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Open government APIs and their impact on smart city service delivery: Evidence from metropolitan areas

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Abstract: This study investigates the role of Open Government APIs (OGAPIs) in enhancing smart city service delivery across five countries with varying digital governance maturity: Singapore, South Korea, the United Kingdom, Brazil, and Indonesia. Employing a comparative qualitative literature review, the research synthesizes findings from academic sources, government publications, and international benchmarks. The analysis is framed around four key dimensions: policy and legal infrastructure, technical and data architecture, organizational readiness, and citizen engagement. Results reveal that countries with centralized digital strategies and standardized API frameworks, particularly Singapore and South Korea, achieve higher integration, transparency, and real-time responsiveness. In contrast, Brazil and Indonesia demonstrate fragmented implementation, hindered by institutional gaps and lack of enforceable legal mandates. The United Kingdom presents a hybrid model balancing decentralization with design standards. The study underscores that the success of OGAPIs is not merely technical but depends on legal enforceability, civic engagement infrastructure, and interagency coordination. Policy implications suggest investing in middleware platforms, adopting binding API standards, and fostering civic tech ecosystems. The findings contribute empirical insights for designing inclusive, efficient, and accountable smart city services through programmable governance interfaces.

Keywords: *Citizen participation, Comparative policy analysis, Digital public services, Open government APIs, Smart city governance.*

1. Introduction

Urbanization has reached an unprecedented scale, placing intense pressure on cities to modernize infrastructure, streamline governance, and enhance the delivery of public services [1]. In response, the smart city paradigm has emerged as a holistic model that integrates digital technologies to improve urban management and citizen well-being [2]. Central to this paradigm is the use of real-time data, interoperable systems, and participatory governance, all of which rely heavily on the transparent and efficient exchange of information [3].

Within this context, Open Government Application Programming Interfaces (APIs) have become key digital enablers. Unlike static data portals, APIs offer structured, programmable access to live governmental datasets, allowing third-party developers, civic technology organizations, and other stakeholders to build services on top of government infrastructure [4]. This openness not only facilitates technical innovation but also supports democratic values such as transparency, accountability, and responsiveness [5].

The promise of Open Government APIs lies in their potential to transform how urban services are designed, delivered, and experienced. For instance, APIs can provide real-time public transit updates, enable dynamic waste collection scheduling, and foster collaborative disaster response systems [5]. However, the actual impact of these APIs on the quality and efficiency of public service delivery remains

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under-researched, especially from an empirical and comparative standpoint across metropolitan areas [4].

Existing literature has largely focused on the technical architecture of open APIs, the regulatory frameworks that support them, or isolated case studies from pioneering cities [6, 7]. Few studies have systematically measured how the adoption of open APIs influences service delivery metrics such as accessibility, user satisfaction, latency, and policy agility. Moreover, cities vary significantly in their digital maturity, governance models, and citizen engagement levels, which affects how APIs are implemented and used in practice [7-9].

This study aims to fill this gap by investigating the following central question: To what extent do Open Government APIs improve smart city service delivery in metropolitan areas? This research analyzes API implementation data, public service performance indicators across a sample of global cities. By doing so, the study seeks to contribute empirical evidence to the discourse on digital government innovation and to offer actionable insights for policymakers, technologists, and civic innovators alike.

2. Literature Review

2.1. Open Government APIs

Open Government APIs (OGAPIs) are defined as application programming interfaces that enable structured access to government data and services in an open and reusable manner [1, 10, 11]. OGAPIs serve as a technological bridge that facilitates interoperability between government systems and enables innovation in the development of government data-based applications [12]. Open Government APIs (OGAPIs) are increasingly seen as foundational infrastructure for smart public services. They facilitate real-time interaction between public data and digital applications, enabling services such as e-participation, transport updates, and dynamic environmental monitoring [13].

The value of APIs is in their ability to promote openness, modularity, and integrability across government systems [14]. Cities with mature API ecosystems tend to exhibit higher transparency and citizen trust. Their cross-country analysis shows that API openness is often accompanied by better feedback loops and governance responsiveness [7]. The success of OGAPIs is tightly linked to institutional arrangements and data governance strategies Khurshid, et al. [15]. Sánchez-Nielsen, et al. [16] developed the SuDaMa framework, showing that API sustainability depends not only on technical design but also on legal compliance, metadata integrity, and continuous data refreshment Sánchez-Nielsen, et al. [16].

