privacy.

Further investigation into energy-efficient consensus mechanisms and improved data privacy techniques is necessary. Additionally, there is a need for more research on privacy preservation in blockchain implementations as current studies predominantly concentrate on security concerns.

Need for Empirical Studies

Assiri (2022) emphasizes the need for a more practical study to investigate the advantages and disadvantages of adopting blockchain technology in the public sector. The literature points out the necessity for more empirical research to thoroughly assess the potential benefits and drawbacks of using blockchain in this domain. Conducting such studies would offer valuable insights for governments that are contemplating the implementation of blockchain-based solutions.

The Synthesis (Thesis vs. Antithesis)

The Thesis: Enhanced Transparency (H1)

1. Blockchain serves as a safe e-governance model for public documents, voting, and identity.

2. It promotes citizen-government trust by limiting system manipulation.

The Antithesis: Infrastructure and Risks (H2)

1. The Technology Gap: Implementation is extremely difficult in nations with inadequate technical infrastructure.

2. Incompatibility: Interoperability and scalability are still "antithetical" to the extensive data requirements of the government.

3. The Paradox of Control: Despite its decentralization goals, blockchain frequently necessitates centralized supervision to ensure legal compliance, which strains governance frameworks.

Critical Synthesis (H3)

1. According to the findings, blockchain is not a solution; its "goodness" for governance is a guided reaction that needs to be weighed against the realities of privacy issues and digital disparities.

2. When these reasons are combined, it becomes clear that blockchain is a "contingent technology" that requires interdisciplinary collaboration.

Document Types:

The distribution of document types in this scoping review highlights the prominence of review articles and research articles, which together make up the majority of the sources. This is consistent with the scoping review methodology, as these document types typically present detailed findings and analyses on specific topics. The balanced use of both review and research articles indicates that the review is based on scholarly synthesis and empirical evidence, enhancing its credibility and rigor.

The inclusion of a case study, a working paper, and a document from a website further enriches the variety of sources. Case studies provide in-depth examinations of specific instances, offering valuable context and illustrating the practical applications of blockchain technology in digital governance. Working papers, while

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preliminary, can offer insights into ongoing research and discussions, potentially highlighting emerging trends and innovative approaches. Although websites are often not peer-reviewed, they can provide current information, perspectives from organizations involved in blockchain implementation, and access to a broader range of stakeholders including practitioners and policymakers.

The combination of these diverse document types contributes to a comprehensive approach in this scoping review. By integrating both in-depth research findings and wider perspectives from various sources, the review aims to deliver a thorough and nuanced understanding of the applications, challenges, and future directions of blockchain technology in digital governance.

Table 5
Table of Document Types

Types of Documents	Number	Percentage
Review Article	11	61.11%
Research Article	4	22.22%
Case Study	1	5.55%
Working Paper	1	5.55%
Document from Website	1	5.55%

Discussions

The thematic analysis of the reviewed literature indicates that blockchain technology has significant potential for digital governance, offering various applications and beneficial effects. However, its implementation presents challenges that require careful consideration of future directions and research gaps.

The analysis highlights the potential of blockchain technology to enhance transparency and efficiency in government operations. Research suggests that blockchain can greatly improve the operational framework of the public sector by streamlining bureaucratic processes and ensuring the integrity and reliability of data records (Ibrahimy et al., 2023; Zhang et al., 2022). Additionally, its ability to facilitate data sharing and collaboration among government agencies is recognized as a major advantage, addressing a fundamental challenge in traditional governance (Zhang et al., 2022). The literature also points out that blockchain can optimize a variety of government functions, including financial transactions, land management, asset tracking, and payment automation (Berryhill et al., 2018; Anil Kolhe & Mandge, 2024).

The studies reviewed highlight the potential of blockchain technology to enhance trust and reduce corruption in the public sector. By preventing manipulation of systems and improving traceability, blockchain not only makes government operations more transparent but also increases accountability (Ibrahimy et al., 2023; Assiri, 2022). This increased transparency can lead to greater confidence among citizens and stakeholders which is essential for effective governance (Assiri, 2022).

