The Challenges of Data Interoperability in Smart Governance Policy

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Abstract. This article explains the data integration and interoperability challenges in smart governance policies. The research was conducted in Tasikmalaya City, West Java, Indonesia, by measuring interoperability indicators in the implementation of smart governance. These indicators include interconnection, metadata, integration, and access management. Researchers conducted smart governance research in one city in Indonesia to explain smart governance policies, which still experience several obstacles in their implementation. However, to achieve ideal implementation, it is necessary to fulfill indicators of community participation, effective governance, and political perspectives and strategies. This research uses qualitative methods with interviews with the Communication and Information Service, Regional Development Planning Agency, and other related agencies. The research results show that the digital service development master plan still has several obstacles, for example, partnership programs are not effectively developed, sectoral ego between agencies exists, and service integration needs improvement. However, the master plan program has been carried out through intensive monitoring activities to speed up the integrated service process. A collaborative approach is also taken to improve the quality of digital-based government system implementation, especially in data interoperability.

Keywords: city, data interoperability, digital, smart governance

1. Introduction

The inhabitants of a “smart city” are more reliant on technological advancements. The six fundamental constituents of a smart city comprise the domains of mobility, economics, governance, housing, environment, and population. Governments and non-profit groups have implemented smart city schemes globally in recent decades. The residents of a “smart city” are more dependent on technology breakthroughs. The six fundamental components of a smart city encompass mobility, the economy, governance, housing, the environment, and the population [1]. In an ideal scenario, an advanced and intellectually adept urban center would possess the capability to leverage real-time data to enhance its situational awareness. This would facilitate individuals and entities in making informed and effective decisions. In an ideal scenario, an advanced and intellectually astute urban center would be able to leverage real-time data to enhance its situational awareness [2]. Towns in the United States have initiated smart city pilot projects to enhance city services and tackle local concerns [3].

Governments are increasingly adopting digital transformation to enhance service delivery and foster a society that is more focused on the needs of its citizens, inclusive in nature, and oriented towards growth [4]. The potential of digital transformation in the realm of government

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resides in its ability to enhance governance through the facilitation of increased integration, collaboration, and citizen involvement [5,6]. New difficulties in controlling the intricate "smart" environment have emerged due to digital transformation. Many governments must overcome obstacles to smooth the transition to smart societies, particularly in developing nations. We have searched for several definitions of smart governance.

Table 1: Smart Governance Definition

No.	Author	Definition
1.	Luna-reyes LF et al (2016); Willke (2007)	A succinct representation of the principles, variables, and capabilities constituting a governance framework well-suited for addressing the complexities of the contemporary information era [7,8].
2.	M. P. Rodríguez Bolívar (2018); H. J. Scholl (2016).	Intelligent technology has emerged as a catalyst for fostering innovation, sustainability, competitiveness, and liveability. This encompasses various aspects such as promoting openness and informed decision-making, facilitating the sharing and utilization of information, encouraging stakeholder participation and collaboration, as well as enhancing the efficiency and effectiveness of government operations and services. [9,10].
3.	Bingham et al. (2005)	The term "governance" refers to creating, executing, and implementing activities supported by the collective objectives of citizens and organizations, regardless of whether they possess formal authority or policing capabilities. Likewise, "governance" encompasses the processes involved in formulating, executing, and implementing actions endorsed by individuals and entities, regardless of their formal authority or enforcement capabilities [11]**.**
4.	Gil-Garcia (2014)	Enhanced inter-organizational communication, information exchange, and integration are fundamental components of an intelligent state or smart government aimed at effectively tackling intricate socioeconomic issues [12].

Based on the definition above, one can derive various attributes of intelligent administration encompassing these aspects. *First*, it is the utilization of big data and monitoring techniques that enhance the informational infrastructure of central or regional administrations. *Second*, information and communications technology help cities educate and provide rights to their residents so they can participate in dialogue about the places where they live. Third, technological advances enable new communication and collaboration between city residents, city officials, the private sector, and non-governmental organizations to improve everyone's understanding of the urban environment.

