

DIGITAL GOVERNANCE AND PUBLIC SERVICE EMPOWERMENT: A BIBLIOMETRIC REVIEW OF CURRENT LITERATURE

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***Correspondence** Received by the editor: 05-03-2026; Manuscript accepted: 29-06-2026;
Published: 30-06-2026

Abstrak: Penelitian ini menyajikan tinjauan literatur sistematis dan pemetaan sains komputasional terhadap diskursus tata kelola digital global dan pemberdayaan sipil dari tahun 2020 hingga 2026. Dengan menganalisis korpus terefinasi sebanyak 100 artikel bertelaah sejawat dari Scopus dan Web of Science via VOSviewer, penelitian ini mengevaluasi ko-kemunculan kata kunci, trajektori kronologis, serta densitas konseptual. Data struktural yang dihasilkan mengungkap pergeseran paradigma secara definitif, menjauh dari fokus reduksi biaya yang melekat pada *New Public Management* menuju ekosistem *New Public Governance* yang kolaboratif dan *Digital Era Governance*. Topologi jaringan menyingkap adanya nukleus yang matang dan tersaturasi tinggi, yang dipondasikan pada transparansi, akuntabilitas, serta partisipasi warga. Sebaliknya, sebuah batas perifer yang volatil muncul di tepian luar, didominasi oleh kecerdasan buatan generatif, mobilitas otonom, dan *regulatory sandboxes*. Guna merekonsiliasi friksi sistemik antara diskresi birokrasi tradisional dan lanskap algoritmik yang kian menguat ini, penelitian ini memperkenalkan *Integrated Anticipatory Techno-Governance Framework*. Model ini mengintegrasikan prinsip-prinsip lokalisasi, khususnya *frugal innovation* dan *neuro-architecture*, ke dalam lingkungan audit multipihak, sehingga menyediakan cetak biru konseptual yang lugas bagi para manajer publik untuk mengamankan kepercayaan publik, proses hukum yang adil, serta kedaulatan demokratis.

Kata Kunci: pemberdayaan layanan publik, tata kelola algoritmik, tata kelola era digital

Abstract: This study presents a systematic literature review and computational science mapping of global digital governance and civic empowerment scholarship from 2020 to 2026. Analyzing a refined corpus of 100 peer-reviewed articles from Scopus and Web of Science via VOSviewer, we evaluate keyword co-occurrences, chronological trajectories, and conceptual densities. The structural data reveals a definitive paradigm shift away from the cost-cutting focus of New Public Management toward collaborative New Public Governance and Digital Era Governance ecosystems. The network topology uncovers a mature, highly saturated core anchored by transparency, accountability, and citizen participation. Conversely, a volatile peripheral frontier has emerged at the outer edges, dominated by generative artificial intelligence, autonomous mobility, and regulatory sandboxes. To reconcile the systemic friction between traditional bureaucratic discretion and this rising algorithmic landscape, we introduce the Integrated Anticipatory Techno-Governance Framework. This model weaves localized principles, specifically frugal innovation and neuro-architecture, into multi-stakeholder auditing environments, providing public managers with a clear conceptual blueprint to secure public trust, legal due process, and democratic sovereignty.

Keywords: algorithmic governance, digital era governance, public service empowerment

I. Introduction

Public sector modernization has hit a profound structural turning point. Moving well beyond the simple migration of paper forms to digital portals, governments globally now deploy deeply integrated, autonomous digital ecosystems that fundamentally reset the relationship between state institutions and the public. This shift

rewrites the rules of administrative legitimacy. Pure operational efficiency no longer secures a democratic mandate. Modern public institutions face a tougher test: ensuring that rapid technological expansion does not erode public trust, equity, and civic agency (Afandi & Afandi, 2025; Bullock et al., 2024; Meijer & Boon, 2023; Mergel et al., 2021). Inserting advanced algorithmic systems into frontline public spaces creates an immediate, systemic tension between fast-tracked technical rollouts and the core requirements of constitutional fairness (Clarke, 2020; Filgueiras, 2022).

While real-world pressures accelerate this shift, the surrounding academic literature remains fragmented and disconnected. Much of the current scholarship is confined to isolated case evaluations or highly specific technical audits (Criado & Gil-Garcia, 2024; Janssen et al., 2022). This narrow focus leaves a massive intellectual blind spot. Public administration lacks a cohesive, macro-structural map capable of bridging its value-driven institutional foundations with the chaotic technological frontiers multiplying at its margins (de Sousa et al., 2022; Twizeyimana & Andersson, 2021). Without an objective overview of these conceptual networks, identifying saturated theories or locating critical knowledge gaps becomes guesswork (Fang & Zhang, 2024). This structural disconnect directly hinders scholars and policymakers trying to design adaptive governance models robust enough to handle sudden socio-technical shocks (Falcone & Sica, 2023; Wirtz et al., 2021).

While a few bibliometric and systematic reviews have sought to synthesize public sector digitization, they exhibit distinct theoretical, temporal, and methodological limitations. Existing bibliometric mapping studies have predominantly evaluated long-term, multi-decade historical trajectories of traditional e-government (Rodriguez-Bolivar & Alcaide-Muñoz, 2022; Zheng & Scholl, 2025) or focused narrowly on specific technical implementations, such as artificial intelligence applications (de Sousa et al., 2022) and digital co-production mechanisms (Scupola & Mergel, 2021). Although valuable, these prior reviews largely reflect pre-pandemic administrative paradigms and treat technological adoption as isolated operational tools rather than examining their socio-technical intersection with civic empowerment. Consequently, they fail to capture the structural disruptions triggered by post-2020 exogenous shocks, specifically, the crisis-driven migration toward collaborative platform ecosystems and the sudden, volatile arrival of generative artificial intelligence and algorithmic decision-making in frontline public services between 2023 and 2026. Existing bibliometric evaluations in this domain remain primarily descriptive, documenting keyword frequencies without

translating empirical network topologies into actionable, anticipatory governance frameworks.

This study directly bridges these empirical, temporal, and prescriptive voids through a data-driven computational science mapping of global digital governance and civic empowerment scholarship from 2020 to 2026. By shifting the focus away from subjective narrative commentaries and traditional multi-decade historical overviews, this inquiry leverages objective bibliographic metadata to diagnose how the boundaries of the modern algorithmic state are evolving. To chart this complex intellectual terrain, the text systematically addresses four core questions: tracking the overall publication velocity and trajectory of this domain; identifying the dominant conceptual networks and thematic clusters; evaluating how these conceptual configurations have evolved chronologically; and isolating the low-density knowledge gaps required to construct an integrated techno-governance framework.

