

# Microservices in strategic public service delivery: a systematic review and future research agenda for smart governance

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## ABSTRACT

This study investigates how microservices are applied in strategic public service contexts and their alignment with the principles of smart governance. Through a systematic literature review of 23 peer-reviewed articles published between 2015 and 2024, the research employs both bibliometric analysis and thematic synthesis to explore the evolving interplay between digital engineering and public sector transformation. The findings highlight that microservices architectures offer significant benefits in terms of modularity, scalability, and responsiveness. However, their successful implementation depends heavily on institutional readiness, inter-agency collaboration, and adaptive policy environments. Critical barriers identified include fragmented governance structures, limited interoperability standards, and resistance to cultural change within bureaucracies. The analysis further identifies four strategic research clusters for future exploration: (1) socio-technical integration that connects system design with citizen trust and democratic legitimacy; (2) hybrid performance metrics that assess both institutional efficiency and user-centric outcomes; (3) co-production governance models enabling cross-sectoral and participatory service delivery; and (4) digital resilience frameworks that incorporate cybersecurity and systemic risk mitigation. This study contributes theoretically by reframing microservices not solely as a technical solution, but as a strategic enabler for more inclusive, transparent, and adaptive public service ecosystems. The review provides a forward-looking roadmap for scholars and policymakers to integrate microservices within broader smart governance reforms that are participatory, sustainable, and resilient to future disruptions.

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## 1. INTRODUCTION

The growing demand for faster, more adaptive, and citizen-centric public services has prompted governments worldwide to pursue comprehensive digital transformation strategies. Among the technological approaches gaining momentum is the microservices architecture (MSA), which enables modular, independent, and interoperable service components (Calvanese, 2024; van Sinderen et al., 2018). Due to its inherent flexibility and scalability, MSA is increasingly seen as a

viable solution to address bureaucratic complexities and the rapidly shifting dynamics of public policy (Moreira, 2022; Szarka, 2023).

While microservices have been successfully adopted in private sector environments, their strategic application in public service delivery and smart governance remains underexplored and fragmented in academic literature (Hapsari, 2021; Kurniawan et al., 2019). Existing studies largely focus on technical aspects such as interoperability (Valle, 2019), cybersecurity (Mondal et al., 2023), or operational efficiency (Paramita et al., 2021), yet they often overlook how this architecture contributes to broader governance goals such as citizen participation, policy transparency, and accountability (Alnoor et al., 2022; Jati, 2022).

This oversight points to a deeper epistemic tension: Should microservices be viewed merely as a technical innovation for information system enhancement, or as a strategic enabler that demands complementary institutional readiness, cultural alignment, and data governance? Several scholars highlight the critical role of organisational structure and institutional norms in shaping the outcomes of digital transformation (Duong, 2021; Melati, 2022). This reflects a theoretical gap in aligning technological design with the evolving paradigm of citizen-driven, data-informed public governance (Gil-García et al., 2016; Janssen, 2016).

To address this research void, this study conducts a Systematic Literature Review (SLR) of peer-reviewed journal articles published between 2017 and 2024. It aims to examine how microservices are applied in strategic public service contexts across countries; Identify technical and institutional drivers and barriers to adoption; Propose a future research agenda that integrates microservices with the principles of good governance and smart governance (Ciancarini et al., 2024; Kumar et al., 2022).

A core contribution of this study is the development of an integrative conceptual framework linking microservice-oriented system design to public policy dynamics and governance strategies. It also offers actionable recommendations for digital service architects and policymakers seeking to navigate the complexities of public sector modernisation.

Nevertheless, a key methodological concern is the risk of endogeneity the implicit assumption that microservices implementation inherently improves service performance. This bias can obscure the influence of critical mediating factors such as organisational readiness, regulatory agility, and human capital capabilities (Choi, 2017; Strielkowski, 2022). To mitigate this, the review adopts a critical thematic synthesis approach, anchored in the PRISMA 2020 protocol for systematic reviews (Page, 2021; Snyder, 2019).