[13] study an essential feature of intelligent governance called the "smart governance arrangement." This term combines several elements, including government management and supply of services, citizen participation, and collaboration among stakeholders. The notion of smart governance covers a complicated process of institutional reform that emphasizes the innately political character of idealized forms of socio-technical governance. This definition was established following an exhaustive analysis of key scholarly publications. The present body of research indicates four major conceptual frameworks for understanding the concept of smart governance. The four major features of smart city development include smart city

governance, smart decision-making processes and their implementation, smart administration, and smart urban collaboration among diverse stakeholders within the city.

In order to facilitate the transition towards more intelligent forms of governance, an organization must possess a cohesive vision or idea, as well as a set of tangible actions such as legislation and policy implementation. These concrete steps are essential in transforming the vision into a practical reality.

a. Smart governance arrangements involve leveraging technical advancements and innovative capabilities to enhance cross-departmental communication, improve international decision-making processes, and enable web-based management of interconnected company operations.
b. Smart governance has various primary outcomes, including a transformation in the governmental organizational framework. The alterations in the comparative power dynamics between governments and other urban players result in subsequent impacts that contribute to the overall enhancement of the city.

Before entering the research problem, we searched the Scopus database, which maps research trends in the theme of smart governance. We found 223 research trends took the theme of smart governance and increased from 2013-2022 in the scope of social sciences. However, it experienced a decline in 2022. This can be seen in the following figure:

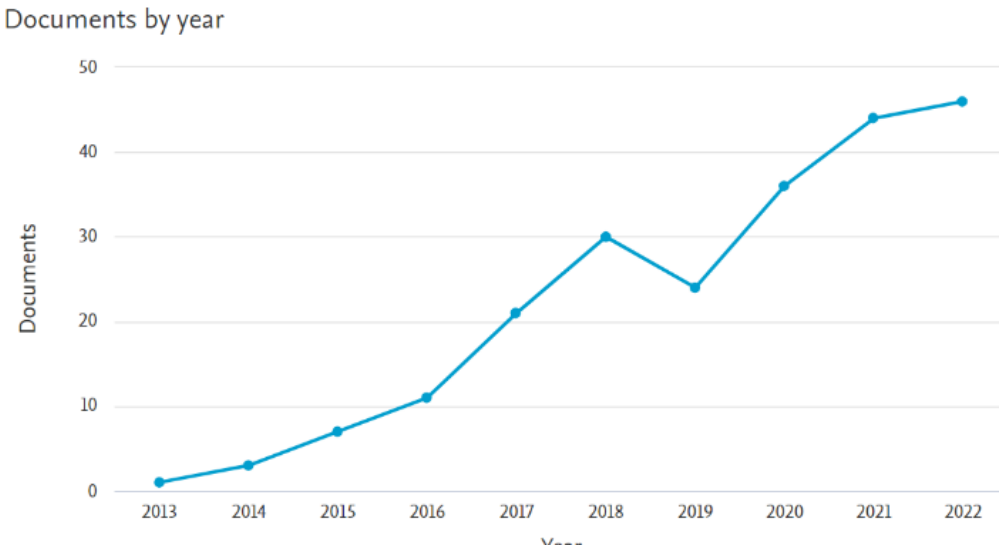

Figure 1: Publication Trends in Smart Governance Research in Social Sciences (2013-2022)
Source: VOSViewer (2023)

Several journals that publish on smart governance research themes include Sustainability Switzerland, Advances in 21st Century Human Settlements, Public Administration and Information Technology, Information Policy, and Cities.

