

# Navigating Diversity of the Smart City Initiatives in Indonesia

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**Abstract** This article explores the diversity and dynamics of smart city initiatives in Indonesia by analyzing the various strategies implemented. This article aims to show how the diversity of smart city initiatives and how smart city strategies respond to global challenges. This article is the result of a systematic literature review. The review's findings suggest that smart city initiatives in Indonesia focus on digital transformation, strengthening regional readiness, the participation and needs of local communities, especially in facing complex and dynamic urban challenges. By implementing smart city strategies, Indonesia has the potential to develop inclusive smart cities.

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## 1. Introduction

The smart city initiatives in Indonesia are based on various driving factors, including urbanization (Jin et al., 2014), development in information and communication technology (ICT), globalization issues, limited resources, and environmental challenges. In the middle of urbanization and the increasing number of people, urban areas are faced with the most important task, namely realizing sustainable development (Bibri, 2021; Allam et al., 2022). Urbanization in the form of rapid population growth motivates the government to search for solutions in managing cities that are getting densely populated and complicated. In reference to the Ministry of Public Works and Housing (PUPR) (2014), urbanization, an increase in population, decreasing environmental quality, poverty, regional capacity, and the level of growth among underdeveloped cities are issues for urban development in Indonesia.

Development in information and communication technology (ICT) makes it possible to create opportunities to optimize different aspects of urban life, such as transportation, infrastructure, and public services. Many countries in the world, including Indonesia, have been developing smart city with significant innovation and sustainable development. This smart city initiative is also one of the efforts toward better management in achieving a livable city (Rachmawati, 2019a). On the other hand, the growing demand for providing public services easily accessible to service users (Rachmawati et al., 2022), limited budgets, and human resources have made the government search for solutions to provide public services that are more efficient and effective. The application of technology in smart city can help reduce negative impacts on the environment, especially related to climate change and pollution.

ICT offers numerous opportunities for regional development by enhancing public services (Mensah et al., 2021). Policymakers view the integration of ICT in urban planning and management as a crucial step towards creating smarter cities (Corcuera et al., 2019). Labeling a city as "smart" comprises developing a set of ethnocentric and uniform expectations (Kong and Woods, 2021). The diversity of smart city in Indonesia reflects the innovation efforts of various districts/cities, especially in responding to challenges and in line with the concept of Society 5.0 and Sustainable Development Goals (SDGs). In general, Innovative technologies and applications of Industry 5.0 combined with society, environment, and economy create the foundation of Society 5.0 (Shiroishi et al., 2018). This concept emphasizes the integration of digital technology into aspects of life to create a balance between economic progress and solving social problems. According to Khanna et al. (2024) and T'oth et al (2023), the core of the Society 5.0 vision is to ensure that the use of artificial intelligence (AI) technology remains transparent, easy to understand, and consistent with human needs and values. SDGs are presented as a framework to combine human- and environmental-focused factors with technological innovation that fosters a more balanced and sustainable development approach (van Zanten & van Tulder, 2021), where each goal has several targets and indicators requiring strict tracking and monitoring (Hassan et al., 2025). Smart city and Society 5.0 are expected to strengthen the contribution to achieving SDGs, especially in goal 11, namely Sustainable Cities and Communities.

A smart city extends beyond having a digital network but requiring using digital technology as a tool to impact all aspects of human life, including social, economic, and existing urban governance. However, there is no universally

accepted definition of a smart city, as each country and city tends to establish individual criteria and indicators for urban intelligence (Tranos & Gertner, 2012).