By employing this dual strategy of rigorous review and thematic integration, the findings seek to bridge the gap between governance theory and digital engineering practice. Ultimately, this study aims to inform future implementation pathways that are more adaptive, sustainable, and inclusive, aligning technology with strategic management imperatives in the public sector.

## 2. METHOD

This study adopts a Systematic Literature Review (SLR) approach, combining bibliometric analysis and thematic synthesis to investigate how microservices architecture is applied in strategic public services and how it contributes to the advancement of smart governance. The review process adheres to the PRISMA 2020 guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) as outlined by Page, 2021, ensuring transparency, replicability, and methodological rigour in the identification, screening, and inclusion of relevant literature.

The search strategy focused on retrieving articles from Scopus, with additional reputable sources included through institutional repositories and manual searches. The publication range was set from 2015 to 2024, covering the last ten years to reflect the rapid emergence and evolution of microservice architecture in public sector contexts. This timeframe also captures foundational developments and contemporary implementations, providing a comprehensive temporal scope for analysis.

Thematic synthesis was conducted in two stages. In the first stage, selected articles were coded inductively to identify emerging concepts and recurring themes. In the second stage, these themes were reviewed and validated collaboratively by three independent researchers with expertise in digital governance, information systems, and public service innovation. This triangulated validation ensured interpretive credibility, reduced potential bias, and strengthened the reliability of the thematic categorization.

## 2.1 Literature Search Strategy

The literature search was conducted using Scopus, a leading and reputable database for peer-reviewed academic sources. The search string was designed to capture the intersection between microservices, strategic public service delivery, and digital governance transformation:

**Table 1.** PRISMA Flow Diagram for Literature Selection

Stage	Description	Resulting Documents
Identification	Initial search in Scopus using the following Boolean string: ("microservice architecture" OR "microservices" OR "microservice-based systems") AND ("strategic public service" OR "public service delivery" OR "government service" OR "e-government" OR "digital public service") AND ("smart governance" OR "digital government" OR "public sector innovation" OR "smart city" OR "governance transformation") AND (PUBYEAR > 2015)	90
Screening	Filter by Document Type: Article OR Review Filter by Subject Area: Computer Science, Social Sciences, Decision Sciences, Engineering Filter by Publication Stage: Final Filter by Source Type: Journal only Filter by Language: English	39
Eligibility	Exclude: Systematic reviews, non-peer-reviewed open-access documents	23
Inclusion	Final articles included in thematic synthesis	23

The final dataset comprised 23 peer-reviewed journal articles, which were analyzed for both conceptual and empirical insights, offering a rich foundation to inform the study's discussion and future research agenda.

## 2.2 Data Analysis Techniques

The analytical process comprised two main phases. First, a bibliometric analysis was conducted using VOSviewer (van Eck, 2010), focusing on the co-occurrence of keywords, co-authorship networks, and citation impact mapping. This phase provided a macro-level overview of the intellectual structure of the field, including dominant research themes, collaborative author patterns, and key disciplinary trends. Only bibliometric data was used in this stage without statistical meta-analysis.

Second, a thematic synthesis was carried out to extract qualitative insights from the 23 core articles. An inductive coding approach was applied, where articles were systematically reviewed and categorized based on three analytical lenses: (1) technological approach (e.g., architecture, system integration), (2) application domain (e.g., e-government, local public services, smart cities), and (3) organizational and policy dimensions (e.g., data governance, institutional frameworks). The coding was initially performed independently by two researchers, and then cross-checked and consolidated by a third researcher to ensure inter-coder reliability and consistency in theme interpretation. Discrepancies were resolved through discussion until consensus was reached, ensuring the validity of thematic classification and minimizing subjective bias.