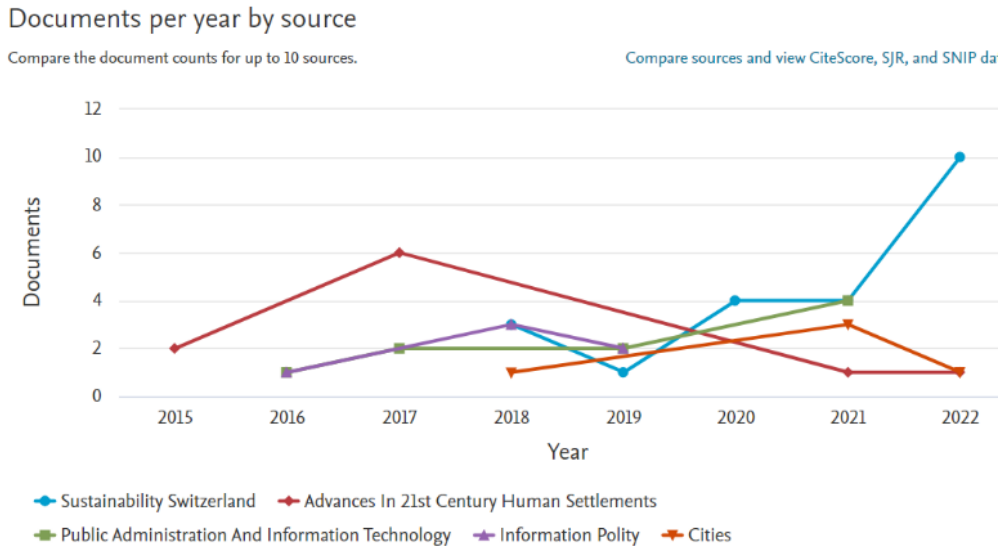

Figure 2: Trend in the Number of Journals that Publish Smart Governance Themes
Source: VOSViewer, 2023

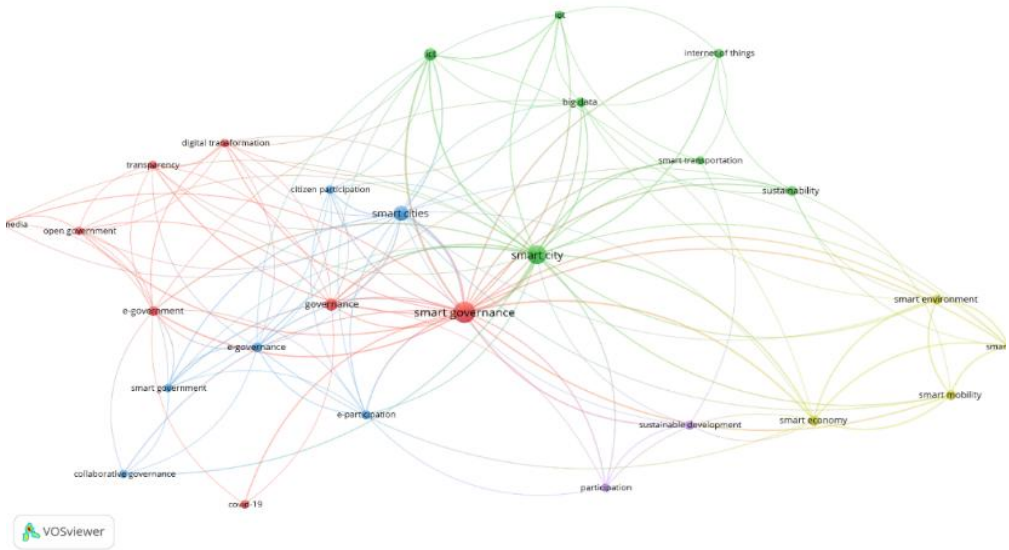

Figure 3: Keyword Co-occurrence Network in Smart Governance Publications in Different International Journals
Source: VOSViewer (2023)

Based on research on the Scopus database, there are 5 clusters in smart governance research. Cluster 1 Covid-19, digital transformation, e-government, governance, open government, smart governance, social media, and transparency. Cluster 2 is big data, ICT, the Internet of Things (IoT), smart cities, smart transportation, and sustainability. Cluster 3: citizen

participation, collaborative governance, e-governance, e-participation, smart cities, smart government, data interoperability. Cluster 4 is about smart economy, smart environment, smart living, and smart mobility. Cluster 5 is about participation and sustainable development.

Based on the results above, we see the novelty of research between smart governance and collaboration. Apart from that, we are also trying to carry out studies by developing links between smart governance and data interoperability processes. This is because Tasikmalaya City still does not have one integrated service between all offices of regional officials. As previously said, this pertains to the national innovation policy, cost-effectiveness, technical requirements for interoperable information systems in the government, and the political considerations of citizen access and user autonomy in the information interchange between citizens and the government [14]. The growing integration of Big and Open Data in the real-time exchange of data among various systems, governmental bodies, and sectors necessitates the establishment of a strong framework for data sharing and interoperability. The successful implementation of Big and Open Data initiatives that employ collaborative analytical methodologies necessitates the smooth integration of data collecting and reporting systems. As previously said, it may be imperative to modify information and data policies to align with this comprehensive data framework [15].