The Indonesian Government has initiated several programs to promote the development of smart city across various regions, including the Movement Towards 100 Smart city and specific projects in major cities namely Jakarta, Surabaya, and Bandung. This initiative aims to create more modern, efficient, and sustainable urban environments. However, the diversity of smart city initiatives in Indonesia has not been identified, leading to the question: How is the diversity of smart city initiatives in Indonesia and how do regions independently initiate smart city? Therefore, this study aimed to show how diverse regional initiatives influence the initiation of smart city. It also shows how smart city strategies emphasize the importance of intellectual diversity as a strength in facing global challenges. Through a multidisciplinary approach, the study addressed technological aspects of smart city development. It advocates for smart urbanism to break barriers and promote unity, ultimately contributing toward the larger discourse on leveraging diversity as an essential asset for a sustainable and inclusive urban future in Indonesia.

## 2. Methods

This study used data gathered from secondary sources pertinent to the topic, including journals, policies, regulations, government documents available online, statistical data from Central Statistics Agency (BPS) (Provinces in Figures), and previous studies that support a comprehensive analysis. The analysis method used was the Systematic Literature Review (SLR) including summarizing, analyzing, and synthesizing a group of related literature, as well as testing certain hypotheses and or developing new theories (Xiao & Watson, 2019).

The diversity of smart city in Indonesia was analyzed from the results of a literature review which was then subjected to qualitative descriptive analysis. The stages carried out in a SLR include:

1. Searching for literature: The data used were studies published from 2022-2024 on various databases including Science Direct, Scopus, and IEEE databases. Journal literature was based on the results of searches with the same keywords: {diversity} & {smart city} & {indonesia}.
2. Screening and assessing quality: Based on the results of the literature search, the selection was then carried out by skimming the abstract and journal components adjusted to the topic and objectives. The selected journals were explored in more depth by thorough reading.
3. Data Analysis and Synthesis: Selected journals from the Scopus database were specifically visualized in the form of bibliometric networks using VOSviewer. This tool is used to map expert authors in a topic and identify articles, journals, and topics (networks between academics, most cited journal articles, and most popular journals). The results of the mapping on the Scopus database were then mapped using VOSviewer.

This approach comprises identifying, evaluating, and interpreting all relevant results on a topic to address specific questions. The literature review method facilitates the formulation of new theoretical hypotheses and the development of policy recommendations to be incorporated (Knopf, 2006).

## 3. Result and Discussion

In general, the results showed the realization of implementing smart city in Indonesia, divided into five parts. These include Searching for Smart City Definition and Implementation, Urban Development Through Smart City Initiatives, Dynamics of Implementation of Smart City Solutions, Relationship between Community and Smart City: Conceptual and Empirical Review (Case Study), Smart City Strategy in Indonesia: Diversity Intellectuals and Strength in Facing Global Challenges, as well as Technological Aspects in Smart City Development. These different parts are explained as follows.

### 3.1. Searching for Smart City Definition and Implementation

Generally, there are many terms for city management with innovative technology (Anthopoulos, 2015). The term smart city is identified as the most commonly applied in studies to identify cities with technological features (Cocchia, 2014; D'Auria *et al.*, 2018). The journal articles were selected using three main databases including Science Direct, Scopus, and IEEE. The whole articles were obtained based on the same keywords between 2022 and 2024 (until May 14, 2024). The results from the Scopus database were then mapped using VOSviewer. The process was carried out to determine the keyword mapping to the research topic. Furthermore, this method aimed at describing the implementation of smart city in Indonesia, particularly in the urban context.

The Vosviewer mapping (Figure 1) results show that besides Indonesia, smart city have also been widely adopted in India, the United States, Germany, Italy, and other countries. This suggests that the concept has been implemented in many different countries around the globe.

Figure 2 shows the results of mapping visualization based on the keywords of the articles. The mapping was divided into six clusters represented by six different colors. Each color in VOSviewer was used to indicate the cluster of the item (Eck and Waltman, 2014). Based on search results, the keyword "smart city" was found 975 times. This number is significantly large compared to other keywords such as cybersecurity, blockchain, and big data.