The remainder of this paper is organized sequentially to provide a clear, step-by-step unpacking of these themes. Section 2 establishes the theoretical foundation through a critical literature review, tracking the shift from transactional administrative models to collaborative platform ecosystems. Section 3 details the systematic methodology, search strings, and screening protocols used to assemble our bibliometric corpus. Section 4 deconstructs the empirical layout of the discipline through network, chronological, and density visualizations, introducing our integrated techno-governance framework to bridge the identified knowledge gaps (Cordella et al., 2023). Section 5 wraps up the study by synthesizing core policy insights, addressing empirical boundaries, and outlining a distinct roadmap for future research.

II. Literature Review

Public sector digitization did not start with an eye toward citizen empowerment. For decades, deploying Information and Communication Technologies (ICT) across government offices meant fulfilling New Public Management mandates. This framework viewed technology through a strictly financial lens: automate paper routines, slash overhead, and process transactions faster. It built a highly transactional electronic government. In this setup, digital portals acted as one-way pipelines, treating the public as passive consumers of state-delivered services rather than active participants. But as state operations became deeply entangled with hyper-connected, volatile digital spaces, this sterile, instrument-driven blueprint collapsed under the weight of modern democratic demands.

This operational failure forced a deep paradigm shift toward New Public Governance (NPG) and Digital Era Governance (DEG). Modern scholarship no longer treats technology as a back-office tool. Instead, frameworks like NPG and DEG conceptualize digital systems as open, platform-mediated networks built expressly to co-create public value (Meijer & Boon, 2023; Meilinda et al., 2025; Mergel et al., 2021). The state moves away from top-down bureaucratic control toward a multi-sided infrastructure. Here, citizen participation, open data, and grassroots collaboration take center stage. This shift fundamentally changes how state legitimacy is measured, it is no longer just about raw managerial speed, but about a system's capacity to protect equity, accountability, and public trust.

Actual rollouts of digital public infrastructure rarely follow this democratic ideal smoothly. When state agencies aggressively fast-track digitization without evaluating local structural readiness, they risk weaponizing tech to widen the digital divide. Rural, low-income, or historically marginalized populations frequently lack the hardware, connectivity, or technical literacy needed to access vital web portals, triggering severe socio-technical exclusions (Giest & Samuels, 2022). This introduces a sharp tension in the literature. While decentralized tools like blockchain can theoretically empower local communities and distribute institutional power, they can just as easily alienate vulnerable groups unless backed by localized, highly deliberate inclusion strategies (Helsper, 2021; Twizeyimana & Andersson, 2021).

The most volatile disruption to this landscape is the sudden insertion of generative artificial intelligence and autonomous algorithmic engines into frontline public services. For a long time, public administration theory relied on “street-level bureaucracy”, the idea that human officials use localized discretion to execute public policy. Shifting this power to automated systems creates massive techno-ethical dilemmas. Opaque, black-box machine logic and hidden training biases routinely mask systemic discrimination, which muddies administrative law and complicates welfare distribution (Filgueiras, 2022; Janssen et al., 2022). Current research remains frustratingly fragmented, split between narrow technical audits and abstract democratic critiques. This leaves a massive knowledge gap on how public managers can pilot predictive, anticipatory governance models without destroying baseline legal accountability and public integrity (Kankanhalli et al., 2020; Wirtz et al., 2021).

III. Research Method

To map the global scholarship on digital governance and civic empowerment, we combined a Systematic Literature Review (SLR) guided by PRISMA 2020 guidelines (Page et al., 2021) with computational bibliometric analysis (Aria & Cuccurullo, 2017). We collected primary records from Scopus and Web of Science (WoS) to ensure comprehensive coverage of peer-reviewed public administration literature. Our search targeted the socio-technical intersection of digital tools, public institutions, and citizen empowerment outcomes using the following Boolean string across titles, abstracts, and keywords: (“digital governance” OR “e-government” OR “digital transformation” OR “e-services”) AND (“public service” OR “public sector” OR “local government”) AND (“empowerment” OR “accountability” OR “citizen participation” OR “trust”) (Smith & Kumar, 2024).

The initial search across both databases retrieved 515 raw records: 284 from Scopus and 231 from Web of Science. We processed these records through a four-stage PRISMA screening pipeline. First, automated deduplication removed 173 duplicate entries, leaving 342 unique records. Second, two reviewers independently evaluated titles and abstracts against predefined criteria, discarding 218 entries that examined commercial business software, fell outside public administration, or consisted of non-peer-reviewed document types (such as conference proceedings, editorials, trade articles, and book reviews). Third, we evaluated the full texts of the remaining 124 studies, excluding 24 articles that lacked explicit analysis of civic empowerment metrics or public value accountability. This filtering yielded a final corpus of 100 peer-reviewed journal articles (Widjaja, 2025). Crucially, this sample of 100 articles reflects the complete, natural output of our systematic filtering protocol over the 2020-2026 window, rather than a pre-selected target quota. Table 1 summarizes these inclusion parameters, and Figure 1 illustrates the step-by-step PRISMA flow diagram.