Luthfi and Janssen [12] and Yu, et al. [17] also emphasize how open APIs contribute to service co-production and public value co-creation when embedded in inclusive governance systems. However, they caution that API proliferation without regulation can lead to system fragmentation and data redundancy [18]. For OGAPIs to function at scale, robust middleware and architectural standards are necessary. Siddiqui, et al. [19] propose an adaptive smart-contract-based architecture that enables secure interoperability of APIs across services such as traffic, utilities, and emergency systems [19]. The research highlights security governance as a persistent challenge in urban-scale integration.

Similarly, Cedillo-Elias, et al. [20] demonstrate how a cloud platform developed by the Jalisco state leverages APIs for orchestrating smart services via Software-Defined Networking (SDN), improving modular control and fault resilience [20]. Smart cities are increasingly adopting federated API systems to allow cross-agency and cross-city coordination. Bellini, et al. [21] investigate API federation in European cities and argue that shared ontologies and standardized endpoints are key to scalable urban data integration Bellini, et al. [21].

Vaghela, et al. [22] reinforce this through a use case on the automation of government workflows via standardized APIs, emphasizing performance gains in bureaucratic procedures such as licensing and civic registration [22]. Despite growing adoption, OGAPIs face several challenges including inconsistent documentation, data quality variability, and lack of citizen-friendly API gateways. Chaturvedi, et al. [23] raise concerns around securing spatial data infrastructures as APIs increasingly

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handle sensitive location-based services [23]. Future directions point toward API marketplaces, AI-augmented service discovery, and API governance dashboards. These trends indicate a shift from "publishing data" to "curating services," where OGAPIs evolve as programmable civic interfaces.

2.2. The Role of Open Government APIs (OGAPIs) in Digital Public-Services

Open Government APIs (OGAPIs) play an important role in building a more transparent and accountable government system. Lnenicka, et al. [7] show that smart cities with mature API ecosystems display higher levels of data openness, real-time reporting, and policy response. In their study of 22 European cities, API transparency was associated with more active citizen participation and positive perceptions of public integrity Lnenicka, et al. [7]. Matheus, et al. [24] added that API design principles designed for digital openness have a direct impact on increasing public trust. In the development of open data-based city dashboards, APIs enable transparency of the decision-making process through real-time visualization of indicators. This strengthens the concept of "governance by data" [24].

OGAPIs support the emergence of civic tech platforms and e-participation tools that enable citizens to engage directly in governance processes Wilson [25]. Simonofski, et al. [26] reveal that the majority of open government data platforms fail to accommodate ordinary citizens, and suggest a gamification-based design approach to increase engagement. This is where APIs come in as the link between raw data and an inclusive user interface Simonofski, et al. [26]. Zhao, et al. [27] proved that API-powered city crowdsourcing systems significantly increased citizen participation. The case study from the City of Sacramento shows that an intuitive and publicly accessible API interface can encourage citizens to report city issues, make suggestions, and directly monitor service performance [27].

Public service efficiency is one of the main targets of smart cities. The implementation of OGAPIs enables the integration of previously siloed systems, accelerates responses to service requests, and reduces data redundancy Adje, et al. [28]. Vaghela, et al. [22] showed that modern APIs accelerate the automation of government service procedures, such as licensing, registration, and complaints, which were previously time-consuming and prone to human error [22]. Research by Sánchez-Nielsen, et al. [16] also emphasizes the importance of sustainable API governance to maintain long-term efficiency. Their proposed SuDaMa framework enables service consistency by maintaining metadata standards and semantic linkages between public data [16].

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Table 1.
Comparative Review of International Studies on OGAPI Impacts in Smart City Services.

Study & Year	Primary Focus	Study Location	OGAPI Role	Key Findings
Lnenicka, et al. [7]	Transparency and citizen trust	22 Smart Cities (Europe)	Transparency	Mature API ecosystems correlate with higher transparency and responsive feedback loops
Matheus, et al. [24]	Design of digital openness systems	Global	Transparency	APIs act as instruments of policy openness and real-time governance
Simonofski, et al. [26]	Accessibility of open data portals	Global (government platforms)	Participation	APIs should be coupled with citizen-friendly interfaces to boost engagement
Zhao, et al. [27]	Crowdsourced civic participation	Sacramento, USA	Participation	API-enabled platforms increase public engagement and direct service monitoring
Vaghela, et al. [22]	Bureaucratic process automation	India (regional level)	Efficiency	Modern APIs streamline public service workflows and reduce administrative delays
Sánchez-Nielsen, et al. [16]	Sustainable API governance	Spain	Efficiency	SuDaMa framework improves long-term service efficiency and data consistency
Das [1]	Digital transparency practices	Brazil	Transparency	Clear API documentation and open licensing influence data reusability
Reggi and Dawes [29]	Transparency–innovation relationship	European Union	Transparency & Participation	APIs foster collaborative public innovation and multi-actor ecosystems

