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Bridging the chasm between ‘what could be’ and ‘what is’: The impact of blockchain technologies on public service management

Introduction and aim of the special issue

While artificial intelligence (AI) has attracted significant attention from public management scholars and practitioners in recent years, another emerging technology, blockchain, deserves similar consideration due to its equally disruptive and transformative potential (Cagigas et al., 2021; Sousa, 2023). In the late 2010s, blockchain technologies (BCT) created considerable hype in policy circles, leading to growing experimentation and small-scale implementations, and a surge of scholarly interest across disciplines, including public administration and management (Clifton et al., 2023; Tan, 2023). A growing body of research have explored the application of this technology in various public sector domains, such as healthcare, education, voting systems, and governance more broadly (Tan et al. 2022; Cagigas et al. 2021; Khan et al. 2021; Rodríguez Bolívar and Scholl 2019; Casino et al. 2019).

In this initial phase (*Phase 1*), public management scholarship has primarily focused on understanding and theorizing the implications of this disruptive technology in reshaping existing processes within the public sector. However, much of this work remains largely conceptual, discussing the potential impacts of blockchain without exploring its real-world effects. While these early studies have been valuable in identifying frameworks and models for the application of blockchain in government processes, our understanding of its actual impact on the public sector remains limited.

One key challenge in assessing blockchain’s real-world impact is that experimentation with the technology has yet to reach to a mature phase, what we might call *Phase 2*, characterized by broader uptake and measurable impact on a larger scale (Lindman et al., 2020; Tan et al., 2022). Some early findings suggest that government organisations across the world have encountered setbacks in scaling up their blockchain projects to full-scale implementation (Berryhil et al. 2018; Cagigas et al., 2021; Khan et al., 2021; Verma and Sheel, 2022). This lack of wider-scale implementation of BCT in the public sector, prevents the scholarly community from fully exploring the potential implication of this technology for public service management and governance. Furthermore, the exploratory and experimental nature of blockchain implementation in government makes it challenging for researchers to collect empirical data to explore the extent of actual implementation and understand the transformative impact of blockchain in the public sector.

The goal of this special issue is to understand better this ‘chasm’ between Phase 1 and Phase 2, and to explore how we might bridge the gap between a conceptual ‘what could be?’ stage to a practical ‘what actually is’ stage. Our approach in this special issue has

been to call for studies that integrate insights from public administration theory and practice, applying the theoretical lenses from managerial and organizational sciences alongside empirical evidence from real-world use cases. We argue that this is an important academic endeavour for public administration scholarship, considering the implications of blockchain about how services are organized and delivered in the digital age, both now and in the future.

With that aim in mind, this special issue presents seven articles that together contribute to the emerging public administration literature on blockchain in three principal ways:

- Outlining theories, concepts and explanatory factors that can help explain the limited uptake and scaling of blockchain in the public sector and the transition from hype to impact.
- Publishing new empirical evidence from different geographic, policy and organizational contexts on the use of blockchain technologies
- Drawing practical implications for policy makers and public managers on bridging the gap between theory and practice regarding blockchain adoption and implementation in the public sector

Before outlining the specific contributions of each article in this special issue, we will first provide a brief introduction to BCT and discuss their potential role in transforming public service management.

Blockchain technologies and their evolution over time

Blockchain, as a concept, gained public attention following the release of the 2008 Bitcoin whitepaper (Nakamoto, 2008), which described a decentralized approach to recording a history of transactions in a peer-to-peer network in a transparent and tamper-resistant way. Each transaction is recorded in a 'block' of information that is linked to previous blocks, forming a 'chain of blocks'. To maintain an unbreakable link between blocks in a blockchain, each block refers to its previous block by its hash. In addition, a timestamp is attached to each transaction to prove that the blocks are in chronological order. This structure makes it computationally unfeasible to control or tamper with the ledger of records through cyberattacks.

Since then, blockchain has evolved into a shorthand term encompassing a compilation of technologies-some that preceded it, such as smart contracts, zero-knowledge proofs, and distributed ledgers, and others that emerged later, like consensus models (e.g. proof-of-work, proof-of-stake), non-fungible tokens (NFTs), decentralized applications (DApps), and decentralized autonomous organizations (DAOs). While the precise conceptual boundaries of blockchain are still being defined, it fundamentally involves a distributed ledger that allows network participants to verify the authenticity of information without relying on a centralized authority to approve or correct transactions. In this editorial, we use the term 'blockchain technologies' (BCT) to refer to a family of

decentralized technologies, including distributed ledgers, smart contracts, DAOs and others that replace the roles of humans, organizations, and institutions in coordinating and managing transactions with code-bound processes.