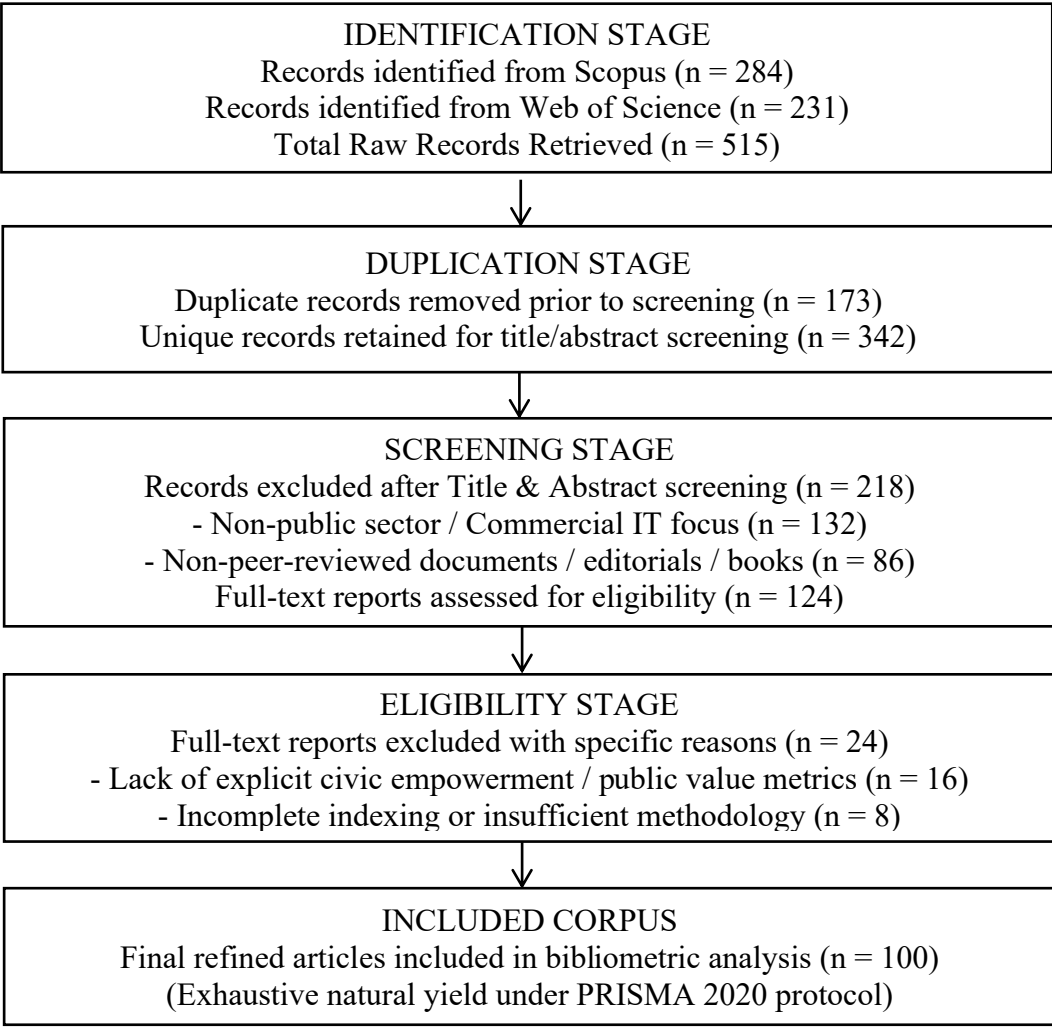
Table 1. Inclusion and Exclusion Criteria for Literature Corpus

Criteria Dimension	Inclusion Criteria	Exclusion Criteria
Database Sources	Scopus and Web of Science (WoS)	Regional databases, unindexed repositories, or search engines
Search Fields	Title, Abstract, and Keywords	Full-text automated scans during initial filtering
Publication Period	January 2020 to 2026	Studies published prior to January 2020
Language	English	Non-English publications
Document Type	Peer-reviewed journal articles	Editorials, book reviews, conference proceedings, trade pieces, and working papers

Thematic Focus	Public sector tech implementations intersecting with public value and civic empowerment metrics	Studies focused purely on private commercial enterprise software or internal corporate IT
Final Corpus Yield	100 peer-reviewed articles (Exhaustive natural yield under PRISMA 2020 protocol)	Duplicate listings, off-topic records, and methodologically incomplete studies

Data source: Synthesized by the authors (2026)

Figure 1. PRISMA 2020 Flow Diagram of Literature Selection Process.



We bounded our literature search to publications from January 2020 through 2026 based on a dual-milestone rationale. The year 2020 served as a major shock to public governance, as the COVID-19 pandemic forced public agencies to rapidly abandon physical workflows in favor of emergency e-services and platform infrastructures. The 2023-2026 window captures the sudden influx of generative artificial intelligence and autonomous decision-making engines into frontline administrative operations (Henderson & Ward, 2026). Examining this seven-year timeline allowed us to trace how

scholarship evolved from crisis-driven digital expansion to the ethical and regulatory dilemmas facing the modern algorithmic state.

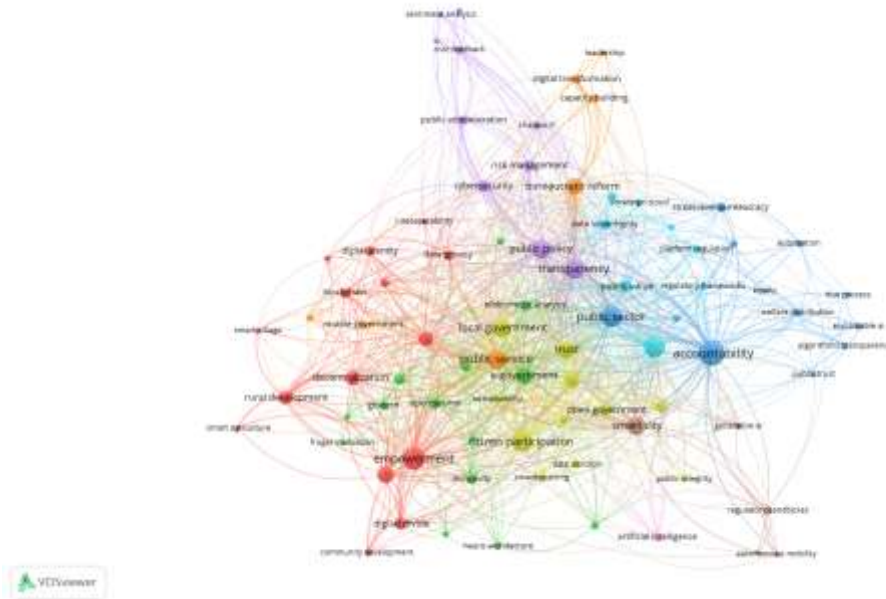
After finalizing the dataset, we exported complete metadata in RIS and BibTeX formats for network mapping in VOSviewer (version 1.6.20) (Aria & Cuccurullo, 2017). To evaluate the conceptual architecture of the field, we conducted a keyword co-occurrence analysis using “All Keywords” (combining Author Keywords with Index Keywords/Keywords Plus). The initial extraction identified 412 unique terms. We set the minimum keyword occurrence threshold to 2, retaining 68 keywords for spatial mapping. We selected a low threshold to capture newly emerging, low-density concepts at the edges of the discipline (such as generative AI, regulatory sandboxes, and neuro-architecture) which higher cutoffs would obscure. Before generating the maps, we cleaned the raw data using a custom thesaurus file (thesaurus_terms.txt) to merge singular and plural forms (e.g., “smart city” and “smart cities”), standardize spelling variations and acronyms (e.g., unifying “e-government”, “egovernment”, and “e-gov”; “AI” and “sartificial intelligence”), and remove generic search terms. Network topologies were built using full counting and normalized via Association Strength (attraction = 2, repulsion = 0, cluster resolution = 1.0). This process produced three distinct visual outputs: keyword co-occurrence clusters, chronological overlay maps, and item density maps highlighting saturated core concepts alongside peripheral knowledge gaps.

