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Blockchain-Enabled Transformation in Public Administrative Services: A Comparative Analysis of Current Applications and Future Potential

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Peer Review Information	Abstract
<p><i>Submission: 16 Jan 2025</i> <i>Revision: 17 Feb 2025</i> <i>Acceptance: 11 March 2025</i></p> <p>Keywords</p> <p><i>Blockchain</i> <i>Public Administration</i> <i>e-Government</i> <i>Decentralization</i> <i>Governance Innovation</i></p>	<p>Blockchain technology is transforming public administrative services through its inherent characteristics of decentralization, immutability, transparency, and enhanced security. This paper examines the global and national implementation of Blockchain in public sector governance, focusing on the comparative study of real-world use cases and current survey insights. Countries like Estonia, Dubai, and South Korea have pioneered Blockchain applications in administrative domains such as digital identity management, smart contracts, and transparent service delivery. Despite these advancements, integration challenges remain due to legal conflicts, digital illiteracy, and bureaucratic resistance. This study synthesizes findings from a detailed literature review and survey-based analysis to explore Blockchain's potential to increase operational efficiency, reduce corruption, and enhance citizen trust in governance systems. It also investigates concerns over privacy, scalability, and governance models that need to be addressed for widespread adoption. Ultimately, this paper provides a roadmap for the scalable and sustainable deployment of Blockchain technology in public administration, aligning innovation with accountability and inclusivity.</p>

INTRODUCTION

Blockchain technology, since its inception with Bitcoin in 2008, has grown beyond its financial roots to become a cornerstone of innovation in numerous domains, including public administration. The technology's decentralized architecture, which eliminates the need for intermediaries, presents unique opportunities for transforming how governments deliver services and maintain records. According to the World Economic Forum, by 2025, Blockchain platforms could be responsible for nearly 10% of global GDP, underscoring the scale of potential impact on

governance systems worldwide [1]. The transparency, immutability, and traceability of Blockchain make it particularly suitable for administrative applications where accountability, data integrity, and trust are paramount. Governments and public service organizations have begun integrating Blockchain into areas like digital identity verification, voting, supply chain logistics, and contract management [2][3]. The IBM Institute for Business Value reports that over 90% of governmental leaders are exploring Blockchain adoption to enhance efficiency and reduce bureaucratic redundancy [4].

A 2021 study highlights that Blockchain can particularly benefit civil servants by reducing red tape and facilitating coordination among departments, even though the adoption process is often hindered by a lack of technical skills and regulatory clarity [5]. Citizens, on the other hand, stand to gain increased transparency and control over their data, with applications like identity management systems already demonstrating enhanced security and user autonomy [6]. In South Korea, pilot projects have demonstrated Blockchain's feasibility in areas such as real estate transactions, shipping documentation, and livestock history management [7]. Estonia, a global pioneer in e-Governance, uses Blockchain for secure medical records, digital ID issuance, and public infrastructure monitoring through systems like X-Road [8].

Despite its promise, Blockchain adoption in the public sector faces several challenges. These include conflicts with existing privacy laws, digital divides that hinder access for vulnerable populations, and resistance from entrenched bureaucratic systems [9]. Furthermore, issues like interoperability, standardization, and scalability require strategic resolution for widespread deployment [10].

This paper aims to investigate Blockchain's transformative role in public administration, highlighting real-world implementations, surveying theoretical insights, and proposing a framework for its sustainable adoption in administrative ecosystems.

EXISTING MODEL

Traditional public administrative systems rely heavily on centralized architectures and hierarchical decision-making processes. These legacy frameworks are often plagued by inefficiencies such as data redundancy, lack of interoperability between departments, and limited transparency in service delivery. Public records, identity management, and regulatory compliance are typically controlled by a central authority, leaving systems vulnerable to manipulation, single points of failure, and cyber threats [1].