The decade following the release of the whitepaper has witnessed the emergence of two prominent developments concerning BCT. First, the whitepaper originally positioned blockchain as the backbone of an alternative financial system in the wake of the 2008 financial crisis, which experienced significant trust erosion. Bitcoin, the first cryptocurrency backed by blockchain technology, heralded a decade of innovations, leading to the rise of initial coin offerings (ICOs), non-fungible tokens (NFTs), and decentralized finance (DeFi). This created a complex and somewhat infamous market that, as of 2024, is estimated to have reached a global capitalization of \$2.5 trillion (Forbes, August 2024).

The second significant development was the launch of Ethereum in 2015, a global blockchain platform that enabled the use of smart contracts and token technologies to create DApps. Following Ethereum, numerous similar blockchain networks emerged, facilitating a wide range of use cases beyond cryptocurrencies and paving the way for the emergence of DAOs, which allow for the automated and decentralized control of transactions.

Nowadays, BCT is being applied in various sectors beyond finance, to enhance transparency and efficiency in numerous digital transactions. In supply chain management, blockchain solutions are used for real-time tracking and verification of goods, with a value proposition for building trust for stakeholders in the entire product journey from origin to consumer (Shahzad et al., 2024). In healthcare, blockchain facilitates secure sharing of patient data, reliant on the interoperability and data integrity among different healthcare providers (Ghosh et al., 2023). The energy sector is utilizing blockchain for peer-to-peer energy trading, which allows consumers to buy and sell energy directly with one another, thus optimizing energy distribution (Juszczak & Shahzad, 2022). Additionally, blockchain is being explored for digital identity verification, providing a secure method for individuals to manage and authenticate their identities (Sullivan & Tyson, 2023). Other applications include voting systems, where blockchain can ensure secure and transparent electoral processes, and intellectual property protection, enabling creators to establish and verify ownership of their works (Berryhill et al, 2018). As organizations continue to explore these applications, blockchain is proving to be a versatile tool across various industries.

Blockchain technologies and their transformative impact on public sector

We render the transformative impact of BCT on public governance and public service management in three functional ways.

First, *as a verification technology*, it provides a means to verify the authenticity of data without the need for trusted intermediaries and allows for greater control over personal data in public service delivery processes. Blockchain can also be used for public and legal activities where citizen data is handled (Lindman, Rossi & Tuunainen, 2017).

Secondly, *as a process tracking technology*, BCT increases the transparency, auditability, and accountability of processes used in public management, thus fostering greater trust between the public and governmental entities.

Third, *as a management technology*, BCT can facilitate peer-to-peer management of public service delivery (Lember, Brandsen & Tönurist, 2019), and through the combination of smart contracts, digital wallets, and token technologies, it can allow service users and stakeholders to contribute to public services directly without requiring public authorities to act as mediators (Tan & Rodriguez-Müller, 2023).

In what follows, we delve into each transformative impact in greater detail:

Verification

Using BCT, actors can independently verify the authenticity of data without relying on intermediaries. This has far-reaching implications for the design of public governance, as it removes the need for trusted third parties such as banks, notaries, or government agencies to validate transactions or information. In the management of public services such as in education, healthcare, and social services, the verification of credentials, medical records, and benefits eligibility could be automated and securely stored on the blockchain.

Especially in service areas where notaries and notarization serve as key trust anchors in the transaction of assets and information, this feature has significant implications. Consider the case of land registry systems, where blockchain has been piloted to verify property ownership and transfer titles in countries such as Ghana, Georgia, and Sweden (Ameyaw & De Vries, 2023, Allesie et al., 2019). Such practices eliminate the need for manual verification by multiple authorities, sped up the process, and reduce the risk of fraud.

In the education sector, some universities are using BCT to support the issuance and verification of academic credentials, including diplomas, certificates, degrees, and qualifications (Tan et al., 2022). For instance, the University of Nicosia is issuing all university diplomas since 2017 on a blockchain (UNIC, October 2024). Similarly, University of Lille issue blockchain-backed digital attestations for diplomas and other educational credentials. As of 2023, the university has reportedly issued over 56,000 blockchain-based credentials (BC diploma, October 2024).

In the context of public services, verification via blockchain means for citizens reduced administrative burden and faster service delivery. For governments, BCT can reduce

costs, enhance security, and build public trust. Citizens no longer rely on intermediaries to validate their credentials, and public service organizations can keep a tamper-proof system for ensuring the legitimacy of the information being exchanged.