### 3.2. Urban Development through Smart City Initiatives in Indonesia

Urban development in Indonesia continues to progress and improve annually (Sinergi, 2016). This growth is driven by the increasing urbanization rate. Data from the BPS indicates that in 2010, 49.8% of Indonesians resided in urban areas, a figure projected to rise to 66.6% by 2035 (Databoks, 2022). The World Bank predicts that by 2045, around 220 million Indonesians, or 70% of the population, will live in urban areas. Urbanization in major cities such as Jakarta can significantly enhance economic growth, but also brings challenges including traffic congestion, slums, crime, and pollution. Rural areas may suffer from slower economic growth as the younger, more productive population migrates to urban centers.

The Indonesian government and stakeholders are addressing these challenges through smart city initiatives aimed at improving the quality of life. On a national scale, the initiatives are crucial for the future, particularly for national integration and the advancement of existing smart city. The concept comprises leveraging ICT to enhance public service efficiency, optimize resource usage, and support sustainable

Table 1. Database Repository Matrix

Keyword	Database for 2022-2024		
	Scient Direct https://www. sciencedirect.com/	Scopus https://www.scopus. com/	IEEE https://ieeexplore.ieee. org/
Smart City	31,874	17,598	10,847
Smart City in Indonesia	1,565	223	325
Implementation of Smart city	24,086	2,221	1,102
Implementation of Smart city in Indonesia	1,304	61	70

Note: Extracted from scopus database between 2022 to 2024 (until May 14, 2024).

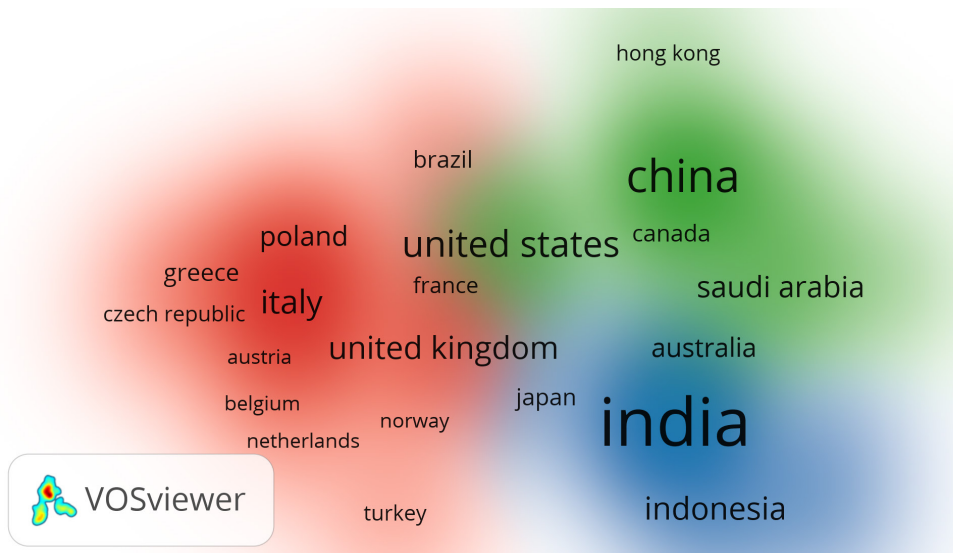


Figure 1. The area of where Smart City is implemented. Analyze from scopus database between 2022 to 2024 (until May 14, 2024).