For instance, in conventional administrative workflows, public data such as land registration or birth certificates are stored in siloed databases managed by specific departments. When inter-departmental data sharing is required, it often results in delays and inconsistencies due to duplicated verification procedures and fragmented IT infrastructures [2]. These systems also impose a burden on citizens who must repeatedly submit the

same information across different government portals, increasing friction in service delivery [3]. The block diagram below illustrates the existing centralized model in public administration:

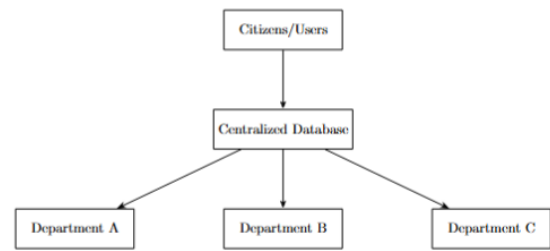


Figure 1: Centralized Architecture of Public Administrative Systems

This centralized model presents critical challenges:

- **Security Risks:** A single breach can compromise the entire database [4].
- **Data Duplication:** Information is redundantly stored and updated across departments [5].
- **Limited Auditability:** Tracking changes or access to data is difficult, reducing accountability [6].
- **Inefficiency:** Processes like document verification, fund disbursement, and compliance checks involve lengthy manual workflows [7].

Furthermore, resistance to innovation within bureaucratic structures and limited digital literacy among the general population exacerbate inefficiencies [8]. According to Cagigas et al., the rigidity of existing public service models limits their adaptability to disruptive technologies such as Blockchain [9].

While e-Governance systems have improved service accessibility in some countries, they still largely depend on centralized IT architectures and do not leverage the full potential of decentralized, tamper-proof record-keeping [10].

PROPOSED MODEL

To address the limitations of centralized administrative frameworks, the proposed model introduces a Blockchain-based decentralized architecture for public service delivery. This model leverages distributed ledger technology (DLT) to enhance data transparency, security, and interoperability across government departments while improving citizen trust and operational efficiency.

In this Blockchain-enabled administrative system, each governmental department operates as a node within a peer-to-peer (P2P) network. Every transaction—be it identity verification, service

request, or benefits distribution—is logged as a cryptographically secured block on a shared ledger. Once verified and appended, these transactions are immutable and time-stamped, ensuring a trustworthy audit trail accessible to all authorized entities [1][2].

Unlike traditional models, this approach eliminates redundant processes. For instance, when a citizen submits a request for a welfare service, the request is authenticated using their unique Blockchain-based identity. The data does not need to be revalidated across departments because all entities share a synchronized view of the ledger [3].

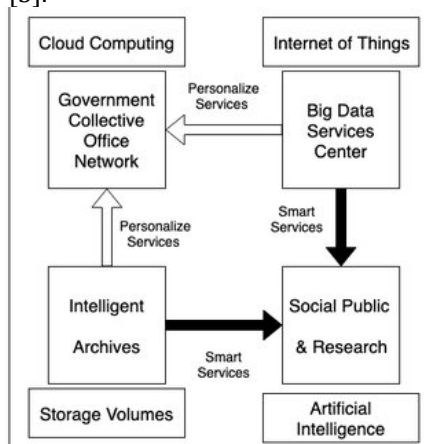


Figure 2: Decentralized Blockchain-Based Public Administration Model

Key features of the proposed system include:

- Decentralization: Each department maintains its own node, contributing to and verifying transactions without relying on a central authority [4].
- Data Integrity: Immutable record-keeping ensures that once data is entered, it cannot be altered without consensus across the network [5].
- Transparency & Accountability: Every transaction is visible to relevant stakeholders, enhancing trust and auditability [6].
- User-Centric Identity: Citizens maintain control over their digital identities using smart contracts, allowing selective data disclosure and consent-driven sharing [7].
- Automation: Smart contracts can automate processes such as benefit disbursement or document verification based on predefined criteria [8].

Use cases already in deployment or pilot stages include Estonia’s X-Road system and Dubai’s paperless public service initiative, both of which exemplify the scalability and real-world viability of

Blockchain in public administration [9][10]. Additionally, the integration of Blockchain with cloud-based infrastructures and Internet of Things (IoT) enhances both administrative reach and environmental sustainability by reducing paperwork and energy-intensive processes [11]. This model aligns with the goals of modern governance—efficiency, inclusivity, and responsiveness—while also safeguarding data privacy and ensuring compliance with evolving regulatory frameworks.

RESULT & DISCUSSIONS

To evaluate the effectiveness of Blockchain integration in public administration, case studies and survey results were analyzed. The findings suggest that Blockchain significantly improves operational efficiency, data integrity, and public trust when compared to traditional centralized systems. In nations like Estonia and Dubai, administrative tasks such as issuing digital IDs, managing health records, and processing legal documents have been optimized using Blockchain. Meanwhile, South Korea’s pilot projects have demonstrated time savings and reduction in fraud across customs, real estate, and voting systems.