2.3. Challenges in the Implementation of OGAPIs

The implementation of Open Government APIs faces a spectrum of technical and cybersecurity barriers. One of the most critical is the lack of standardization in data formats and access protocols, which hampers interoperability between government systems and third-party platforms [30]. According to Chaturvedi, et al. [23] the complexity of managing spatial data infrastructures through APIs in smart cities necessitates multi-layered security frameworks, particularly when handling sensitive geospatial data. Their research emphasizes the importance of identity federation and access control in distributed environments [23].

Additionally, Hussain, et al. [31] explore the rising threat of cyber vulnerabilities in public APIs, especially those exposed to third-party developers. They argue that APIs represent a growing attack surface, and without proper API gateways, traffic management, and threat detection mechanisms, they can compromise government networks [31]. The tension between openness and security, noting that sustainable open data management must balance transparency with the enforcement of metadata integrity, license control, and data lifecycle governance [16].

From a non-technical perspective, many governments, especially in developing countries, face institutional limitations that hinder the successful adoption of OGAPIs. Galdino de Magalhães Santos [32] identifies a lack of skilled human resources, inadequate digital literacy among civil servants, and outdated legacy systems as key bottlenecks in Brazil's national digital governance efforts. The study shows that even where open data policies exist, implementation often stalls due to organizational inertia and fragmented ICT governance [32].

Similarly, Vaghela, et al. [22] conducted a qualitative investigation into API adoption within Indian public services. They found that the costs of maintaining and scaling APIs, along with the need for ongoing technical training, are often underestimated, resulting in short-lived pilot programs rather than sustainable digital transformation [22]. Building long-term API capabilities, therefore, requires more than just software, it calls for investment in institutional capacity, change management, and interdepartmental coordination.

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3. Research Methodology

This research adopts a comparative qualitative literature review methodology, aimed at synthesizing key insights from academic, policy, and technical literature regarding the implementation of Open Government APIs (OGAPIs) and their impact on smart city service delivery. The study is structured as a multi-country comparative desk study, analyzing trends, policy frameworks, and institutional practices through structured document analysis.

3.1. Case Selection

This study examines five countries selected based on global digital government indices such as the UN E-Government Development Index [33] and the OECD Digital Government Index [34]. The selection ensures variation in both digital maturity and regional representation, allowing comparative insight between more advanced and developing digital ecosystems.

- Advanced digital governments: *Singapore*, *South Korea*, *United Kingdom*
- Emerging digital adopters: *Brazil*, *Indonesia*

3.2. Data Sources

The study relies exclusively on publicly accessible secondary sources published between 2019 and 2024, covering academic, policy, and technical documentation. These sources were selected for their relevance to Open Government API (OGAPI) implementation and smart city service strategies in the five selected countries. Data were collected from the following four categories:

3.2.1. Academic Literature

Peer-reviewed journal articles and conference papers were retrieved from Scopus and Web of Science, focusing on keywords such as *open government APIs*, *digital government*, *smart city platforms*, and *interoperability*. Preference was given to comparative and empirical studies, especially those addressing governance, technical frameworks, and digital service outcomes.

3.2.2. Official Government Publications

National digital strategies, open data frameworks, e-government regulations, and government modernization reports were collected from official portals (e.g., *gov.uk*, *data.gov.sg*, *smartcity.go.kr*, *data.go.id*, and *gov.br*). Technical implementation documents and whitepapers related to public APIs were also included where available.

3.2.3. API Portals and Technical Repositories

Documentation from official government API platforms (e.g., *Singapore Developer Portal*, *UK Government API Catalogue*, *Smart Korea API Hub*) were reviewed to understand the scope, governance structure, and accessibility of APIs in each country. Sandbox environments and API usage analytics were analyzed when public.