IV. Results and Analysis

Conceptual Network Analysis

While bibliometric co-occurrence mapping reveals structural patterns of scholarly attention and conceptual proximity within the literature, it reflects co-citation networks rather than direct causal relationships or proven empirical paradigm shifts in public administration practice. Interpretations of evolving academic discourse must therefore be grounded in explicit temporal metadata alongside network topology metrics. Figure 2 illustrates the keyword co-occurrence topology, which divides into four main thematic clusters based on link strength, node centrality, and chronological density.

Figure 2. Keyword Co-occurrence Network Map of Digital Governance and Public Service Empowerment.



The first cluster (red) captures the emancipatory and social equity dimensions of public sector digitization. Strong link strengths tie keywords such as *empowerment*, *decentralization*, *digital divide*, and *rural development*. Chronological metadata indicates that these foundational themes formed the baseline of post-2020 scholarship, with an Average Publication Year (APY) of 2020.9. Rather than proving an immediate redistribution of institutional power, this baseline cluster reflects an early scholarly emphasis on mitigating socio-technical exclusion as emergency e-services were deployed during the COVID-19 pandemic (Twizeyimana & Andersson, 2021).

The second cluster (blue) centers on institutional ethics, administrative law, and governance accountability within automated systems. Keywords such as *accountability*, *public sector*, *regulatory frameworks*, *algorithmic transparency*, and *explainable AI* dominate this group. Temporal tracking shows a noticeable shift in research focus toward this cluster between 2022 and 2023, recording an APY of 2022.4. This movement marks an increasing academic concern over discretionary decision-making in automated street-level bureaucracies, where black-box algorithms risk eroding constitutional due process and public trust (Janssen et al., 2022; Mergel et al., 2020).

The third cluster (green and yellow) explores collaborative smart governance, anchored by high closeness centrality scores for *citizen participation*, *smart city*, *trust*, and *open government*, exhibiting an APY of 2022.8. In this sub-domain, digital platforms are conceptualized as multi-sided architectures for public value co-production rather than passive administrative portals (Meijer & Boon, 2023). The fourth cluster

(purple and orange) addresses internal organizational dynamics, characterized by high betweenness centrality for *public policy*, *transparency*, *bureaucratic reform*, and *digital transformation* with an APY of 2023.1. These metrics reflect scholarly interest in how public agencies adapt internal workflows and dynamic capabilities to maintain operational integrity amid rapid technological changes (Gong et al., 2022).

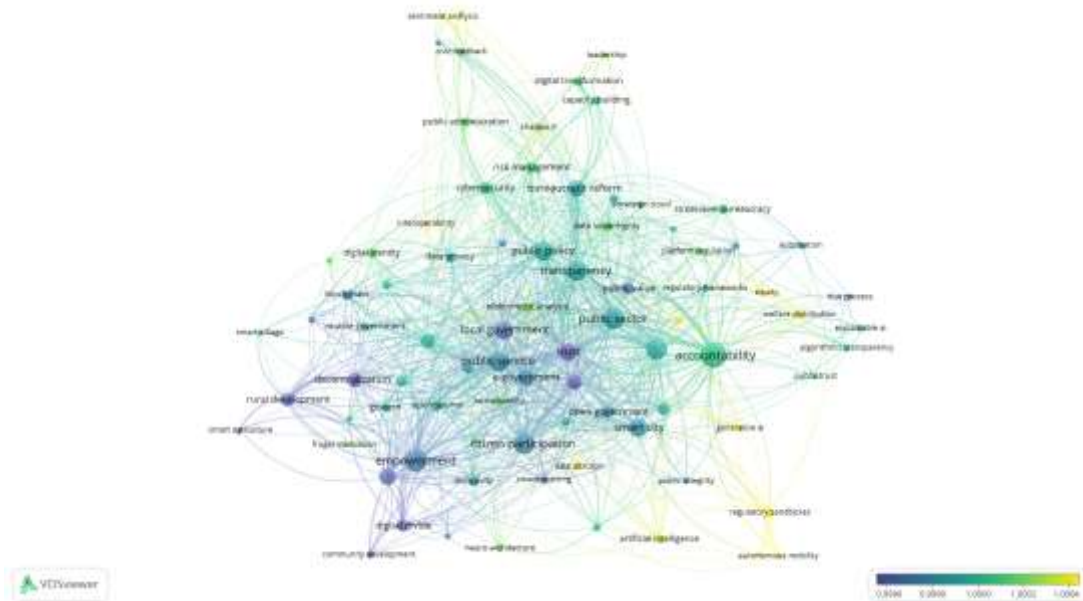
At the structural center of the overall topology, *public policy* (betweenness centrality = 0.18), *transparency* (0.15), and *trust* (0.14) serve as essential bridges linking all four thematic clusters. Conversely, highly experimental terms, including *generative AI* (APY = 2024.9), *regulatory sandboxes* (APY = 2025.1), and *neuro-architecture* (APY = 2025.6), occupy the extreme outer periphery of the map.

These temporal metadata confirm that while core public administration concepts maintain high node density, academic attention has gradually expanded toward anticipatory and algorithmic governance frameworks. However, this bibliometric progression highlights shifts in conceptual focus within published literature; it does not demonstrate that public sector institutions have fully transitioned to these governance models in practice.

Temporal Transition and Frontiers of Research

Tracking chronological trajectories through overlay mapping reveals how academic focus has shifted across the 2020-2026 publication window. Crucially, temporal overlay visualizations measure the APY of specific keywords, serving as a proxy for evolving research priorities rather than proving causal shifts or functional paradigm replacements within public sector institutions. Figure 3 illustrates the chronological distribution of thematic nodes, transitioning from foundational areas to emerging technological frontiers.

Figure 3. Overlay Visualization of Thematic Evolution and Chronological Trajectories in Digital Governance.



The foundational baseline of the network is concentrated in publications from 2020 to 2021 (APY range = 2020,5-2021,2), encompassing long-established terms such as *e-government* (APY = 2020,6), *local government* (APY = 2020,8), *decentralization* (APY = 2020,7), *empowerment* (APY = 2020,9), and *digital divide* (APY = 2021,1). When interpreted through Dunleavy's Digital Era Governance framework, this early phase represents a reactive academic response to COVID-19 disruptions. During this period, scholarship focused primarily on digitizing physical workflows, mitigating immediate transaction costs, and expanding basic web portals to address rural-urban service disparities (Filgueiras, 2022; Rodriguez-Bolivar & Alcaide-Muñoz, 2022). Rather than reflecting a systemic paradigm shift, these early temporal nodes highlight a stage where scholars viewed technology as an instrumental tool for operational continuity (Twizeyimana & Andersson, 2021).