Interoperability defines the exchange of information and communication across organizations as an essential requirement for cooperation. Furthermore, mechanisms for measuring, evaluating, and improving performance are anticipated [16]. As one of the cities that applies smart city principles, Tasikmalaya City still experiences many challenges in its implementation. This article will discuss how the principles of data interoperability support smart governance in Tasikmalaya City.

2. Research Method

This study used a qualitative method. Previous researchers conducted a literature review to see research gaps by searching the Scopus database and using the VOSviewer application after finding a literature review to find the relationship between research variables between smart governance and the concept of collaboration. Thus, we collected data by interviewing the Tasikmalaya City Communication and Information Office, the Regional Development Planning Agency, and other related agencies. The research was carried out by analyzing four main aspects of implementing data interoperability: interconnection, integration, metadata, and access to information [17–19].

3. Result And Discussion

3.1. Data Interoperability

The lack of extensive study and analysis of the various aspects at play makes it difficult to achieve interoperability among public information systems, which already face challenges from the diverse technical needs and distinctive features of the organizations that deploy them [20]. This response highlights some noteworthy trends recognized as potential areas of interest for future study in smart cities. These trends encompass several aspects, including privacy, information security, open data, interoperability, collaborative culture, the confidence of stakeholders engaged in co-production, and the public benefits derived from the concept of public value in smart cities [21]. A significant proportion of e-government initiatives face challenges when connecting with external services. As a result, there is a noticeable lack of

coordination and information sharing among various electronic services in the field of public administration [17]. Data interoperability is more involved than the ad hoc integration of compatible technology and software since it necessitates constant data access, gathering, and aggregation. The capacity to continually access, aggregate, and combine data from many sources is essential for interoperability [22].

To realize data interoperability, the Tasikmalaya City Government has several targets for implementing smart governance, including the following:

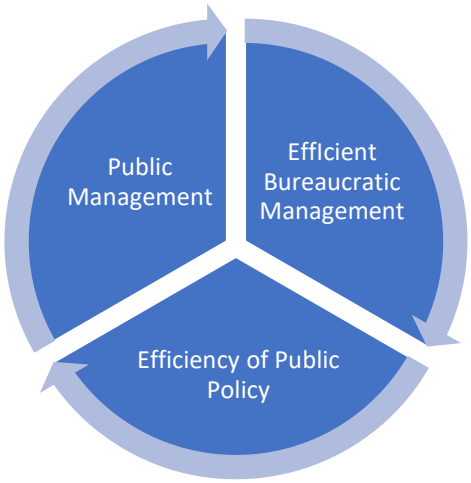

Figure 4: Smart Governance Target Policy in Tasikmalaya City
Source: Data from various sources (2023)

3.1.1 Public Management

To provide intelligent governance to the community, public management is carried out, which seeks to improve professional, innovative, and satisfying public services based on information technology, which is implemented through the Tasik Prima Service Program. Second, it deals with improving the quality and quantity of officials, strengthening institutions, and providing adequate infrastructure. Third, it is about expediting the integration of information systems and technology across various public services and augmenting information and public communication transparency. Fourth, it is to foster awareness and a culture of orderly administration in society.

3.1.2 Efficient Bureaucratic Management

One of the principles of smart governance is creating efficient public organizations. Here are some actions taken. First, it is about optimization of management and utilization. IT components in government implementation through collaboration with third parties and other local governments. Second, it deals with utilizing information technology for governance and transparent bureaucracy. Third, it is about increasing the quality of innovative technology-based bureaucracy information.

3.1.3 Efficiency of Public Policy

The Tasikmalaya City Government implements many techniques to execute public policies effectively. Developing a public policy information system aims to create an interactive, informational, communicative, and IT-based platform that encourages participatory engagement. Furthermore, it is recommended to disseminate policies and standard operating

procedures (SOPs) through IT-based platforms accessible to the general public. The immediate objectives in the implementation of smart governance in Tasikmalaya City encompass:

a. One area of focus that warrants attention is enhancing information technology-based public services in terms of quality.
b. Enhancing the accountability framework for financial management and regional performance.