Source: Scopus database processing results, 2024

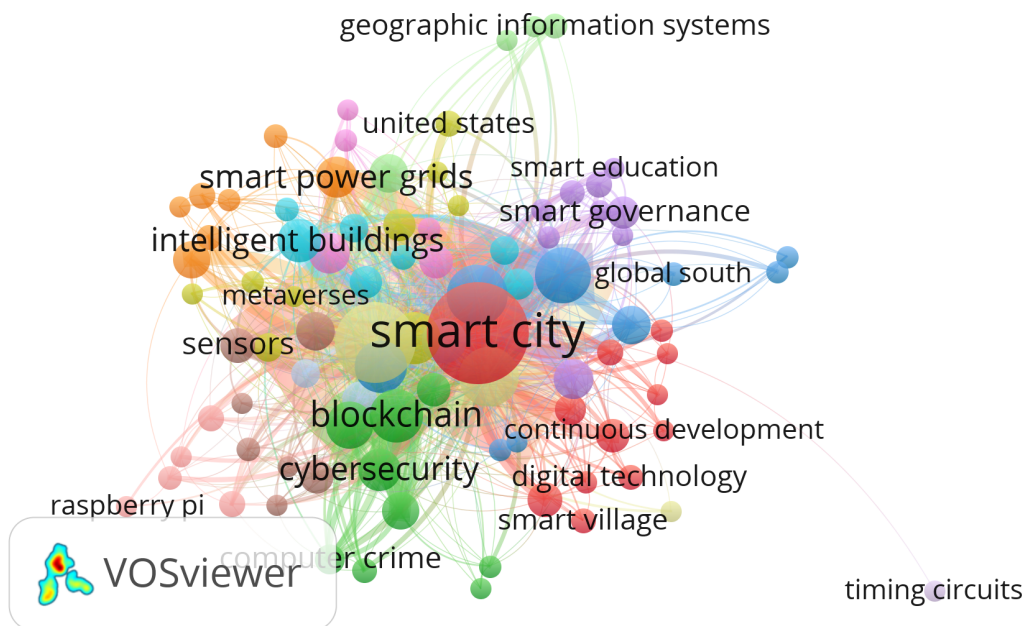


Figure 2. Study Topic within Smart City. Analyze from scopus database between 2022 to 2024 (until May 14, 2024).

Source: Scopus database processing results, 2024

development. The government has launched various policies and programs to foster smart city development.

A significant initiative is the Movement Towards 100 smart city, launched in 2017. This program, a collaboration between

the Ministry of Communication and Information, Ministry of Finance, Ministry of Home Affairs, Ministry of PUPR, Ministry of Administrative and Bureaucratic Reforms, and the Agency for National Development Planning, is consistent with

the 2045 Golden Indonesia Vision. The vision aims to position Indonesia as a developed, prosperous, and competitive nation with significant global influence (Kemenkominfo Press Release, 2023). Numerous frameworks or models provide guidelines and standards for effective smart city development. Over the past two decades, studies on smart city and digital applications have increased globally (Burns et al., 2021; Dowling et al., 2021), reflecting the growing complexity in selecting and implementing smart city frameworks (Ulya et al., 2024).

Indonesia smart city initiatives focus on digital transformation and strengthening government operations. These initiatives aim to enhance the quality of life and public service efficiency in various cities by using digital technology, data, and connectivity (Suryawan and Lee, 2023; Tehupeiry et al., 2023; Nath et al., 2023). For example, the Nusantara Capital City is being developed as a smart city to avoid issues faced by Jakarta and improve residents quality of life (Rachmawati et al., 2024a). This sustainable city aims to promote economic development in surrounding areas and achieve economic equality in Eastern Indonesia (Bappenas, 2024). Rachmawati et al. (2024a) outlined six service domains that encapsulate the elements of sustainability and smart city for the future of IKN. In general, smart city initiatives have successfully enhanced public service accessibility and availability, improving people quality of life.

In the future, development in Indonesia is expected to expand as more cities adopt smart technologies. This initiative aims to improve urban quality of life, public service efficiency, and sustainable development. Continued collaboration among the government, private sectors, and society is essential to address challenges and leverage opportunities, fostering the development of inclusive and competitive smart city. By emphasizing innovation and collaboration, Indonesia smart city have the potential for significant positive transformation in various aspects of urban life.