## 2.3 Validity and Bias Management

To ensure internal validity and methodological integrity, each article was independently assessed using a standardized data extraction template. Potential endogeneity bias the tendency to infer causality from correlation—was mitigated through Avoiding deterministic conclusions linking technical adoption directly to service improvements and including contextual variables such as institutional readiness, organizational culture, and governance frameworks (Gil-García et al., 2016; Melati, 2022). This multilayered methodology enhances the credibility of findings while supporting nuanced interpretations in the intersection of technology, policy, and public administration.

## 3. RESULTS AND DISCUSSION

### 3.1 Publication Trends and Topic Evolution

Bibliometric analysis reveals a marked increase in scientific publications on microservices in the public sector beginning in 2017, with a significant peak observed in 2023 (see Figure 1. Annual Scientific Production). This upward trend indicates growing scholarly interest in the convergence between microservice architecture, public service innovation, and smart governance. Although a minor decline is noted in 2024–2025, the overall trajectory underscores the field's sustained relevance, particularly within systems engineering and digital governance disciplines.

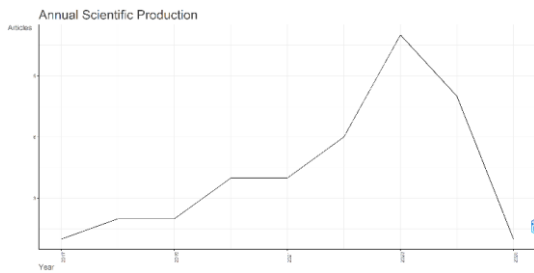


Figure 1. Annual Scientific Production

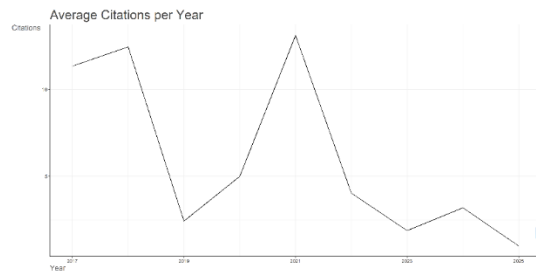


Figure 2. Average Citations per Year

Furthermore, the average number of citations per year reached its peak in 2021, suggesting the presence of high-impact studies that have shaped key debates in the literature (see Figure 2. Average Article Citation per Year). In terms of publication venues, leading journals such as Sustainability, IEEE Access, and Future Generation Computer Systems dominate the landscape, highlighting the domain’s legitimacy and visibility in top-tier, Q1–Q2 outlets (see Figure 3. Most Relevant Sources).