3.2.4. International Reports and Benchmarks

Comparative digital governance reports from institutions such as the UN Department of Economic and Social Affairs (UNDESA), OECD, and World Bank (GovTech Maturity Index) were used to contextualize each country's progress and institutional maturity. These were triangulated with the primary documentation to reduce bias and ensure consistency.

3.3. Analytical Approach

The analysis follows a qualitative comparative literature synthesis, integrating techniques from content analysis and cross-case thematic mapping to examine how OGAPI-related initiatives differ across varying levels of digital maturity.

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3.3.1. Content Analysis

A directed content analysis was conducted across documents. A coding framework was developed deductively based on themes identified in OGAPI and smart governance literature. Codes were grouped under four main analytical categories:

- Policy and Legal Infrastructure
- Technical and Data Architecture
- Organizational Readiness
- Citizen Interface and Engagement

Each document was reviewed manually and thematically annotated to capture evidence of national policy orientation, implementation strategy, challenges, and innovations.

3.3.2. Cross-Case Comparison

The coded data were synthesized into country profiles, which were then compared to identify patterns of convergence and divergence among advanced and emerging digital governments. Special attention was paid to:

- API openness and licensing models.
- Integration of APIs with public service delivery systems.
- Presence of cross-agency API governance bodies.
- Strategies for citizen and developer engagement.

This approach allowed us to map institutional configurations and their relationship to observable implementation trends.

3.4. Limitations

This study is subject to several limitations inherent to literature-based comparative research. First, the analysis relies exclusively on secondary data sources, which vary in scope, granularity, and public availability across countries. While every effort was made to ensure completeness, not all government portals or technical documents provide the same level of detail.

Second, country-level generalizations should be interpreted with caution. Each nation's smart city strategy is context-dependent, often shaped by subnational dynamics, agency-specific frameworks, and political priorities. As such, this study provides a high-level synthesis rather than an exhaustive, micro-level evaluation. Finally, while the comparative thematic approach enables cross-country insights, it does not account for longitudinal dynamics or post-implementation impacts that require time-series or primary fieldwork, which fall outside the scope of this literature review.

3.5. Research Ethics

This research was conducted in adherence to international standards for academic integrity and responsible data use. All data analyzed were publicly available documents, open-access literature, or sourced from authorized institutional repositories.

4. Result and Discussion

This section presents a cross-country comparison of OGAPI implementation across five countries, identifying institutional patterns, infrastructure readiness, and public engagement mechanisms. The findings reveal significant variation in both strategic alignment and operational capacity.

4.1. Institutional Models and Governance

Singapore and South Korea exhibit centralized digital governance models characterized by strong regulatory oversight and national digital transformation agendas. Singapore's approach is anchored in its Smart Nation initiative, which mandates a unified, whole-of-government digital infrastructure,

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including centralized API governance under the GovTech Singapore [35]. The *Singapore Government Developer Portal* provides standardized technical guidelines and sandbox environments to support API integration across ministries [35].

Similarly, South Korea operates under the Smart City Master Plan and the *Act on the Establishment of Smart Cities*, which provide a legal mandate for digital governance and urban data integration through centralized API systems [36]. The Korean Smart City Data Hub is a national initiative aimed at unifying city-level API services, particularly in domains such as transport, public safety, and utilities [37].

In contrast, Brazil and Indonesia exhibit fragmented or evolving governance structures, where implementation of API-based services varies significantly between agencies and administrative levels. Brazil's open data initiatives are supported by the Presiden Republik Indonesia [38] and the Presiden Republik Indonesia [38] but API integration remains uneven, with limited enforcement and coordination at the federal level [39]. Similarly, Indonesia's digital governance is guided by Presidential Regulation No. 95/2018 on SPBE (Electronic-Based Government System), which outlines goals for integration and interoperability but leaves technical API governance to be interpreted by individual ministries and local governments [38].

The United Kingdom follows a decentralized but standardized model, where individual departments manage their own APIs in line with national guidance from the Government Digital Service (GDS). This model allows agency-level autonomy while promoting consistency through enforced design standards and open API specifications [33].

4.2. Technical Infrastructure Maturity

Technical maturity aligns closely with policy leadership. Singapore and South Korea offer highly scalable and real-time API platforms that are tightly integrated with digital public services. Singapore's Smart Nation API Exchange (APEX) is a national middleware platform enabling agencies to securely publish and consume APIs, facilitating interoperability across ministries [35]. This is supported by formal policies such as the Digital Government Blueprint which explicitly mandates agency-level API standardization and service integration [40].