### 3.3. Dynamics of Smart City Solution Implementation in Indonesia

Developing a smart city requires navigating a range of complex and dynamic challenges. Although Indonesia has witnessed rapid progress in implementing smart city solutions, several significant obstacles remain. These efforts are characterized by the optimization of technology use and the commitment of regional governments. Connectivity and the role of information technology make smart city inseparable from infrastructure (Sensuse et al., 2022). According to Rachmawati et al (2021), technological developments in this digital era in terms of digital governance are an important factor in state administration. For example, the technology in IKN cybersecurity shows that all cybersecurity technologies are used in smart city, while securing crucial infrastructure relies more on big data management (Sensuse et al., 2022). In general, the infrastructure required for the urban development to be the capital city comprises ICT, social and regional development, as well as physical and environmental aspects (Rachmawati et al., 2021).

Challenges include the capacity of human resources within regional government communities, funding availability, and the need to shift bureaucratic work cultures and public habits. Generally, smart city implementation must be tailored to the unique cultural and social characteristics of Indonesian cities (Rachmawati, 2019).

Several cities in Indonesia during the COVID pandemic were encouraged to adopt the use of ICT. For example, the pandemic has caused changes in the transformation of digital services, especially in the DKI Jakarta Provincial Government, starting from work systems, office administration processes, and public service delivery, to cultural changes (Rachmawati et al., 2023). Consequently, during the COVID pandemic, food delivery services became one of the services that are in great demand by the public. Online Food Delivery Service Providers in Yogyakarta provide significant benefits in terms of performance effectiveness and efficiency, strategic advantages, organizational structures, as well as competitive advantages through the available features (Salma and Rachmawati, 2022).

Applying the smart city concept to urban management can enhance efficiency in public services, speeding up governmental administrative processes. Technologies such as mobile applications and websites make services more efficient and accessible, leading to improvements such as better-organized transportation systems, more efficient waste management, and enhanced public services. A key aspect of successful smart city development is infrastructure planning, which should be integrated with overall city planning. Currently, infrastructure systems are often planned independently of city planning (Rachmawati et al., 2024b). A comprehensive transport master plan is essential for contemporary urban development, making sustainable transportation systems a critical component of sustainability (Rachmawati et al., 2024b).

Optimizing the use of technology cannot be separated from the digital transformation in every region, the commitment of regional governments, and the human resource capacity. According to Ataman, (2022), every city must transform to become more livable. This suggests that transformation or awareness of regional changes is an important aspect of implementing smart city. Digital transformation and the dynamics of smart city implementation are closely related, mutually supporting and strengthening each other. Digital transformation indirectly builds the basis for smart city initiatives. Infrastructure such as fast internet networks, smart sensors, and data management systems are the main basis for smart city to collect, manage, and efficiently analyze data. Digital transformation enables the availability of more efficient and responsive public services, while smart city make use of technology to improve city services. According to Rohmah et al. (2023), the typology of implementing digital health services in Indonesia is dominated by the Western and Central Parts. It is very different from the Central and Eastern Parts of Indonesia where limited forms of digital transformation are still found. Furthermore, digital transformation pushes innovation in different sectors, including smart city development, indicating that the dynamics of smart city implementation is diverse. This diversity is formed by different related factors such as differences in the speed of digital transformation, regional readiness, and the digital gap of every region. Smart city can also create opportunities for start-ups and new companies to develop innovative solutions by making use of technology. This shows that different factors form the implementation of digital transformation and initiatives in Indonesian smart city.

### 3.4. The Relationship between Community and Smart City: Conceptual and Empirical Review (Case Study)

The concept of smart city fundamentally revolves around leveraging ICT to enhance the quality of life for urban residents. The term "community" covers various levels, including

families, rural and suburban areas, urban communities, regional areas within a country, national regions, or even entire nations (Debertin and Goetz, 2008). Consequently, the connection between communities and smart city includes several facets such as providing efficient and integrated public services, fostering active community engagement in decision-making processes, enhancing social quality (Rachmawati et al., 2024c), improving access to information and services for all societal segments.