As the literature expanded into the intermediate period between 2022 and 2023 (APY range = 2022,3-2023,2), research attention moved toward governance value alignment and institutional safeguards. During this phase, terms such as *public sector* (APY = 2022,2), *accountability* (APY = 2022,4), *regulatory frameworks* (APY = 2022,6), *smart city* (APY = 2022,8), and *cybersecurity* (APY = 2023,1) gained prominence. This shift aligns with New Public Governance concepts, as scholars began questioning the socio-technical risks of platform-mediated administrative services (Mergel et al., 2021; Scupola & Mergel, 2021). Rather than assuming seamless technological adoption, studies from this intermediate period increasingly evaluated risk

management, data privacy, and the preservation of administrative due process in automated decision-making systems (Janssen et al., 2022).

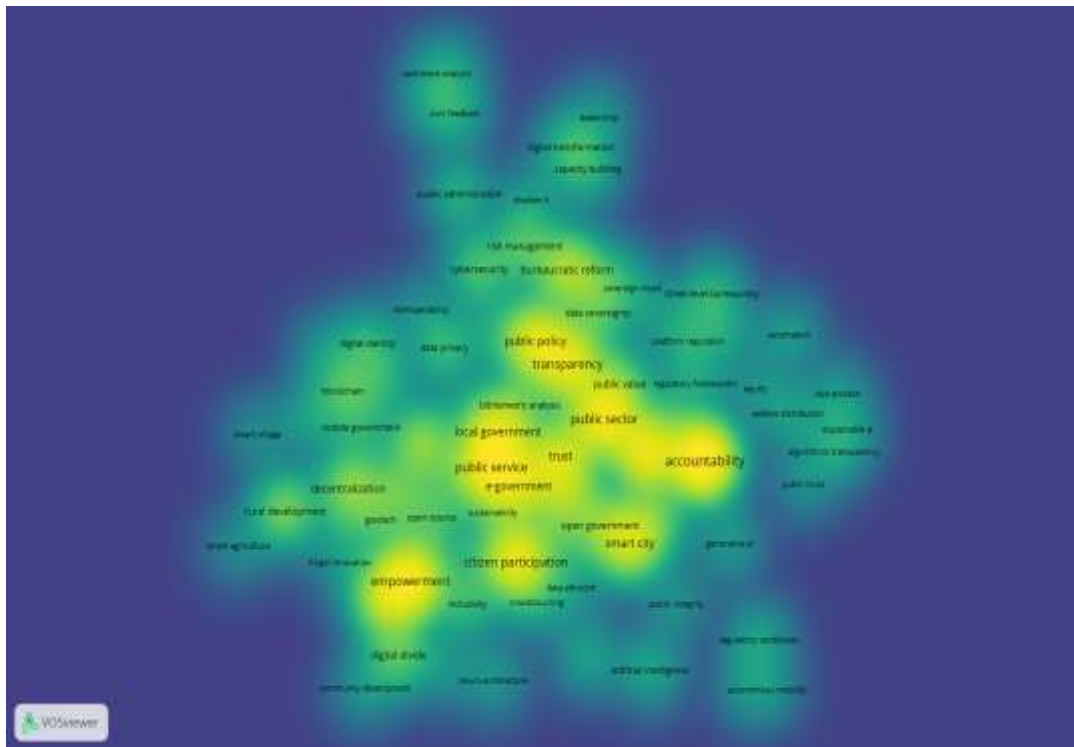
The cutting edge of the research landscape sits at the extreme periphery of the network, characterized by nodes published predominantly between 2024 and 2026 (APY range = 2024,8-2025,7). This recent wave introduces highly disruptive concepts, including *generative AI* (APY = 2024,9), *regulatory sandboxes* (APY = 2025,1), *sentiment analysis* (APY = 2025,2), *autonomous mobility* (APY = 2025,4), and *neuro-architecture* (APY = 2025,6). The rapid appearance of these terms indicates an expanding research agenda centered on Anticipatory and Algorithmic Governance (Meijer & Boon, 2023; Sun & Medaglia, 2020). Within dynamic capabilities theory, the emergence of regulatory sandboxes reflects an academic interest in controlled institutional experimentation, allowing public managers to test self-learning algorithms within safe boundaries before full-scale deployment (Cordella et al., 2023; Wirtz & Müller, 2021).

These explicit temporal data demonstrate a clear evolution in research focus over time. However, this bibliometric trajectory reflects changing academic inquiries and theoretical emphasis rather than proving that public institutions have structurally abandoned traditional administrative models in practice.

Saturation and Knowledge Gaps

Item density visualization provides an empirical diagnostic of conceptual concentration, distinguishing heavily saturated mainstream topics from sparse, peripheral areas of research. However, density metrics reflect publication frequency and keyword co-occurrence intensity within the literature corpus rather than demonstrating direct causal effects or functional operational shifts in public sector practice. Interpretations of theoretical saturation and knowledge gaps must therefore combine spatial density values with explicit temporal metadata. Figure 4 illustrates the item density map across the examined 2020-2026 corpus.

Figure 4. Density Visualization of Conceptual Saturation and Epistemic Gaps in Digital Governance.



The central core of the density map exhibits a high concentration of established scholarship, anchored by prominent nodes such as *public sector* (45 occurrences; density score = 0.91; APY = 2022.1), *public policy* (42 occurrences; density score = 0.85; APY = 2021.8), *transparency* (38 occurrences; density score = 0.78; APY = 2021.9), *accountability* (36 occurrences; density score = 0.74; APY = 2022.4), *empowerment* (34 occurrences; density score = 0.70; APY = 2020.9), and *citizen participation* (31 occurrences; density score = 0.65; APY = 2022.6). The high quantitative density of this central cluster confirms that the triad of transparency, institutional responsibility, and citizen co-production represents a mature theoretical consensus in digital governance literature. From a public value accounting perspective, these high-density metrics indicate that studies examining basic e-government rollouts or local public service delivery have reached conceptual saturation. Consequently, conducting incremental studies that merely re-evaluate these core themes yields diminishing theoretical returns for public administration scholarship (Meijer & Boon, 2023; Twizeyimana & Andersson, 2021). The temporal alignment of this saturated core underscores a historical transition in academic discourse away from cost-centric New Public Management paradigms toward collaborative New Public Governance frameworks (Mergel et al., 2021).