South Korea operates the Smart City Data Hub, which aggregates sensor and service data across urban systems into a unified national API infrastructure. It is governed under the Smart City Act and coordinated by the Ministry of Land, Infrastructure and Transport (MOLIT), ensuring interoperability and data security at scale [36].

In the United Kingdom, the Government Digital Service (GDS) has developed a comprehensive set of API standards and public API catalogues, such as the UK API Catalogue. However, implementation remains inconsistent due to legacy systems in critical sectors like health and criminal justice, which are slower to adopt modern API architectures [22, 35].

Brazil and Indonesia are actively pursuing platform consolidation, often supported by digital transformation roadmaps. Brazil's Plataforma Integra aims to unify digital public service delivery and includes limited API capabilities, but struggles with infrastructure disparities across federated states and agencies [39]. Indonesia's efforts are coordinated through SPBE (Sistem Pemerintahan Berbasis Elektronik), guided by Presidential Regulation No. 95/2018, yet API implementation varies significantly by institution, and faces funding limitations, especially at the local government level [38].

4.3. Legal Frameworks and Policy Clarity

Clear legal frameworks are a cornerstone of successful OGAPI strategies. In Singapore, OGAPI implementation is underpinned by the Digital Government Blueprint and governed operationally by GovTech, which provides legal and technical guidelines for API development, integration, and interoperability across public agencies [40]. The legal foundation is further strengthened through alignment with Singapore's Personal Data Protection Act (PDPA), ensuring that API openness is balanced with data privacy and security.

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South Korea enforces API-related service integration through the Act on the Establishment of Smart Cities and the Promotion of Smart City Industries, which includes legal mandates for standardizing digital infrastructure and public data systems [36]. This legislative clarity has enabled nationwide API platforms, particularly in the domains of urban mobility, energy, and public safety.

In contrast, the United Kingdom promotes open APIs through a non-binding framework led by the Government Digital Service (GDS), particularly under the Government Transformation Strategy and API Design Guidelines. While GDS standards are influential, no single statute legally compels agencies to publish or govern APIs, resulting in uneven uptake across departments [22, 35].

Brazil and Indonesia operate under broader digital governance laws without API-specific mandates. Brazil's legal foundation is grounded in the Lei de Acesso à Informação (Law No. 12.527/2011) and the General Data Protection Law (LGPD). While the country promotes open data through national transparency policies, there is no enforceable API governance regulation, leading to inconsistent adoption among ministries [39].

Indonesia's API efforts are framed by the Presidential Regulation No. 95 of 2018 on the Electronic-Based Government System (Sistem Pemerintahan Berbasis Elektronik – SPBE), which outlines principles for interoperability, standardization, and integration. However, API governance is often left to be implemented ad hoc by individual agencies, resulting in fragmented practices and a lack of technical coherence [38].

4.4. Citizen Engagement and Interface

Public-facing API platforms are most developed in the United Kingdom and Singapore, both of which offer structured developer portals, interactive dashboards, and institutionalized citizen feedback mechanisms. The UK Government Digital Service (GDS) operates a centralized API Catalogue that hosts well-documented APIs from various departments, complete with usage guides, feedback channels, and sandbox access for developers [33]. These APIs support services ranging from transport updates to taxation, and are governed by open licensing standards to encourage reuse and transparency.

Singapore's Developer Portal, managed by GovTech, provides an even more unified interface for public APIs. The platform integrates live API testing environments (sandbox), metadata standards, and clear versioning protocols [35]. Singapore also enables public feedback and co-creation via initiatives under the Smart Nation programme, linking APIs directly to national digital services such as Singpass and LifeSG [40]. South Korea has made progress in exposing APIs through the Smart City Data Hub and Data.go.kr, but many services remain agency-led and top-down, with limited focus on user experience or participatory mechanisms [41]. While APIs are publicly accessible, their discoverability and usability lag behind UK and Singapore standards.

In Brazil and Indonesia, civic tech communities are growing, with several local and NGO-led projects leveraging public datasets. However, official API platforms remain fragmented, and public awareness of available APIs is limited. Brazil's Dados.gov.br focuses on open data but offers few interactive API tools, and lacks centralized developer documentation [39]. In Indonesia, data.go.id serves as a national data portal, but API capabilities are inconsistently implemented and rarely promoted across ministries [42].