The interaction between government and society forms a bidirectional synergy aimed at realizing a smart city. A smart government develops through community participation and interests (Handayani et al., 2021). The relationship between communities and smart city includes three critical aspects including technology introduction, bridging the digital divide, and enhancing digital literacy (Evita and Mukhaer, 2019). Building a smart city is not solely about investing in technology but also about fostering a mindset and aspiration for improvement. The connection between communities and the smart city concept is crucial for sustainable and inclusive urban development. A core element of a smart city is the active engagement of the community in designing, implementing, and using technology-based solutions to enhance quality of life. It is crucial to engage communities in the decision-making processes to ensure the solutions are consistent with needs and aspirations. Furthermore, smart city must be designed to be accessible to all societal layers without discrimination, which includes ensuring widespread availability of digital infrastructure, providing technology training, and tailoring solutions to meet diverse community needs.

In line with SDG 11 (Sustainable Cities and Communities), the link between communities and smart city is significant. Studies in 61 journal articles from the Scopus database and visualized through VOSviewer show that smart city development in Indonesia is closely related to the Internet of Things (IoT) and sustainable development. The concept inherently comprises using ICT to improve the quality of government services and the well-being of citizens.

Referring to the Vosviewer analysis results, the topic of Smart City implementation in Indonesia mostly discusses smart city. Meanwhile, topics related to sustainable development and the IoT are discussed with the same frequency. The concept of sustainable development is integral to the implementation

of smart city (Han and Kim, 2024). Sustainable development includes meeting the needs of the present without compromising the ability of future generations. Various urban development initiatives, such as eco, knowledge, and resilient cities, have emerged based on different approaches and values, but all aim to create more sustainable and better urban environments (De Jong et al., 2015). Smart city support sustainable development in numerous ways, including energy efficiency, water resource management, sustainable transportation, and reducing carbon emissions. The integration of IoT technology in Indonesian smart city plays a significant role in achieving sustainable development. By leveraging this technology, Indonesian cities can become more efficient, environmentally friendly, and responsive to citizens needs, thereby contributing to SDGs.

Smart city clearly have the potential to drive the transition towards sustainable development and address the challenges posed by climate change. With the recent uncertain climate, developing resilient cities and communities is increasingly important for city managers and policymakers (Kim and Kim., 2021). Although smart city often emphasize the innovative use of ICT to enhance urban infrastructure and business sectors, the ultimate aim is not only to protect critical infrastructure and management from crises but also to achieve sustainable development for society (Chung et al., 2021). This suggests that smart city must identify both material and non-material resources within the community (Zhu et al., 2019). The specific ways in which the relationship between communities and smart city is implemented in Indonesia are detailed as follows.

Table 2 shows that there are several examples of how the community or society plays a role in the success of the regional smart city program. For example, in the city of Bandung, there is an application called *SIP Bandung Juara*, a forum for public participation. It is a creative space as a form of social innovation and an effort to develop creativity and improve the economy. The development cannot be separated from technology. In general, the transformation and dynamics of cities currently taking place are understood to be geared toward informational cities and information economies (Castells, 1989; 1990), one of which is realized in the form of creative spaces. In addition to the city of Bandung, programs such as "Surabaya Owns a Story" (Surabaya City), Jogja Smart Province (DIY), and *Sapa Mbak Ita* (Semarang City) are several examples of how the community or society plays a role in the success of the

Table 2. Examples of Forms of Relationship between Communities and Smart city in Indonesia

No	Region/City	Forms of Implementation
1	Bandung	The application <i>SIP Bandung Juara</i> is the one managed by the City Government of Bandung to become a forum for public participation as a means of collecting information for city villages and sub-districts throughout the city of Bandung.
2	Surabaya	Programs such as "Surabaya Owns a Story" use social media and online platforms to promote the potential of tourism and culture of the city. Meanwhile the application "Media Center Surabaya" provides various services to accommodate participation from community in the form of complaints/claims /information/suggestions in the development process.
3	Jakarta	The application <i>Qlue</i> enables Jakarta settlers to report problems in their surrounding environment, such as flooding or noise, allowing for a faster response from the authorities.
4	DIY	Yogyakarta has a program called "Jogja Smart Province", aimed at improving public services and sustainable development.
5	Semarang	<i>Sapa Mbak Ita</i> is a medium for the people of Semarang City to express their aspirations and complaints to the Mayor of Semarang directly.