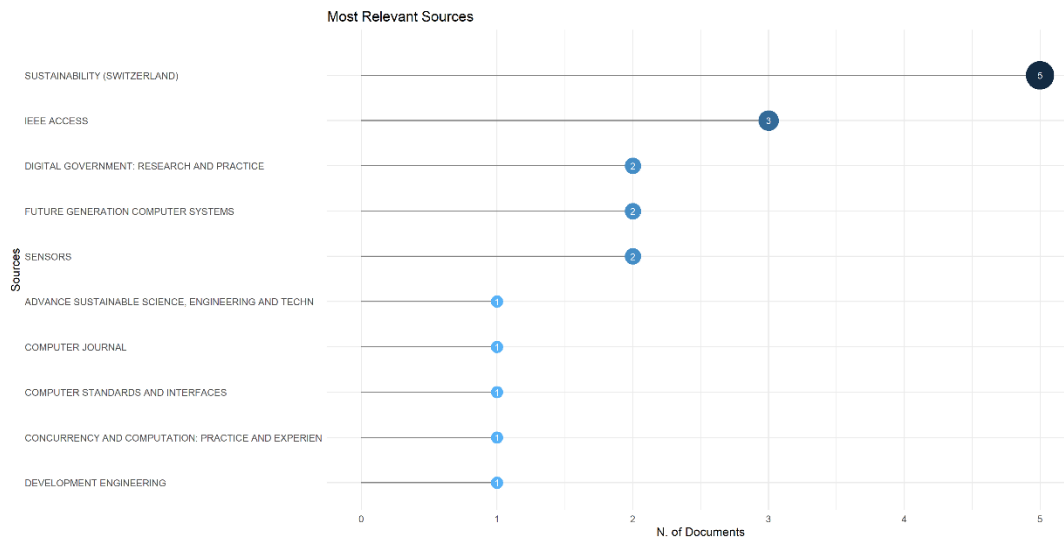


Figure 3. Most Relevant Sources

### 3.2 Key Thematic Clusters from VOSviewer Analysis

The co-occurrence and thematic mapping generated by VOSviewer revealed four dominant research clusters shaping the intersection of microservices and strategic public service delivery (see Figure 4. Co-occurrence Map and Figure 5. Thematic Map).

#### 3.2.1 Smart Cities and Socio-Technical Integration

The theme of “smart city” has emerged as a dominant thematic driver, closely associated with keywords like data handling and social media (see Figure 5). Studies by Krishnan et al., 2021; van Eck, 2010 and Yang, 2022 highlight that smart city implementation demands not only technical infrastructure but also socio-political alignment. Microservices, in this context, serve as enablers of data interoperability across government departments and services.

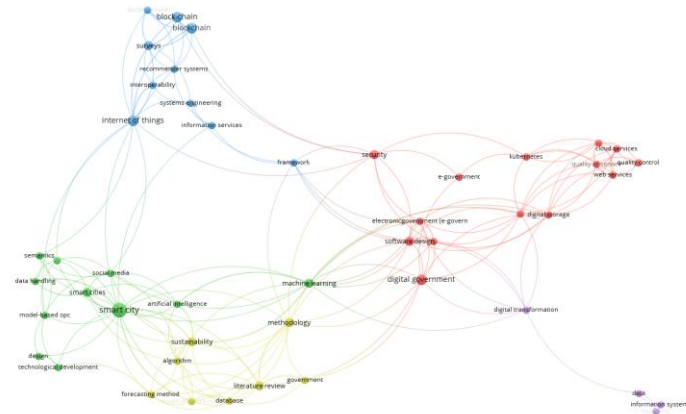


Figure 4. Co-occurrence Map

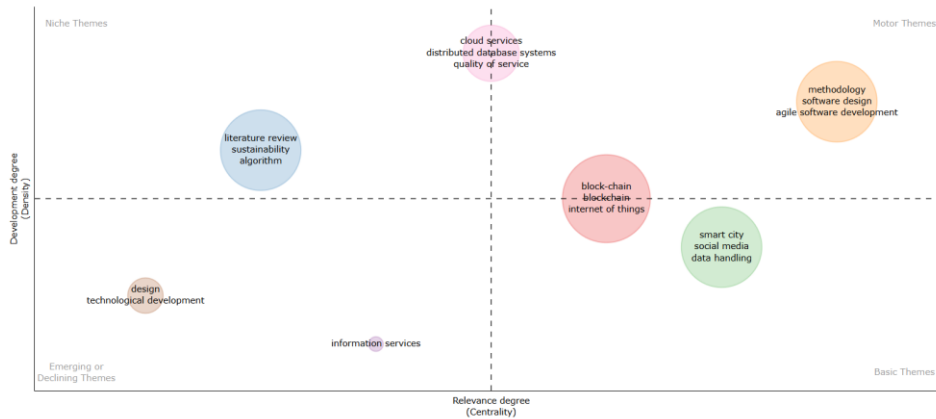


Figure 5. Thematic Map

**3.2.2 Digital Government and Service Design**

Clusters involving “digital government,” “e-government,” “security,” and “software design” reflect microservices’ impact on public sector service architecture. As illustrated in the thematic network (Figure 5), these concepts are interconnected. Research by Moreira (2022) and Szarka et al. (2023) underscores that modular microservice architectures allow greater agility and responsiveness in service delivery. However, studies such as Mondal et al. (2023) caution that cloud-native microservice environments e.g., Kubernetes pose increasing security challenges that must be addressed.