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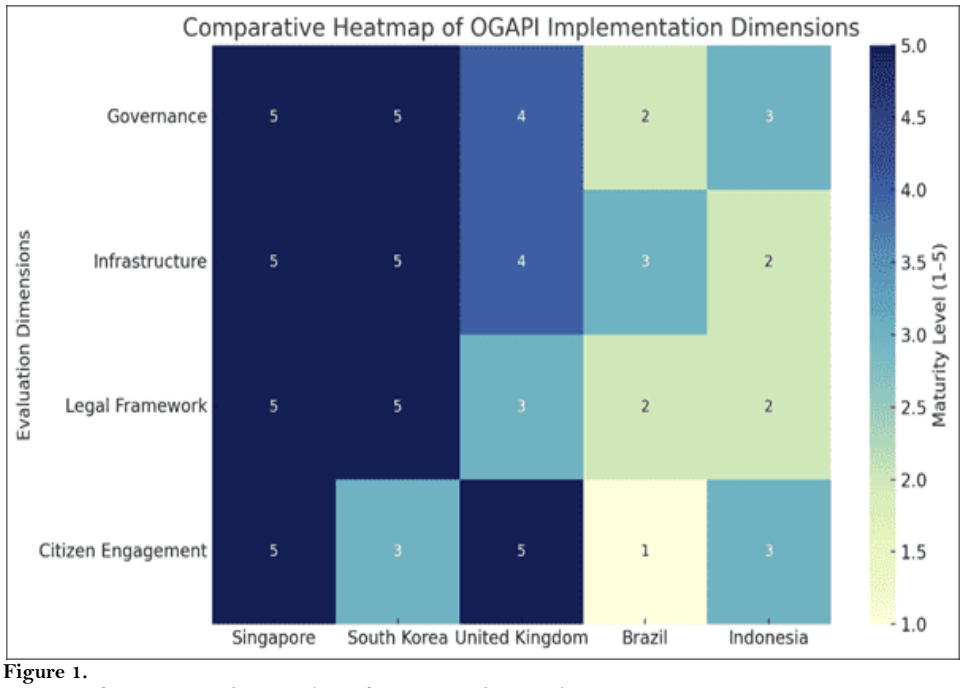

Figure 1.
Heatmap of Country-Level Comparison of OGAPI Implementation.

Explanation of the heatmap above, can be seen in the following table.

Table 2.
Country-Level Comparison of OGAPI Implementation

Country	API Governance Model	Technical Infrastructure Maturity	Policy and Legal Framework	Citizen Interface and Engagement
Singapore	Centralized, regulatory-led with strong agency coordination	High – Unified developer portal, real-time services, scalable APIs	Strong – Clear API directives under Smart Nation program	High – Active feedback channels, dashboards, developer engagement
South Korea	Centralized with smart city mandates and strong infrastructure	High – Integrated API hubs and service layers for city operations	Strong – Backed by national smart city policies and data acts	Moderate – Interface improving, more agency-led interactions
United Kingdom	Decentralized but standardized across government departments	Moderate to High – Open APIs used in many services, some legacy barriers	Moderate – APIs encouraged under open data initiatives	High – Strong focus on service usability and digital inclusion
Brazil	Fragmented, developing coordination mechanisms	Moderate – APIs in use but technical fragmentation remains	Weak – Open data policy exists but API governance is vague	Low – Limited public API awareness or civic tech integration
Indonesia	Emerging, mixed models across ministries and local governments	Low to Moderate – Inconsistent platform integration, some innovative pilots	Evolving – Presidential decrees on digital services; lacking API-specific rules	Moderate – Civic tech ecosystem growing, localized participation tools

4.5. Country Profiles

4.5.1. Singapore

Singapore stands out as a global leader in OGAPI implementation, characterized by a centralized, regulation-driven model under the Smart Nation initiative. The country boasts a mature API

infrastructure with real-time integration across health, transport, and municipal services, supported by a unified developer portal and clear policy mandates. Citizen engagement is actively cultivated through dashboards, feedback loops, and transparent reporting mechanisms. The legal framework is among the most advanced, aligning data governance with service transformation. Singapore serves as a benchmark for structured, agile, and citizen-centric API governance [40].