Quick Win Smart City in the Smart Governance dimension of Tasikmalaya City, namely the district administration service application. This application is included in the cluster of smart governance policies. We conducted research in several offices of regional officials, for example, the Communication and Informatics Service and the Regional Development Planning Agency. The research results explain that the smart governance policy does not yet have an integrated application that can reach all basic services in Tasikmalaya City. Each service dimension is still separate for each office of regional officials. Therefore, efforts to improve public services must be carried out comprehensively by innovating smart governance services.

One of the applications in the smart governance component is the sub-district service application for processing administrative services in sub-districts. One of the advantages of this application is the use of an e-KTP reader, making it easier to collect data from the public. The principle of data interoperability already exists in this application, which is integrated with the Ministry of Home Affairs, for example. Unfortunately, the principle of interoperability is the ability of applications and systems to securely and automatically exchange data without regard to geographic, political, or organizational boundaries. Interoperability must ensure that data between OPDs can be used simultaneously based on maximum data processing.

3.2. Interconnection

As to the World Wide Web Consortium's definition, "linked data" refers to data accessible on the Internet in a form that computer systems can understand. The data above exhibits distinct semantic clarity, interconnectivity with other datasets, and external dataset accessibility [23]. Data integration is carried out through smart governance principles; for example, the Tasikmalaya City Communications and Information Service accommodates the data-based sub-district service application. The issue of centralized accountability poses a significant obstacle to implementing the idea of interconnectedness. To facilitate the shift from the existing e-government framework to a smart government model, numerous individuals have been appointed to formulate governance prioritizing citizen-centricity, data-driven decision-making, and performance orientation. We have encountered challenges, including regulatory limitations and the complexities associated with integrating diverse infrastructure, considering technological, economic, and privacy perspectives. In order to enhance problem-solving, optimize resource usage, and foster policy innovation, we propose a novel approach to modeling information systems. This approach incorporates an integration layer to integrate with pre-existing databases and services [24].

3.3. Integration

This research focuses on improving integrated smart governance services, starting from government services, health, labor, public services, tourism, and conveying aspirations. However, not one application is integrated with all services. One instance of using smart branding can be observed in the statistical analysis of tourist numbers. The PAKTANI application serves as an exemplification of a smart economic application aiming to enhance the promotion of agricultural products through digital media. Additionally, an online student admission application has been developed to enhance the quality of education services. Lastly,

the Tasikmalaya city government offers digital reading services. Gemah Ripah is a garbage sorting service that operates as an intelligent environmental management solution.

The applications available in Tasikmalaya City do not yet have an integrated service to realize smart city services. Strategic regional policy formulation can accommodate this integrated service by considering data efficiency and interoperability. Several services that are spread throughout the OPD must be able to be accommodated by the local government.

3.4. Metadata

For smart governance to work in the real world, social, organizational, and institutional methods must adapt to new technologies. Our findings also show that dealing with legacy data is not only an obstacle to be solved but rather an operational condition that defines the dynamic nature of smart governance [25]. Metadata refers to the embedded information within a file that provides an explanatory context about the content of the file. The provided metadata encompasses pertinent details regarding the substance of data, which is subsequently utilized for the purpose of file or data management within a database. Metadata can be maximized by implementing one data in the Tasikmalaya City Government. The current development of digital technology makes it very easy for anyone who wants to access data anywhere and at any time; the various displays of data information presented are intended to speed up access for users to obtain the data they need. Metadata is fundamental data that explains or offers information about other data. Sectoral statistical metadata is unquestionably handled to ensure better data accuracy and information needed to support One Data Indonesia's proper implementation.

3.5. Access to Information

The European Interoperability Framework (e-GIF) delineates the requisite interoperability standards essential for efficiently executing many elements, including interconnection, data integration, content and metadata management, access and presentation of information, and security [26]. From earlier study findings, a six-layer technology architecture for e-government has been proposed. Display, content management, application integration, data interchange, interconnection, and security levels are all included in the architectural components.