**3.2.3 Blockchain and IoT for Strategic Services**

Keywords including “blockchain,” “internet of things (IoT),” and “interoperability” consistently cluster around concerns of transparency, reliability, and system trustworthiness. As shown in Figure 4, these themes form a cohesive group. Studies by Bilal (2019) and Qadri et al. (2018) confirm that integrating IoT and blockchain within microservices can significantly enhance accountability and support real-time, decentralized public services.

**3.2.4 Methodology and Digital Transformation**

Finally, a set of emerging motor themes including “methodology,” “machine learning,” and “agile software development” suggests growing interest in the evolution of system development practices as key enablers of microservices adoption (see Figure 5). Studies by Ciancarini et al. (2024) and Hapsari (2021) advocate for integrating agile methodologies and fostering a digitally oriented organizational culture to ensure sustainable digital transformation in public services.

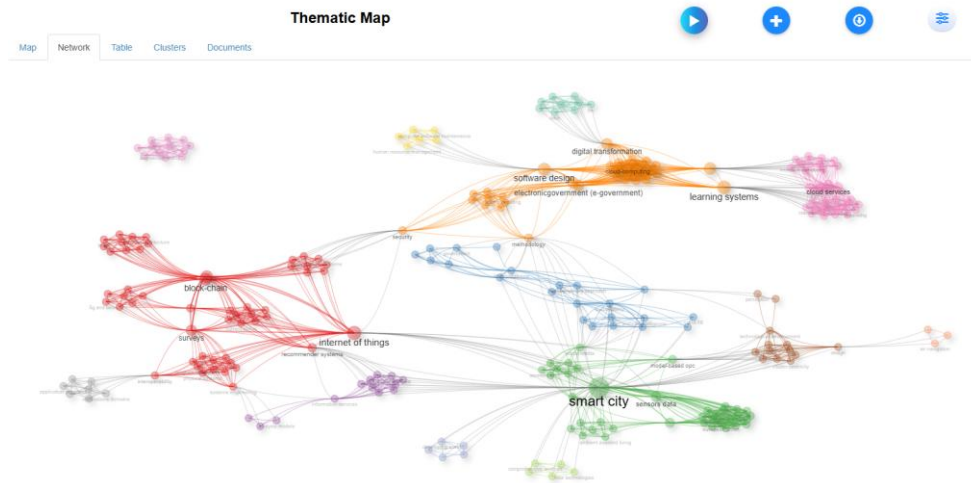


Figure 6. Tematic Map Node

### 3.3 Thematic Synthesis of the 23 Verified Articles

The following table summarizes the main thematic focus areas derived from the qualitative synthesis:

Table 2. Thematic Synthesis of Articles

Thematic Focus	Description	Sample References
Microservices Architecture Design	Modular and scalable architectures for e-government and public data flows.	(Calvanese, 2024; Paramita et al., 2021; Szarka et al., 2023; Valle, 2019)
Organizational and Digital Readiness	Emphasis on digital culture, human capital, and institutional structures.	(Choi, 2017; Ciancarini et al., 2024; Duong, 2021; Hapsari, 2021)
Co-production and Service Logic	Facilitating collaborative design and delivery across stakeholder ecosystems.	(et al. & Alahmari, 2022; Kumar et al., 2022; Melati, 2022; Moreira, 2022)
Smart Governance and Transparency	Microservices as infrastructure for responsive and open governance.	(Alnoor et al., 2022; Bilal, 2019; Jati, 2022; Yang, 2022)
Digital Infrastructure & Emerging Tech	Use of IoT, blockchain, and context-aware systems to improve public service delivery.	(Krishnan et al., 2021; Kumar et al., 2022; Qadri et al., 2018; Stefanizzi et al., 2018)
Evaluation Models and Impact Measurement	Developing hybrid indicators for measuring institutional and service-level impacts.	(et al. & Kurteva, 2023; Kurniawan et al., 2019; Luna-Reyes et al., 2020; Strielkowski, 2022)