Process Tracking

Blockchain's ability to provide transparent and immutable tracking of processes is another key application in public governance. This feature allows for the continuous, verifiable tracking of the status and history of public services, projects, or assets throughout their lifecycle. By recording every step of a process on a blockchain, governments can improve accountability and transparency, reducing the risk of corruption and fraud.

One example of this is the use of blockchain to track the supply-chain in government procurement and to track public funds and grants. Governments can ensure that funds intended for specific projects, such as infrastructure development or education programs, are used as planned. By recording every financial transaction on a blockchain, public authorities can offer complete transparency about how public money is spent. This increases public trust and prevents financial mismanagement or corruption, as anyone can verify the status of funds at any point in time.

For instance, the United Nations World Food Programme (WFP) uses blockchain to track cash, food, medicine delivery and distribution in humanitarian aid programmes. The project "Building Blocks" states that the BCT-backed system enables the WFP to track the movement of aid supplies from the moment they leave the warehouse to their final distribution to beneficiaries (UN WFP, 2024). The immutable record of transactions ensures that resources are not misappropriated and reach the intended recipients without interference. Additionally, the system reduces transaction fees and speeds up the distribution of aid.

A blockchain-enabled procurement industry is emerging particularly in the public sector where fairness and openness in procurement departments need to be ensured. For example, the General Service Administration initiated a new project to develop a new procurement blockchain for the US government that can preserve records of procurement data regarding time, deliverables, pricing and assessments to improve confidence in the procurement process (Lumineau et al., 2020).

Another example is the use of blockchain to track and verify products to ensure they meet standards in production, sustainability, and authenticity. For instance, several government initiatives are currently developing and testing digital product passports, in combination with digital signatures, IoT, and blockchain solutions, to combat

counterfeiting, supply chain disruptions, and fraud in industries such as sustainability, fair trade, and waste management (Zhang & Seuring, 2024).

In summary, blockchain's process-tracking capabilities can significantly improve governments' capabilities to ensure that public resources are properly allocated, and that the delivery of public services remains compliant with established policy standards.

Automated Management

Automated management through smart contracts is one of the most transformative aspects of BCT in public management. Smart contracts are self-executing contracts with the terms of the agreement directly written into code. Since BCT does not directly depend on the enforceability of external legal obligations (Werbach, 2018), smart contracts facilitate rules enforcement by their embedded codes and algorithms in blockchain-based networks (Catalini & Boslego, 2019). In essence, they automatically execute and enforce contractual agreements when predefined conditions are met, reducing the need for manual intervention and minimizing administrative overhead.

For example, the Estonian government uses such automated management systems in the delivery of public services. Utilizing KSI blockchain, in combination with eID system and X-road interoperability solution, Estonia's e-government program (e-Estonia, October 2024) uses a decentralized and automated system to manage its national health, judicial, legislative, and commercial systems.

Another example can be seen in the Smart Dubai initiative, where the city has begun implementing smart contracts across various government services. For instance, the Dubai Land Department uses blockchain-based smart contracts to facilitate real estate transactions. The smart contracts automate the process of payment verification and transfer of ownership, for the automatic execution of transactions and recording on the blockchain (Dubailand, 2017).

Another area where automated management through blockchain is gaining traction is the use of DAOs in public governance. DAOs are organizations in a digital space where traditional management processes are replaced by autonomously executed codes (Rikken et al, 2023; Wright, 2020). While most practical examples in the public sector remain largely theoretical, DAOs hold the potential to transform citizen participation in public budgeting, management, and the delivery of public services (Rikken et al., 2023; Tan & Rodriguez Müller, 2023).

By using BCT for automated management, public authorities can significantly reduce the administrative workload and human errors involved in managing public services. Furthermore, processes can be streamlined, administrative delays can be reduced and bottlenecks in service delivery can be avoided.

Explaining the gap between what ‘could be’ and ‘what is’

Despite these promising examples, the development of blockchain technology into a mature innovation that public sector organizations can fully rely on remains limited (Berryhill et al., 2018). Consequently, there is a need to understand what explains its limited and patchy impact in the public sector. Existing research points to several reasons for the unused potential of BCT in the public sector, including unclear regulatory and procedural guidelines, privacy and security concerns, inefficient and energy-intensive transactions, interoperability challenges, and insufficient data infrastructure (Tan, 2023; Janssen et al., 2020; Ølnes et al., 2017; Zachariadis et al., 2019). However, much of the empirical evidence in the published research is either anecdotal, sharing the perceptions and expectations of project owners, or heavily reliant on secondary sources and self-reported data, without verifying the true extent of implementation. As a result, the actual use of blockchain in public sector organisations may be more limited than existing research suggests.