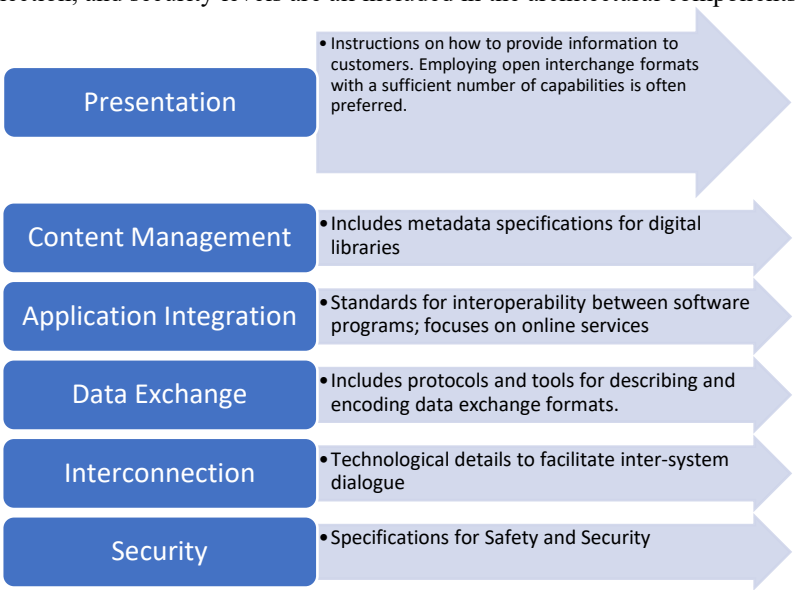

Figure 5: E-Government Technical Architecture
Source: [19]

When two systems can exchange services efficiently without changing or degrading the information exchanged, they are said to be interoperable with each other [25]. This study focuses on four main variables: interconnection, integration, metadata or content management, and information presentation/access, as discussed previously. The city of Tasikmalaya is classified as not well established in implementing data integration and data interoperability. One thing that needs to be done is to facilitate access to information for the public by conveying real-time information that can be accessed via mobile-based applications. Based on research results, for example, labor data and access to information still use non-digital work patterns, which means that the principles of digital-based work patterns have not been implemented properly.

4. Conclusion

The research elucidates that data interoperability in Tasikmalaya City is hindered by several hurdles, which can be categorized into four primary indicators: connectivity, metadata, integration, and access management. The interconnectivity indicates the absence of connected apps or services, aiming to achieve intelligent governance through data collection among regional apparatus groups. Clear data links are essential for several applications inside the smart city framework, including government, living, economy, and smart people. Establishing a cohesive structure within each office of regional officials is vital to facilitating a unified data service that prioritizes enhancing public services. Furthermore, it is vital to implement integration services in Tasikmalaya City by amalgamating multiple fundamental services into a single application that is readily available to the general public. Thirdly, it is imperative to guarantee that metadata, which refers to any data made available to the general public, is accessible in real time and can be efficiently processed. Access management is the comprehensive facilitation of services provided to the public through online platforms, spanning the entirety of the process from the commencement of service requests through the delivery of service outcomes.

References

[1] Liu F, Shi Y, Chen Z. Intelligence Quotient Test for Smart Cities in the United States. J Urban Plan Dev. 2021;147(1):04020053.

[2] Bartelt VL, Urbaczewski A, Mueller AG, Sarker S. Enabling collaboration and innovation in Denver's smart city through a living lab: a social capital perspective. European Journal of Information Systems. 2020;29(4):369–87.

[3] Bifulco F, Tregua M, Amitrano CC. "ICT and sustainability in smart cities management," *International Journal of Public Sector Management*, vol. 29, no. 2, pp. 132-147, 2016.

[4] Manda M. Towards "smart governance" through a multidisciplinary approach to e-government integration, interoperability and information sharing: A case of the LMIP project in South Africa. Vol. 10428, Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). 2017. p. 36–44.