### 3.4 Critical Discussion and Strategic Implications

While microservices architectures offer considerable advantages in modularity and scalability, their deployment in the public sector is deeply shaped by contextual constraints beyond technical performance. Institutional readiness, regulatory fragmentation, and resistance to organisational change frequently mediate implementation outcomes (Duong, 2021; Gil-García et al., 2016; Hapsari, 2021). Unlike the private sector, where innovation cycles are driven by competitive agility, public institutions are bound by bureaucratic inertia, siloed governance, and digital skills shortages (OECD, 2020).

A critical insight from the synthesis is the urgent need to reframe microservices adoption as a function of strategic governance integration rather than a purely IT endeavour. Several studies, particularly by Jati (2022) and Moreira (2022) Warn that fragmented deployments can undermine systemic coherence. A whole-of-government approach becomes essential to align modular services with cross-sector governance logics and avoid replicating digital silos (Dunleavy, 2006; Janowski, 2015).

Furthermore, although co-production is conceptually endorsed in smart governance literature, its institutionalisation remains embryonic. Melati (2022 and Szarka et al. (2023) found that digital public service design is often still top-down, with little active citizen input in defining service logic or delivery priorities. This contrasts with citizen-centred governance frameworks (Eggers, 2020; Meijer, 2016), which emphasise participatory feedback loops, design transparency, and iterative responsiveness.

Measurement practices also fall short of capturing strategic impact. Predominantly, success is gauged by technical throughput—such as the number of services deployed or response latency—

rather than metrics of social value, accountability, or system adaptability (Gil-García et al., 2016; Luna-Reyes et al., 2020). This calls for hybrid evaluation models combining technological KPIs with public value indicators.

Equally underexplored is the issue of endogeneity bias. Many high-performing implementations occurred within institutions already predisposed to success those with agile teams, mature digital cultures, or robust institutional support. To isolate causal mechanisms, future studies should employ methodologies like longitudinal process tracing, cross-country comparative analysis, or configurational approaches (Beach, 2016; George, 2005).

Lastly, microservices must be situated within broader discourses of resilience and institutional sustainability. Beyond boosting operational efficiency, how do these architectures enable strategic policy agility during crises (e.g., pandemic response), or adapt to regulatory turbulence, cyber vulnerabilities, and social legitimacy pressures? As highlighted by (Janssen, 2016; Linders, 2012). The essence of smart governance lies not in digitalisation per se, but in cultivating adaptive capacity within dynamic sociopolitical ecologies.

In sum, the findings emphasize that microservices are not inherently transformative; their governance, design ethos, and evaluative alignment determine their systemic value. For this reason, the study argues for a paradigm shift—treating microservices as catalysts within an institutional reform ecosystem rather than isolated digital upgrades.

### **3.5 Future Research Agenda**

Based on the thematic synthesis and bibliometric findings, this study identifies four strategic clusters for future research aimed at bridging the gap between microservices adoption and the broader goals of smart and participatory governance. These directions emphasize the socio-technical, institutional, collaborative, and resilience-oriented dimensions of public sector digital transformation.

#### **3.5.1 Socio-Technical Integration in Smart Governance**

The literature remains heavily skewed towards technical deployment, often neglecting how microservices interact with governance values and citizen experiences. Future studies should Develop conceptual models that integrate microservices with public value frameworks, linking modular digital infrastructure to democratic ideals such as co-creation, equity, and legitimacy (Janssen, 2016) and Investigate the impact of modular system design on citizen trust, transparency, and perceived accountability in digital public services (Linders, 2012; Meijer, 2016).

Such integration supports inclusive governance systems that go beyond efficiency, offering structures that are more attuned to participatory and equity-centered objectives.