Another important application of blockchain technology in digital governance is digital identity management. The literature indicates that blockchain presents a promising solution for managing digital identities, addressing a significant challenge faced by traditional e-governance systems (Berryhill et al., 2018; Hakimi et al., 2024). By offering a secure and decentralized platform, blockchain can enhance

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the reliability of government services, reduce the risk of identity fraud, and empower citizens with more control over their personal information (Hakimi et al., 2024).

Furthermore, the analysis emphasizes blockchain's ability to create a "transparent, open, safe, and reliable environment" for data governance, helping to prevent "data falsification and fraud" (Feizal et al., 2024). The versatility of blockchain technology is evident in its wide-ranging applications within the e-governance landscape, including voting systems, public records management, procurement, and regulatory compliance (Anil Kolhe & Mandge, 2024).

Despite the potential benefits, the studies reviewed also highlight several challenges and barriers that hinder the widespread implementation of blockchain technology in digital governance. A primary concern is technical limitations; specifically, scalability and interoperability issues present significant obstacles (Zhang et al., 2022; Ibrahimy et al., 2023; Hakimi et al., 2024; Yadavalli, 2024). The large volumes of data in government and the need for blockchain compatibility with existing systems pose substantial integrative challenges (Ocampo, 2024).

Legal and regulatory issues also create considerable barriers. The lack of clear legal and regulatory frameworks, along with a general lack of awareness among policymakers, significantly impedes the adoption of blockchain technology in digital governance (Ibrahimy et al., 2023; Hakimi et al., 2024; Blockchain for Digital Government – The ASEAN Way, 2021).

Implementing blockchain technology within a government context is complex and resource intensive. It requires significant financial investment, specialized knowledge, and a robust infrastructure (Hakimi et al., 2024; Blockchain for Digital Government – The ASEAN Way, 2021). The shortage of skilled labor, combined with high initial costs associated with data integration and system development, further exacerbates these challenges. Additionally, establishing effective governance models, defining storage criteria, and implementing rigorous access controls are critical challenges that need to be addressed when using blockchain as the foundational infrastructure for developing government models (Mansour et al., 2023).

Looking ahead the literature, it identifies several future directions and research gaps that require further attention. There is a growing recognition of the need for more research into blockchain governance, particularly regarding the relationship between trust in the public sector and the adoption of decentralized governance models (Tan et al., 2021; Laatikainen et al., 2023). Future studies should also investigate how contextual factors—such as cultural, economic, and political environments—affect the effectiveness of blockchain-based governance structures (Laatikainen et al., 2023).

The reviewed studies also underscore the necessity of addressing the practical challenges of implementing blockchain technology. This includes examining how organizations can effectively develop this technology and determining its suitability for specific applications in e-government systems (Batubara et al., 2018). Additionally, there should be a greater emphasis on fostering collaboration between academia and industry, as well as on government investment in research and development to promote the adoption of blockchain technology (Hakimi et al., 2024; El Khatib et al., 2022). Several research gaps related to data and technology have been identified; these include the need for further investigation into the development of energy-efficient consensus mechanisms, the enhancement of data privacy techniques, and the exploration of how artificial intelligence and machine learning can be integrated with blockchain technology (Feizal et al., 2024; Lykidis et al., 2021).

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Additionally, the literature emphasizes the necessity for more empirical research to rigorously assess the potential benefits and drawbacks of adopting blockchain technology in the public sector (Assiri, 2022).

Limitations

This review has several limitations. First, the search process may have introduced biases in the selection of studies. It primarily focused on studies published in English, which could have led to the exclusion of relevant research available in other languages. Additionally, given the rapidly evolving nature of blockchain technology and its applications in digital governance, some of the information may be outdated. The reliance on academic databases may have also restricted the inclusion of valuable reports from government and international organizations. Finally, there is a lack of studies examining the long-term impacts and practical applications of blockchain solutions which represents another limitation of this review.