Why, then, is there such a significant gap between theory and practice when it comes to the use of blockchain in the public sector? Is there something inherently unique about blockchain that makes it difficult to implement in public service processes? Or is there something unique about the use of disruptive technologies in the public sector? Research on other disruptive technologies, such as AI, reveals a similar pattern of limited actual implementation despite numerous reported projects (Van Noordt & Misuraca, 2022). This suggests that the uncertainty surrounding these potentially disruptive technologies, particularly regarding regulatory conditions, practical challenges, and ethical implications, need to be reevaluated to comprehend their potentially transformative impact.

Furthermore, there is a noticeable lack of theoretical studies explaining the limited uptake of blockchain technologies in the public sector, despite the rich theoretical perspectives and the interdisciplinary nature of the field of public administration (Hattke & Vogel, 2023; Meyers et al., 2023; Raadschelders, 2019). A disconnect exists between public administration theories, on the one hand, and blockchain practices, on the other. This highlights the potential for further research to bridge this gap and develop theoretical explanations that rely on public administration theories. Illustrative examples include institutional theory, public sector innovation theory, governance theory, organizational culture theory, public value theory, and sensemaking theory. Institutional theory offers useful insights into the diffusion and adoption of blockchain, particularly in explaining the barriers innovators face in driving technological advancements in administrative environments. Institutional theory can also help examine how blockchain technology gains social approval and legitimacy among key stakeholders, as well as how new organizational arrangements introduced by blockchain adoption interact with existing institutional norms, rules, and values (Hinings et al., 2018). Similarly, public sector

innovation theories can shed light on the role of leadership, organizational culture, stakeholder engagement, and external political, economic, and technological drivers for the integration of blockchain technologies within administrative processes and public service delivery systems (Haug, Dan & Mergel, 2023). Sensemaking theory (Weick, 1995; Combe & Carrington, 2015) can, for example, be employed to understand how policy makers and public administrators grapple with the uncertainty and risks posed by scaling up blockchain projects and incorporating them into digital transformation programmes over time.

The contribution of the special issue articles to bridging the gap between ‘what could be’ and ‘what is’ the impact of blockchain technologies on public service management

The seven articles cover various policy areas, types of services, and empirical settings, ranging from local government initiatives in public finance management (Kenetey & Popesko, 2024) to circular economy (Acosta Llano et al., 2024) and cultural services (Rubino et al., 2024). These studies explore both country-specific (Acosta Llano et al., 2024; Haq et al., 2024; Mahula et al., 2024) and multi-country blockchain projects across different levels of government and types of institutions (Curry, 2024; Rodriguez-Müller et al., 2024), as outlined in Table 1. Theoretically, the articles draw on a rich array of theories, incorporating perspectives from design science research, public sector innovation, trust and legitimacy theories, public service motivation, institutional theories, public value theories, sense-making and leadership theories. Methodologically, the studies employ a variety of research designs and methods, including design artefacts (Kenetey & Popesko, 2024), scoping reviews (Rubino et al., 2024), interviews (Acosta Llano et al., 2024; Mahula et al., 2024), analysis of country databases (Rodriguez Müller et al., 2024), and comparative case studies of different blockchain use cases (Curry, 2024; Haq et al., 2024; Mahula et al., 2024).

Table 1. Overview of the special issue articles

<i>Reference</i>	<i>Policy area/ type of service</i>	<i>Theoretical perspective(s)</i>	<i>Methods</i>
Kenetey & Popesko (2024)	Public finance management	Design science	Observational technique, semi-structured interviews at local government in Ghana
Acosta Llano et al. (2024)	Circular economy	<ul style="list-style-type: none"> • Transparency • Public participation 	Semi-structured interviews, document analysis with public and private entities in Finland

		Incentivization and standardization as regulatory mechanisms	
Rodriguez-Müller et al. (2024)	Public sector (general)	Public value theories	Document analysis, descriptive statistical analysis among EU countries
Rubino et al. (2024)	Cultural services	Innovation adoption and diffusion theories	Scoping review
Curry (2024)	Governance models	Trust, legitimacy, and governance theories	Case studies
Mahula et al. (2024)	Multiple public services at local and national levels	Public service motivation theories, institutional theories, organizational culture theories	Semi-structured interviews with public entities in the Netherlands
Haq et al. (2024)	Multiple policy areas	Sensemaking, public service leadership	Semi-structured interviews with public and private entities in Finland

What insights do these articles offer on why BCT have not yet reached a more mature stage of implementation in the public sector? Common themes emerging across the studies include a lack of regulatory clarity and standards, insufficient technological understanding and risk-averse behaviours among managers, concerns over the sustainability and public value of blockchain solutions, as well as uncertainties about the adoptability and interoperability of new solutions with existing practices. Table 2 provides a summary of the key explanations from each study regarding the limited adoption of BCT in the public service areas analysed.