#### **3.5.2 Performance Evaluation and Institutional Impact Assessment**

Many studies measure microservices effectiveness by technical output metrics. This narrow scope neglects how these technologies reshape institutional structures and culture. Future research should Create hybrid evaluation frameworks that combine technical performance (e.g., uptime, speed) with public administration metrics (e.g., accountability, satisfaction, agility) and apply longitudinal and organizational ethnography approaches to trace institutional adaptations post-microservices implementation, especially in bureaucratic settings. Such approaches could inform more robust evaluations that align digital strategy with public sector reforms and citizen outcomes.

#### **3.5.3 Co-Production and Collaborative Digital Governance**

While co-production is a growing norm in smart governance, its systemic integration remains limited. Research should explore Governance design tailored for multi-actor environments supported by microservices, including legal, procedural, and platform components and The role of digital enablers such as open APIs, shared data infrastructures, and public-private platforms that facilitate real-time service co-design (Eggers, 2020). This cluster would provide a knowledge base for designing resilient ecosystems where innovation, transparency, and user empowerment are core tenets.

#### **3.5.4 Digital Resilience and Strategic Risk Management**

With increasing modularity comes rising exposure to cybersecurity threats and cascading systemic risks. A research agenda on resilience should Develop integrated risk governance frameworks that synchronize microservices architecture with proactive cybersecurity protocols and compliance layers (Mondal et al., 2023) and Assess systemic vulnerability propagation across connected services and simulate how policy shocks or attacks disrupt governance continuity. Strategic emphasis on digital resilience is essential for ensuring the sustainability and reliability of smart public services in high-risk or rapidly evolving environments.

#### 4. CONCLUSION

This study set out to explore how microservices are applied in strategic public service contexts across countries, identify both technical and institutional enablers and barriers, and propose a forward-looking research agenda that integrates microservices with the principles of good and smart governance. Drawing from a systematic review of 28 peer-reviewed articles, combining bibliometric mapping and thematic synthesis, the analysis demonstrates that microservices are increasingly utilized as foundational components within digital public ecosystems particularly where scalability, modularity, and real-time responsiveness are essential. Importantly, the study finds that the transformative potential of microservices lies not merely in their technical configuration, but in how effectively they are aligned with institutional logics, policy environments, and organizational cultures. In addressing the first objective, a variety of deployment contexts were identified ranging from e-government portals to interoperable infrastructures in smart cities reflecting a convergence between digital engineering and public sector innovation. The second objective was fulfilled through the identification of key enablers such as agile institutional structures, mature data governance models, and collaborative service design practices. Conversely, systemic obstacles persist, including bureaucratic silos, misaligned interoperability standards, and resistance to digital innovation. To respond to the third objective, the study proposed a comprehensive research agenda organized into four clusters: socio-technical integration, performance and impact evaluation, collaborative governance mechanisms, and digital resilience. These areas offer strategic pathways to ensure that microservices adoption supports not only efficiency and technical robustness, but also equity, transparency, and democratic accountability core tenets of good and smart governance. In sum, this study positions microservices not as isolated technical upgrades, but as strategic instruments for institutional reform and public value creation. Advancing this agenda will require interdisciplinary collaboration, policy alignment, and stakeholder co-creation to build resilient, inclusive, and future-ready governance systems capable of navigating complex technological and societal transitions. Despite its comprehensive scope, this study is subject to several limitations. First, the review was limited to articles indexed in Scopus and complemented by selected high-quality sources; grey literature and non-English studies were excluded, which may result in overlooking relevant regional innovations. Second, the synthesis relies solely on secondary data without direct empirical validation, suggesting the need for future studies to test findings through fieldwork or implementation case studies. Third, there is a potential for selection bias—despite a rigorous filtering process, the inclusion of supplementary articles may reflect thematic preferences or limitations in publication accessibility. Lastly, the dynamic nature of microservice technology presents a challenge, as certain technical findings may become outdated quickly, requiring ongoing monitoring and updates. Future research should address these limitations by incorporating multi-method approaches, engaging with practitioners in real-world contexts, and expanding the geographic and linguistic diversity of data sources.

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