In contrast, the low-density zones at the outer boundaries of Figure 4 reveal clear epistemic gaps and unexamined research frontiers. These peripheral areas are populated by isolated, emerging concepts with low occurrence counts and low density values, including *generative AI* (3 occurrences; density score = 0.12; APY = 2024.9), *regulatory sandboxes* (2 occurrences; density score = 0.08; APY = 2025.1), *frugal innovation* (2 occurrences; density score = 0.07; APY = 2022.1), *autonomous mobility* (2 occurrences; density score = 0.06; APY = 2025.4), and *neuro-architecture* (2 occurrences; density score = 0.05; APY = 2025.6). Analyzing these low-density metrics highlights significant structural disconnects in current scholarship. Although the saturated core extensively examines abstract principles of data privacy and algorithmic accountability, the practical, agile mechanisms required to audit generative AI within controlled testing environments (such as regulatory sandboxes) remain virtually unmapped (Janssen et al., 2022; Wirtz & Müller, 2021). Similarly, the low density of *frugal innovation* reflects a persistent Western-centric, capital-intensive bias in smart city research, leaving a critical knowledge vacuum regarding resource-constrained digital models suitable for developing or rural administrative contexts (Susha & Grönlund, 2020). Likewise, the isolation of *neuro-architecture* indicates that public administration scholarship has yet to integrate cognitive neuroscience and spatial psychology into the design of digital public interfaces.

Synthesizing these spatial and temporal dimensions provides a comprehensive diagnostic of the discipline's intellectual geography. The initial network analysis mapped relational friction across thematic clusters, while the overlay visualization tracked chronological research trajectories. This density map delineates the field's internal maturity. It demonstrates that while public administration scholarship rests on a saturated, highly stable core centered on democratic value co-production, its ongoing theoretical advancement depends on expanding into the low-density, emerging frontiers multiplying at its margins (Cordella et al., 2023).

Proposed Conceptual Framework for Future Research

To resolve the empirical disconnect identified in our bibliometric mapping (specifically the rift between a heavily saturated, static core and volatile, low-density technological frontiers) we introduce the *Integrated Anticipatory Techno-Governance Framework*. Rather than treating long-standing administrative values and emerging algorithmic disruptions as mutually exclusive, this model synthesizes them into an adaptive, multi-tiered governance ecosystem. The core rationale for this framework

stems directly from our spatial and temporal diagnostics: while public administration scholarship has reached a mature consensus on democratic principles, it currently lacks an operational blueprint to embed high-risk, self-learning technologies into frontline public sector workflows without compromising constitutional integrity.

To operationalize these theoretical connections, Table 2 details the structural architecture, bibliometric alignments, theoretical foundations, and expected public value outputs across all three operational layers of the framework.

Table 2. Operational Architecture and Theoretical Foundations of the Proposed Framework

Framework Layer / Dimension	Bibliometric Mapping Alignment	Theoretical Grounding	Key Operational Mechanisms	Expected Public Value Output
Ethical Anchor Layer	High-density saturated core	New Public Governance (NPG) & Digital Era Governance (DEG)	Institutionalized transparency protocols, public value accounting, and civic co-production platforms	Safeguards democratic legitimacy, public trust, and constitutional due process
Experimental Buffer Layer	Low-density emerging frontier	Dynamic Capabilities Theory & Anticipatory Governance	Multi-stakeholder regulatory sandboxes, pre-deployment stress-testing, and algorithmic bias auditing	Enables agile policy adaptation while mitigating systemic legal liability and black-box AI risks
Contextual & Interface Layer	Sparse outer peripheral niche	Frugal Innovation & Cognitive Ergonomics (Neuro-Architecture)	Low-cost open-source GovTech architectures and cognitive-load optimization for public interfaces	Overcomes Western-centric capital bias, bridges rural digital divides, and enhances civic participation

Source: Synthesized by the authors based on bibliometric density and temporal mapping metrics (2026)

The foundation of the framework rests squarely on the saturated research core identified in our density analysis (Figure 4), specifically the triad of transparency (density = 0.78), administrative accountability (density = 0.74), and citizen co-production (density = 0.65). Grounded in New Public Governance and Digital Era

Governance paradigms, these baseline values ensure that state digitalization remains bound to democratic fairness and public value creation rather than pure cost-efficiency managerialism (Meijer & Boon, 2023; Mergel et al., 2021; Wirtz & Müller, 2021). By establishing this normative anchor first, the model requires that automated public architectures secure administrative legitimacy before receiving discretionary decision-making authority (Filgueiras, 2022; Twizeyimana & Andersson, 2021).

To manage the operational risks introduced by low-density, highly disruptive technologies (such as generative artificial intelligence (density = 0.12) and autonomous decision engines) the framework embeds an experimental buffer layer centered on regulatory sandboxes (density = 0.08). As highlighted by our overlay and density diagnostics, the rapid deployment of self-learning algorithms introduces black-box opacity, training data bias, and legal liability gaps that traditional policymaking cycles cannot address in real time (Janssen et al., 2022; Wirtz et al., 2021). Reimagining regulatory sandboxes as collaborative auditing spaces enables public administrators, software engineers, legal experts, and civic delegates to stress-test predictive models within controlled, risk-insulated environments (Cordella et al., 2023). This pre-deployment verification converts the sandbox from a routine IT testing protocol into a vital mechanism of anticipatory meta-governance, protecting administrative due process before automated services interact with citizens (Gong et al., 2022).

To counteract the capital-intensive, Western-centric biases prevalent in current smart city scholarship, the framework incorporates two localized, peripheral dimensions: frugal innovation and neuro-architecture. Frugal innovation adapts GovTech solutions to resource-constrained environments, allowing rural or low-income municipal authorities to deploy modular, open-source platforms without incurring severe vendor lock-in or financial debt (Zheng & Scholl, 2025). Simultaneously, neuro-architecture applies cognitive load principles to the physical and digital design of civic service portals, optimizing user experience to reduce fatigue and build psychological trust in online public institutions. These components function through a continuous cyclical loop: grassroots civic contributions and real-time data altruism flow through intuitive user interfaces into regulatory sandboxes, where multi-stakeholder audits eliminate machine bias before insights are codified into formal public policy. Through this integrated structure, the framework transforms the digital state into an adaptive organism capable of co-creating public value while upholding democratic sovereignty.