[5] Manda MI, Backhouse J. Addressing trust, security and privacy concerns in e-government integration, interoperability and information sharing through policy: A case

of South Africa. In: In Proceedings of the 2016 international conference on information resources management. 2016.
[6] Chourabi H, Nam T, Walker S, Gil-Garcia JR, Mellouli S, Nahon K, et al. Understanding smart cities: An integrative framework. In: In 2012 45th Hawaii international conference on system sciences. IEEE; 2012. p. 2289–97.
[7] Luna-reyes LF, Picazo-vela S, Luna DE, Gil-garcia JR. Creating Public Value through Digital Government : Lessons on Inter- Organizational Collaboration and Information Technologies. In: Hawaii International Conference on System Sciences Creating Creating. 2016. p. 2840–9.
[8] Willke H. Smart governance: governing the global knowledge society. Campus Verlag; 2007.
[9] Rodríguez Bolívar MP. Fostering the citizen participation models for public value creation in cooperative environment of smart cities. In: H.J. S, O. G, E. T, E. K, P. P, S. V, et al., editors. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). University of Granada, Granada, 18071, Spain: Springer Verlag; 2018. p. 235–48.
[10] Scholl HJ. Smart governance as key to multi-jurisdictional smart city initiatives: The case of the eCityGov Alliance. Social Science Information. 2016;55(2):255–77.
[11] Bingham LB, Nabatchi T, O'Leary R. The new governance: Practices and processes for stakeholder and citizen participation in the work of government. Public Adm Rev. 2005;65(5):547–58.
[12] Gil-Garcia JR, Helbig N, Ojo A. Being smart: Emerging technologies and innovation in the public sector. Gov Inf Q. 2014;31(S1):I1–8.
[13] Bolívar MPR, Meijer AJ. Smart Governance: Using a Literature Review and Empirical Analysis to Build a Research Model. Soc Sci Comput Rev. 2016;34(6):673–92.
[14] DeNardis L. E-Governance Policies for Interoperability and Open Standards. Policy Internet. 2010;2(3):127–62.
[15] Bertot JC, Gorham U, Jaeger PT, Sarin LC, Choi H. Big data, open government and e-government: Issues, policies and recommendations. Information Polity. 2014;19(1–2):5–16.
[16] Pereira GV. Increasing collaboration and participation in smart city governance: a cross-case analysis of smart city initiatives. Inf Technol Dev. 2017;23(3):526–53.
[17] Pamungkas Y, Santoso AB, Ashari B, Sensuse DI, Mishbah M, Meiyanti R. Evaluation of interoperability maturity level: Case study Indonesian directorate general of tax. Procedia Comput Sci. 2019;157:543–51.
[18] Zhou S, Zhang X, Liu J, Zhang K, Zhao Y. Exploring development of smart city research through perspectives of governance and information systems: a scientometric analysis using CiteSpace. Journal of Science and Technology Policy Management. 2020;11(4):431–54.
[19] Ray D, Gulla U, Dash SS, Gupta MP. A critical survey of selected government interoperability frameworks. Transforming Government: People, Process and Policy. 2011;5(2):114–42.
[20] Casalino N, Cavallari M, Marco M De, Gatti M, Taranto G. Defining a Model for Effective e-Government Services and an Inter-organizational Cooperation in Public Sector. In: Proceedings ofthe 16th International Conference on Enterprise Information Systems (ICEIS-2014). 2014. p. 400–8.
[21] Rocha Á, Ferras C, Marin CEM. Information Technology and Systems. In: Advances in Intelligent Systems and Computing. 2020.

[22] Janssen M, Estevez E, Janowski T. Interoperability in Big, Open, and Maturity, Organizational Linked Data-Capabilities, and Data Portfolios. In: IEEE Computer Society. 2014. p. 44-.
[23] Galiotou E, Fragkou P. Applying Linked Data Technologies to Greek Open Government Data : A Case Study. Procedia Soc Behav Sci. 2013;73:479–86.
[24] Bojović Ž, Klipa Đ, Bojović PD, Jovanović IMš, J Šenk V. Interconnected Government Services: An Approach toward Smart Government. Applied Sciences, 13(2), 1062. Applied Sciences. 2023;13(2):1062.
[25] Lodato T, French E, Clark J. Open government data in the smart city: Interoperability, urban knowledge, and linking legacy systems. J Urban Aff. 2021;43(4):586–600.
[26] Kanagwa B, Nakatumba-Nabende J, Mugwanya R, Kigozi Kahiigi E, Ngabirano S. Towards an interoperability e-Government framework for Uganda. Vol. 250, Lecture Notes of the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering, LNICST. Springer International Publishing; 2018. 16–28 p.