Source: processed from various sources, 2024

Smart City program. The government of Jakarta created an application called *Qlue*, through which residents can report problems in the surrounding area, such as flooding or noise, thereby enabling a faster response from the authorities. Jakarta the capital of Indonesia, is part of the Smart City trend in the world. According to Iyengar (2017) in "Asia's Cities: Necessity, Challenges, and Solutions for Going Smart", Jakarta is one of several large cities (megacities) besides Tokyo, Seoul, Beijing, Shanghai, Manila, Mumbai, Delhi, Karachi, and Istanbul that belongs to this group.

The implementation of smart city in Indonesia does not only include the development of technological infrastructure but also pays attention to the participation and needs of local communities. Therefore, smart city initiatives in Indonesia have the potential to improve people quality of life and accelerate sustainable development in different regions. The relationship between community and society signifies the presence of a new human civilization called Society 5.0 which is closely related to Industry 4.0 in the sustainable development of society (Wang et al., 2016; Savaget et al., 2019). Society 5.0 focuses on humans adapting to developments by overcoming social problems with the help of online-integrated machines (Evita and Mukhaer, 2019). Smart city will not work when not supported by the community, hence, the term Society 5.0 is closely related to the implementation.

By making use of technology, smart city can create new opportunities for the economic and social empowerment of people. Examples include digital platforms for marketing local products, digital skills training for job searches, or participation in more open and transparent decision-making processes. Therefore, the relationship between communities and smart city underscore the importance of collaboration among the government, the private sectors, academicians, and society in putting urban development towards a smarter, more sustainable and inclusive future.

### 3.5. Smart City Strategy in Indonesia: Diversity in Intellectual and Strength in Facing Global Challenges

Smart cities play an important role in solving the challenges and taking opportunities of urbanization in Indonesia (Rachmawati et al., 2024c). One of the main challenges in initiating this concept is the lack of technological infrastructure that can inhibit the implementation of various services such as smart transportation systems, technology-based waste management (Nasir and Yuslinaini, 2024), and the lack of regulations supporting the implementation of the Smart City system, such as in Serang City (Pangestu & Anggraini, 2022). Susilowati et al (2025) showed that ICT is among the determining factors in the concept of smart cities in Indonesia.

Smart urbanism is a way to solve broader challenges related to the use of diversity as an important asset for a sustainable and inclusive urban future in Indonesia. The development of smart city in Indonesia is a big challenge and requires a targeted strategy and collaboration among the government, private sectors, community and academicians. Among the several strategies that can be implemented include:

1. **Digital Infrastructure:** Building strong digital infrastructure, including a fast and extensive internet network as well as required information technology infrastructure namely sensors, CCTV cameras, and monitoring systems.
2. **Digital Public Services:** Improving public services by making use of digital technology, such as online

payments, public service applications, and integrated public information portals.

3. **Innovation in Education and Health:** Integrating technology in the education and health sectors, such as e-learning, telemedicine, and public health monitoring to improve access and quality of services.
4. **Community Participation:** Foster active participation from communities in the development of smart city by undergoing training programs, socialization, and platforms for public participation.
5. **Collaboration between the government and private sectors:** Fostering collaboration between the government and the private sectors in the development and implementation of smart city technology, including partnership for project funding and management.

Smart strategies can also be realized in the form of planning products. For example, the strategy made to support the new capital city is prepared in the form of planning products as well as spatial and environmental plans (Rachmawati et al., 2021b). By implementing these strategies holistically and sustainably, Indonesia will achieve the goals of becoming more efficient, sustainable, and inclusive by developing smart city. At the same time, the concept is promoted to overcome local sustainability challenges, and smart city strategies can be used to support the transitions of urban sustainability (Clement et al., 2023).