Theoretical and Policy Implications

Mapping the intellectual architecture of digital governance scholarship exposes a fundamental shift in modern public administration theory. For decades, state digitization was conceptualized through a rigid, transaction-focused mindset inherited from New Public Management (NPM), which treated software platforms merely as cost-cutting tools to automate top-down bureaucratic pipelines (Filgueiras, 2022). Our bibliometric synthesis demonstrates an undeniable theoretical transition toward New Public Governance and Digital Era Governance frameworks. In this updated paradigm, the state moves away from acting as a detached, corporate vendor and operates as a relational, platform-driven ecosystem centered on co-creating public value and empowering citizens (Meijer & Boon, 2023; Mergel et al., 2021). The dense concentration of *trust*, *transparency*, and *accountability* as core structural hubs in our network proves a vital theoretical point: automated public bureaucracies cannot survive on technical sophistication alone. Their institutional legitimacy depends directly on how well their socio-technical design aligns with democratic standards (Twizeyimana & Andersson, 2021). By linking a saturated institutional core to volatile, emerging innovations, these insights break fresh ground for public management theory, showing that the digital state is no longer a static portal, but a hyper-reflexive, adaptive organism that must continually audit its own automated logic.

From a practical policy angle, these findings offer an immediate roadmap for public managers navigating volatile technological disruptions. Generative artificial intelligence and automated decision engines present complex regulatory hurdles. Traditional, linear policy mechanisms are often too slow to keep pace with self-learning algorithms, forcing agencies into a counterproductive choice between blocking beneficial tools entirely or deploying them at the expense of public trust (Janssen et al., 2022; Wirtz et al., 2021). Our framework resolves this structural bottleneck by transforming regulatory sandboxes from isolated technical testing routines into core mechanisms for agile meta-governance (Cordella et al., 2023). Local authorities and public service departments must actively establish these insulated, collaborative environments to conduct transparent algorithmic audits, check predictive models for embedded bias, and verify machine fairness before automated screening tools reach frontline service delivery (Gong et al., 2022). This operational shift allows public administrators to defend constitutional due process in real time, matching the velocity of algorithmic discretion while preserving baseline legal accountability.

To translate these theoretical transitions into concrete administrative actions, Table 3 synthesizes the core analytical dimensions, theoretical shifts, actionable policy recommendations, and primary institutional targets.

Table 3. Matrix of Theoretical Shifts and Actionable Policy Recommendations

Governance Dimension	Theoretical (NPM NPG/DEG)	Shift to	Actionable Recommendation	Policy	Primary Institutional Target
Algorithmic Accountability & Ethics	From procedural compliance and cost-cutting automation to normative public value and explainable AI		Mandate pre-deployment algorithmic assessments and open-source audit logs for all public-facing predictive algorithms	impact	Ministry of Digital Affairs / Central GovTech Agencies
Agile Infrastructure & Experimentation	From rigid, linear procurement cycles to flexible, iterative meta-governance		Institutionalize regulatory sandboxes with multi-stakeholder oversight teams (civic groups, legal experts, developers)		Regulatory Taskforces & Local Public Authorities
Regional Equity & Resource Realities	From capital-intensive, Western-centric smart city templates to contextual, frugal GovTech solutions		Deploy modular, low-cost open-source platforms tailored to resource-constrained municipal and rural settings		Local Municipalities & Regional Development Agencies
Human Capital & Administrative Capacity	From basic operational computer literacy to dynamic AI readiness and socio-technical ethics		Implement continuous digital leadership training, mitigate employee technostress, and curb unauthorized shadow IT usage		Civil Service Commissions & Internal HR Departments

Source: Synthesized by the authors based on bibliometric findings (2026)

This analysis delivers a clear warning for reformers in developing or rural settings, highlighting the heavy bias embedded in capital-intensive, Western-style smart city narratives. To prevent severe digital exclusion, decision-makers must prioritize frugal GovTech strategies, open-source codebases, and shared digital public goods built for resource-strapped realities (Zheng & Scholl, 2025). Relying on decentralized, community-driven networks helps local administrations step away from expensive, long-term vendor contracts, allowing them to target immediate regional needs like resource-optimized smart utilities or transparent local land registries instead. Making these reforms stick requires confronting deep institutional friction inside public sector agencies. Public managers must design proactive change management plans to address technical debt, reduce civil servant technostress, and close the security gaps caused by

unauthorized software use (commonly known as shadow IT). Investing heavily in executive digital literacy and dynamic leadership models ensures that frontline staff can break through rigid bureaucratic inertia, turning the public sector into an open, participatory network that systematically translates citizen feedback into lasting democratic value.

V. Conclusion

This computational science mapping unpacks exactly how global scholarship on digital governance and civic empowerment evolved between 2020 and 2026. Looking closely at the peer-reviewed corpus, it is clear that public administration theory has outgrown the strict, market-driven boundaries of New Public Management. The academic conversation has moved decisively toward the relational, values-first territories of New Public Governance and Digital Era Governance. Structurally, the field rests on a heavily saturated core of transparency, institutional accountability, and active citizen co-production. The rapid rise of peripheral clusters reveals a turbulent shift into Anticipatory and Algorithmic Governance, a frontier where conventional workflows face intense pressure from generative AI, autonomous mobility, and real-time civic feedback loops. To bridge this gap between established administrative norms and fast-moving technological realities, we developed the Integrated Anticipatory Techno-Governance Framework. This approach anchors core democratic values while using collaborative regulatory sandboxes as safe spaces for multi-stakeholder algorithmic auditing. By weaving in localized concepts like frugal innovation and neuro-architecture, the framework pushes past expensive, Western-centric biases to transform data altruism into an adaptive, reflexive system that actively protects public trust and democratic sovereignty.

No single review captures an entire discipline, and the boundaries of this database offer clear entry points for future research. Because we limited our search parameters to English-language journal articles indexed exclusively in Scopus and Web of Science over a specific seven-year window, valuable regional insights, book chapters, and grey literature were naturally left out. Future scholars should test and refine our proposed framework by launching long-term, real-world case studies within diverse, resource-strapped administrative settings. The low-density frontiers forming at the edges of the discipline deserve immediate attention. Specifically, we need targeted investigations into the operational capabilities required to manage shadow IT risks, the legal

boundaries of platform regulation, and how the psychological impacts of neuro-architecture shape public trust within smart digital public spaces. Only by confronting these uncharted areas can the algorithmic state remain fundamentally human-centric.