4.5.2. South Korea

South Korea adopts a strong centralized model with a focus on urban digital services through its *Smart City Master Plan*. Its API infrastructure is highly integrated, especially in urban mobility, public safety, and utility management. However, public-facing interfaces remain more agency-centric than citizen-driven, and participatory features are limited. The legal framework supports open data, but specific API legislation is relatively new. Nevertheless, Korea's progress in automated service delivery and data interoperability marks it as a technical frontrunner in the region [43].

4.5.3. United Kingdom

The UK presents a hybrid model of decentralized but standardized OGAPI adoption. Various departments operate their own APIs under guidance from the Government Digital Service (GDS), resulting in consistency without over-centralization. API platforms are supported by strong documentation, open licensing, and usability guidelines, making them among the most developer-friendly in the world. The focus on *digital inclusion* has strengthened citizen interaction, although legacy systems in health and justice continue to pose integration barriers. The UK remains a policy innovator in balancing openness with autonomy [33].

4.5.4. Brazil

Brazil's OGAPI ecosystem is in a transitional phase, with fragmented efforts across federal, state, and municipal levels. While the country has an open data strategy, the lack of API-specific governance has resulted in uneven implementation and limited citizen engagement. Technical infrastructure is present but lacks consistency, and institutional capacity remains a challenge, especially outside major cities. Despite this, Brazil's civic tech community is vibrant, with several bottom-up innovations emerging from NGOs and local governments. The country reflects both the challenges and potential of digital transformation in large federations [39].

4.5.5. Indonesia

Indonesia represents an emerging model in OGAPI development, with growing interest in digital service transformation spurred by Presidential Regulations on SPBE (Electronic-Based Government Systems). However, implementation remains uneven across ministries and regional governments, and coordination is often ad hoc. Some promising initiatives—such as Jakarta Smart City and the Ministry of Finance's open API efforts—demonstrate what is possible. Citizen engagement is rising through localized platforms, but national integration and legal clarity are still evolving. Indonesia offers insight into the adaptive experimentation typical of developing digital economies [38].

5. Conclusion and Policy Implications

5.1. Conclusion

This comparative literature-based analysis reveals that the successful implementation of Open Government APIs (OGAPIs) is deeply influenced by a country's digital governance maturity, legal frameworks, institutional coordination, and civic engagement culture. Among the five countries studied, Singapore and South Korea represent advanced, centralized models with high technical integration and policy alignment. The United Kingdom showcases a more decentralized yet standardized approach, balancing agency autonomy with common infrastructure. In contrast, Brazil and Indonesia reflect the challenges of fragmented governance, uneven technical readiness, and limited regulatory specificity.

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Despite these differences, a shared trend emerges: countries that align API development with national digital strategies, support developer and citizen ecosystems, and enforce clear legal mandates tend to realize stronger public service delivery outcomes. Conversely, lack of cross-agency coordination, outdated legacy systems, and absence of enforceable API policies remain persistent barriers in emerging digital contexts. This study highlights that OGAPIs are not simply technical tools, but strategic assets for participatory, efficient, and transparent governance.

5.2. Policy Implications

5.2.1. Institutionalize API Governance Through National Frameworks

Countries should embed API development into formal digital government strategies and ensure it is supported by interministerial coordination bodies or digital transformation units. Centralized governance (as seen in Singapore and Korea) promotes standardization and cross-sector interoperability.

5.2.2. Adopt Legally Binding API Standards

Legal mandates, not just policy guidance, are critical for ensuring long-term sustainability and accountability. Jurisdictions like the UK could strengthen their model by introducing mandatory open API requirements across all public service domains.

5.2.3. Invest in Scalable Infrastructure and Legacy System Integration

Modern, cloud-based middleware platforms (e.g., Singapore's APEX) enable real-time service delivery and reduce duplication. Emerging economies must allocate consistent investment to upgrade fragmented systems and promote shared service architectures.

5.2.4. Foster Developer Ecosystems and Civic Engagement

Providing public-facing developer portals, open documentation, and feedback mechanisms helps integrate external innovation into government systems. Brazil and Indonesia, in particular, can benefit from supporting grassroots civic tech while improving API visibility and usability.

5.2.5. Tailor Capacity Building to Context

Training programs for public officials, especially in local governments, are essential to overcome technical and governance gaps. International organizations and bilateral partnerships can play a role in scaling OGAPI literacy among bureaucrats and digital practitioners.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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