Table 2. Main explanations behind limited uptake

<i>Reference</i>	<i>Main explanations of the gap between what 'could be' and 'what is'</i>
Kenetey & Popesko (2024)	<ul style="list-style-type: none"> • Insufficiently developed legislative framework and digital infrastructure • Integration of blockchain in administrative processes and readiness to embrace digital innovations • The need to develop acceptance and legitimacy of blockchain solutions
Acosta Llano et al. (2024)	<ul style="list-style-type: none"> • Insufficiently harmonised legislative framework • Insufficient technological understanding of what blockchain can be used for and what it can deliver • Making the case for how blockchain can enhance transparency, engagement, standardized metrics and incentivization

	<ul style="list-style-type: none"> • The need for governments to develop partnerships with private actors
Rodriguez-Müller et al. (2024)	<ul style="list-style-type: none"> • Trade-offs in blockchain use • Disruptive impact of blockchain • Uncertainty regarding benefits, implementation process, and effects on public values • Insufficient continuity of most blockchain projects influenced by the requirement to show immediate results
Rubino et al. (2024)	<ul style="list-style-type: none"> • Insufficiently harmonised legislative framework • Privacy concerns • Copyright protection and data management concerns • Insufficient interoperability and inter-institutional collaboration and data sharing • Insufficient technological understanding of what blockchain can be used for and what it can deliver
Curry (2024)	<ul style="list-style-type: none"> • Insufficient legitimacy of blockchain-based services • The need to develop political and public trust in blockchain applications • Limitations regarding political decentralisation, immutability and consensus protocols of blockchain solutions
Mahula et al. (2024)	<ul style="list-style-type: none"> • Insufficiently harmonised legislative framework • Risk-averse organizational characteristics and decision-making • Uncertain sustainability and value-added of experimental blockchain projects
Haq et al. (2024)	<ul style="list-style-type: none"> • The need to develop leadership competencies that help drive the process of blockchain adoption and implementation • Insufficient understanding of what blockchain can be used for and what it can deliver • The need to integrate the characteristics of blockchain into organizational processes and align them with organizational goals

Nonetheless, each study offers valuable insights and policy-level recommendations on how to transition from Phase 1 ‘Hype’ to Phase 2 ‘Scaling and Impact.’ Below, we provide a brief overview of each study, offering both academics and practitioners key takeaways on leveraging this important technology to enhance public service management.

Kenetey & Popesko (2024) use design science research to create a blockchain artefact for local public administration in Ghana and find potential benefits of using blockchain, yet implementation relies heavily on developing the legislative framework and digital infrastructure to enable the integration of blockchain applications into a developing public administration system.

Acosta Llano et al. (2024) report that enhancing transparency, driving incentives, promoting engagement and standardizing data are essential for the uptake of blockchain in circular economy policy in Finland. They find that a harmonised legislative framework and alliances with the private sector can leverage blockchain implementation. They note that creating more understanding of how blockchain can be used and what it can deliver, and making a case for its value added, is likely to further support implementation.

Rodriguez-Müller et al. (2024) use public value theory to explore the impact of over one hundred blockchain projects across the European Union (EU) and find that about 10-15% of the projects are operational. They note that trade-offs in values need to be considered along with the disruptive impact of blockchain on existing administrative arrangements.

Rubino et al. (2024) conducts a scoping review of blockchain research in the cultural sector and identify key advantages of BCT for the culture services through tokenization of cultural assets, decentralized financing, digital asset, and digital rights management, while pointing out the need for better understanding among managers concerning the digital leadership, adopting human-centred design approaches, and exploring better the user needs and value propositions associated with BCT solutions.

Curry (2024) uses governance theory, drawing upon co-governance, self-governance and hierarchical governance mechanisms, to examine the legitimacy of and trust in the use of blockchain technologies. The study concludes that lack of perceived legitimacy affects the public and political trust in blockchain applications.

Mahula et al. (2024) draws on neo-institutional, public service motivation, organizational culture theories to examine what motivates public service managers to pursue blockchain projects in the public sector and concludes that varying (de)motivating factors of the public managers in initiating blockchain pilots may explain why some projects pass to an implementation phase while others are abandoned.

Finally, Haq et al. (2024) use sensemaking and leadership competencies research to explore the perceptions of Finnish experts about the likelihood of blockchain implementation in the future. The study concludes that developing a set of generic and blockchain-specific leadership competencies will likely improve the adoption of blockchain solutions to the extent that the technology is properly understood and aligned with organizational processes and goals.

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