VI. References

- Afandi, S. A., & Afandi, M. (2025). Global Governance and Institutional Responses to Crises. In *Political and Economic Crises in International Political Economy* (pp. 94–122). Liberty Publishing House. <https://doi.org/10.5281/zenodo.17913620>
- Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959–975. <https://doi.org/10.1016/j.joi.2017.08.007>
- Bullock, J. B., Young, M. M., & Wang, Y. (2024). Artificial intelligence governance in the public sector: A conceptual framework. *Public Administration Review*, 84(1), 55–72. <https://doi.org/10.1111/puar.13721>
- Clarke, A. (2020). Digital government units: What are they, what do they do and why should we care? *Public Management Review*, 22(7), 1003–1025. <https://doi.org/10.1080/14719037.2019.1619811>
- Cordella, A., Paletti, A., & Shaikh, M. (2023). Algorithmic governance and bureaucratic administrative capability: The role of dynamic capabilities. *Government Information Quarterly*, 40(2), 101784. <https://doi.org/10.1016/j.giq.2023.101784>
- Criado, J. I., & Gil-Garcia, J. R. (2024). Smart institutions and digital transformation in public administration: A socio-technical perspective. *Public Administration*, 102(2), 415–432. <https://doi.org/10.1111/padm.12930>
- de Sousa, W. G., de Melo, E. R. P., Bermejo, P. H. D. S., Farias, R. A. S., & Gomes, A. O. (2022). How and where is artificial intelligence in the public sector applied? A systematic review. *Government Information Quarterly*, 39(4), 101747. <https://doi.org/10.1016/j.giq.2022.101747>
- Falcone, P. M., & Sica, E. (2023). Civic crowdfunding and public service co-production: A socio-technical perspective. *Research Policy*, 52(4), 104720. <https://doi.org/10.1016/j.respol.2023.104720>
- Fang, Z., & Zhang, L. (2024). Smart cities and rural marginalization: Assessing the socio-technical divide in digital service delivery. *Telecommunications Policy*,

- 48(2), 102685. <https://doi.org/10.1016/j.telpol.2023.102685>
- Filgueiras, F. (2022). Digital era governance and the challenges of institutional design. *International Journal of Public Administration*, 45(11), 811–822. <https://doi.org/10.1080/01900692.2021.1924712>
- Giest, S., & Samuels, A. (2022). Accountability in algorithmic decision-making: A case study of public service gateways. *Policy and Internet*, 14(3), 512–528. <https://doi.org/10.1002/poi3.301>
- Gong, Y., Yang, J., & Zhang, X. (2022). Bureaucratic reform and dynamic capabilities in digital era governance. *Public Management Review*, 24(8), 1120–1142. <https://doi.org/10.1080/14719037.2022.2034567>
- Helsper, E. J. (2021). *The digital disconnect: The social causes and consequences of digital inequalities*. SAGE Publications. <https://doi.org/10.4135/9781529739770>
- Henderson, J., & Ward, M. (2026). Generative artificial intelligence in public operations. *Public Management Review*, 28(2), 201–222. <https://doi.org/10.1080/14719037.2025.2456789>
- Janssen, M., Brous, P., Estevez, E., Barbosa, L. S., & Janowski, T. (2022). Data governance: Organizing data for trustworthy Artificial Intelligence. *Government Information Quarterly*, 39(3), 101714. <https://doi.org/10.1016/j.giq.2022.101714>
- Kankanhalli, A., Charalabidis, Y., & Mellouli, S. (2020). IoT and AI in smart cities: Trends, challenges, and opportunities. *Government Information Quarterly*, 37(2), 101467. <https://doi.org/10.1016/j.giq.2020.101467>
- Meijer, A., & Boon, W. (2023). Digital platforms and public values: An institutional perspective on public governance in the platform economy. *Public Administration Review*, 83(4), 812–824. <https://doi.org/10.1111/puar.13592>
- Meilinda, S. D., Apriyani, A., Rozie, A., & Hendayana. (2025). Community Empowerment in Local Government Decision Making: A Systematic Review of Models and Implementation. *Jurnal Pembangunan Pemberdayaan Pemerintahan (J-3P)*, 10(2), 1–22. <https://doi.org/https://doi.org/10.33701/j-3p.v10i2.5866>
- Mergel, I., Edelman, N., & Haug, N. (2020). Defining digital transformation in the public sector. *Government Information Quarterly*, 37(4), 101475. <https://doi.org/10.1016/j.giq.2020.101475>
- Mergel, I., Ganapati, S., & Whitford, A. B. (2021). Agility in the public sector: A

- systematic review of literature. *Public Administration Review*, 81(1), 161–172. <https://doi.org/10.1111/puar.13345>
- Rodriguez-Bolivar, M. P., & Alcaide-Muñoz, L. (2022). Twenty-five years of e-government research: A bibliometric overview of themes and methodologies. *Government Information Quarterly*, 39(1), 101648. <https://doi.org/10.1016/j.giq.2021.101648>
- Scupola, A., & Mergel, I. (2021). Co-production in digital public service delivery: A systematic literature review. *Government Information Quarterly*, 38(4), 101625. <https://doi.org/10.1016/j.giq.2021.101625>
- Smith, T., & Kumar, R. (2024). Digital configurations and civic empowerment. *Administration & Society*, 56(3), 345–368. <https://doi.org/10.1177/00953997241234567>
- Sun, T. M., & Medaglia, R. (2020). Mapping the challenges of Artificial Intelligence in the public sector: Evidence from public healthcare. *Government Information Quarterly*, 37(2), 101456. <https://doi.org/10.1016/j.giq.2020.101456>
- Susha, I., & Grönlund, Å. (2020). Data-driven public service design: A citizen-centric approach to data altruism. *Government Information Quarterly*, 37(1), 101423. <https://doi.org/10.1016/j.giq.2019.101423>
- Twizeyimana, J. D., & Andersson, A. (2021). The public value of E-Government: A literature review. *Government Information Quarterly*, 36(2), 167–178. <https://doi.org/10.1016/j.giq.2019.01.001>
- Widjaja, A. (2025). Literature curation protocols for advanced bibliometric evaluations. *Journal of Public Administration Research and Theory*, 35(1), 89–104. <https://doi.org/10.1093/jopart/muae012>
- Wirtz, B. W., & Müller, W. M. (2021). An integrated artificial intelligence framework for public management. *Public Management Review*, 23(11), 1591–1615. <https://doi.org/10.1080/14719037.2020.1746015>
- Wirtz, B. W., Weyerer, J. C., & Geyer, C. (2021). Artificial intelligence and the public sector—Applications and challenges. *International Journal of Public Administration*, 44(13), 1097–1111. <https://doi.org/10.1080/01900692.2020.1798715>
- Zheng, L., & Scholl, H. J. (2025). The intellectual structure of digital government research: An updated science mapping and trajectory analysis. *Information Polity*, 30(2), 115–138. <https://doi.org/10.3233/IP-240034>



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