Table 1: Comparison of Traditional vs Blockchain-Based Administrative Models

Criteria	Traditional Model	Blockchain-Based Model
Data Integrity	Medium	High (Immutable)
Transparency	Low	High
Operational Speed	Moderate	High
Cost Efficiency	Low	High (due to automation)
Trust Among Citizens	Moderate	High

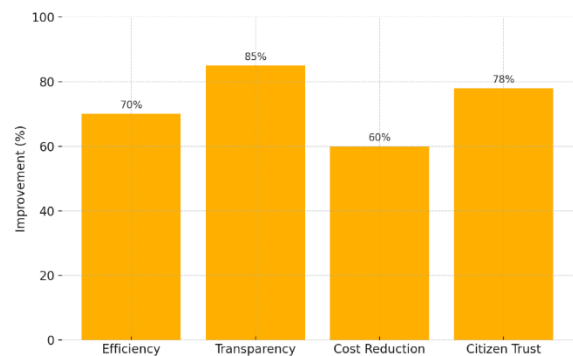


Figure 1: Adoption Impact Metrics in Public Administration (Based on Survey)

Table 2: Challenges Faced During Implementation

Challenge	Frequency (Observed in Case Studies)
Legal/Regulatory Conflicts	High
Technical Skill Gap	Medium
Budget Constraints	Medium
Public Digital Literacy	High
Interoperability with Legacy IT	High

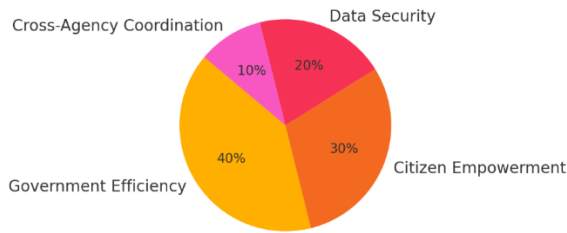


Figure 2: Stakeholder Benefits Distribution

This distribution highlights that Blockchain’s greatest contribution lies in improving internal governmental efficiency and citizen experience.

CONCLUSION & FUTURE SCOPE

Blockchain technology offers transformative potential for the public administrative sector by introducing transparency, decentralization, and enhanced data integrity. The proposed model, based on real-world use cases and literature, demonstrates its ability to eliminate redundancy, increase operational efficiency, and build citizen trust in governance. Countries like Estonia, South Korea, and Dubai have already reaped measurable benefits by integrating Blockchain into public services such as identity management, documentation, and digital governance. However, to achieve widespread implementation, challenges related to regulatory frameworks, digital literacy, and interoperability must be strategically addressed. Governments must invest in technical capacity building and standardization efforts to ensure inclusive and scalable adoption. Future work should focus on integrating Blockchain with emerging technologies like AI and IoT to further enhance smart governance capabilities. A globally coordinated effort involving policymakers, technologists, and civil society is crucial to unlocking the full potential of Blockchain in transforming public administration.

References

Cagigas, D., Clifton, J., Diaz-Fuentes, D., & Fernández-Gutiérrez, M. (2021). Blockchain for public services: A systematic literature review. *IEEE Access*, 9, 13904–13921.

Lykidis, I., Drosatos, G., & Rantos, K. (2021). The use of blockchain technology in e-government services. *Computers*, 10(12), 168.

Lee, C. H. (2020). A Study on the Application of Blockchain Technology on the Impact of Public Administrative Services. *Journal of Internet Computing and Services*, 84, 4629–4633.

Karaszewski, R., Modrzyński, P., & Modrzyńska, J. (2021). The use of blockchain technology in public sector entities management. *Energies*, 14(7), 1873.

Sung, C. S., & Park, J. Y. (2021). Understanding of blockchain-based identity management system adoption in the public sector. *Journal of Enterprise Information Management*, 34(5), 1481–1505.

Tan, E., Mahula, S., & Cromptvoets, J. (2022). Blockchain governance in the public sector: A conceptual framework for public management. *Government Information Quarterly*, 39(1), 101625.

Ahmad, D., et al. (2021). Blockchain technology immutability framework design in e-government. *Jurnal Administrasi Publik*, 11(1), 32–41.

Shahaab, A., et al. (2023). Public service operational efficiency and blockchain – A case study of Companies House, UK. *Government Information Quarterly*, 40(1), 101759.

Dziundziuk, V., & Dziundziuk, B. (2022). Public administration using blockchain technology and platforms: new opportunities. *Pressing Problems of Public Administration*, 2(61), 104–115.

Kassen, M. (2022). Blockchain and e-government innovation: Automation of public information processes. *Information Systems*, 103, 101862.