Conclusion

This scoping review systematically explores the literature on the transformative potential of blockchain technology in digital governance. It identifies a variety of applications such as enhanced transparency and efficiency, increased trust, reduced corruption, improved government operations, and better management of digital identities. However, implementing blockchain in this sector faces several challenges. Key barriers include technical limitations like scalability and interoperability, as well as legal and regulatory uncertainties, and obstacles related to costs and expertise. Despite these challenges, the literature highlights promising future directions. There is a need for further research on blockchain governance, strategies to overcome implementation challenges, and investigations into its broader impacts and integration with emerging technologies. In conclusion, blockchain technology has significant potential to revolutionize digital governance, creating opportunities to improve transparency, efficiency, and citizen trust. However, realizing this potential requires a collective effort to address the identified challenges and pursue the suggested future research directions. It is essential for policymakers, practitioners, and researchers to collaborate in developing robust frameworks, policies, and solutions that facilitate the responsible and effective implementation of blockchain technology in the public sector.

Recommendations

The scoping review recommends a multifaceted approach to effectively and responsibly integrate blockchain technology into digital governance. Policymakers should focus on creating clear and flexible legal and regulatory frameworks that ensure compliance with data protection and privacy laws while also accommodating future technological advancements. Governments are encouraged to promote collaboration and knowledge sharing among various stakeholders, including government agencies, private sector organizations, academic institutions, and international bodies, through specialized forums, working groups, and pilot initiatives. Investing significantly in education and training programs is crucial to enhance the understanding of blockchain technology among public officials, politicians, and citizens. This will help address the current lack of awareness and build trust in blockchain-based solutions. Governments should allocate financial resources to promote research and innovation in the public sector. This can involve exploring new applications of blockchain technology and developing solutions to address specific governance challenges while maximizing its benefits. This effort includes

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encouraging research on how blockchain can be integrated with other emerging technologies, such as artificial intelligence and the Internet of Things. When implementing blockchain systems, practitioners must adopt a user-centric design approach to ensure accessibility and usability, which will enhance adoption and optimize benefits across various government functions. A phased deployment strategy is recommended, starting with pilot projects and gradually scaling successful initiatives. This approach will help reduce risks and facilitate continuous learning and adaptation. It is also essential to address interoperability challenges by focusing on creating solutions that seamlessly integrate with existing government systems and other blockchain platforms. This prevents the development of isolated systems and improves overall workflow efficiency. Furthermore, practitioners should establish clear standards and protocols for data collection, validation, and storage. They must implement robust security measures to protect blockchain systems from cyber threats and safeguard the confidentiality of sensitive information, thereby maintaining public trust and confidence. Researchers should prioritize empirical studies to investigate the tangible effects of blockchain technology on digital governance. They need to use rigorous methods to evaluate the benefits, costs, and risks across various settings and sectors. Given the interdisciplinary nature of blockchain technology, collaboration among fields such as computer science, law, public administration, political science, and sociology is essential to develop a comprehensive understanding of its complex implications for governance and to devise more effective solutions. Researchers are also encouraged to explore the long-term sustainability of blockchain solutions by assessing their economic, social, and environmental impacts to ensure alignment with broader societal goals. Additionally, it is important for researchers to address the ethical implications of using blockchain in governance, focusing on issues like data ownership, privacy, accountability, and algorithmic bias. They should work on creating ethical frameworks and guidelines to promote responsible and equitable applications in the public sector.

Declaration of AI Assistance

This document represents our original work, and we want to be transparent about how we used Artificial Intelligence (AI) to enhance our understanding of the data presented in the Results section. Specifically, we utilized Google Gemini AI, which we subscribed to, as a tool to help interpret the information we gathered. Think of it as a helpful guide that enabled us to create a clearer and more logical flow for explaining the data in the Results section. The AI did not write the content for us; instead, it served as a starting point and assisted us in deepening our analysis and understanding of the data.

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