### 3.6. Aspects of Information and Communication Technology in the Development of Smart City

The development of smart city in Indonesia presents significant opportunities driven by technological advancements and the demand for more efficient and sustainable infrastructure. However, several challenges must be addressed to successfully implement these initiatives in the country. The rapid growth of technology, opportunities for collaboration, infrastructure needs, and government support are key factors in the development of smart city in Indonesia. The swift technological advancements, including high internet penetration and widespread adoption of digital technology, create opportunities to integrate advanced technologies into urban infrastructure. Moreover, public-private partnerships and support from the private sector, through investment and innovation, can expedite the development of smart city. The Indonesian Government has demonstrated the commitment to promoting the concept through various policies, programs, and incentives aimed at fostering the implementation of smart city across the nation.

Several obstacles still exist including technology gaps, limited resources and budget, data security and privacy, changes in culture and awareness, complicated system integration, as well as inadequate infrastructure. The gaps in access and use of technology throughout Indonesia have indirectly affected the process of smart city initiatives in every region. In addition, there are also still problems related to basic infrastructure such as unevenly distributed electricity and internet networks, especially in 3T (left behind, foremost, and outermost) areas.

Smart city initiatives can significantly empower communities, particularly by using ICT to enhance access to information, education, and economic opportunities. Implementing smart city in Indonesia can be a strategic approach to addressing global challenges more effectively, creating more sustainable, efficient, and inclusive urban

environments. For the successful implementation of smart city, several issues need to be addressed. The government must develop comprehensive strategies and plans that integrate technology and advancements in ICT systems. Additionally, ICT-based innovations included in the master plan need to be aligned with broader development plans (Rachmawati, 2019b).

The IoT is increasingly becoming a crucial component of smart city (Zanela et al., 2014; Rhee, 2016). IoT consists of physical devices connected to the internet, enabling data collection and exchange (Ilyas, 2021). Within the smart city framework, IoT is used to enhance services through automation and reduce operational costs (Mora et al., 2018). It also introduces new products that enhance daily life (Arulkumar et al., 2024) and links various city elements to generate real-time data (Wei et al., 2024), aiding decision-making and optimizing city services. IoT applications are anticipated across all smart city dimensions, including healthcare, energy, transportation, and more. The implementation in smart city covers facilities that allow government monitoring (Ali and Calis, 2019) such as smart lighting, air quality control (Mishra et al., 2020), and waste management (Amira et al., 2024).

Developing smart city also demands substantial investment in both budget and high-quality human resources. The deployment of technology in smart city must be balanced with robust data security measures to protect citizen privacy. Additionally, raising public awareness about the benefits of smart city and addressing cultural resistance to technological change are essential challenges. Effective coordination among various stakeholders is necessary for integrating different systems and applications. According to the Ministry of PUPR (2014), challenges in developing smart city also stem from the absence of clear roadmaps from regional governments, resulting in a fragmented implementation level in Indonesia. By leveraging existing opportunities, the government is expected to overcome these challenges. The development of smart city is anticipated to provide significant benefits to society, enhance quality of life, improve administrative efficiency, and promote sustainable economic growth.

#### 4. Conclusion

In conclusion, the implementation of smart city initiatives in Indonesia has shown diverse results from different aspects at the city or district level. There are many terms concerning smart city often used in the world. Based on the Vosviewer mapping results, smart city have also been widely implemented in India, the United States, Germany, and Italy. The implementation in Indonesia does not only require the development of technological infrastructure but also pays attention to the participation and needs of local communities. The achievement of a high level of community and societal progress is a marker of new human civilization called Society 5.0, which is related to the use of technology. Furthermore, community relationships and smart city are in line with SDG 11 (Sustainable Cities and Communities).

Numerous cities and regencies across Indonesia have integrated advanced technologies to enhance public services and infrastructure. This technological adoption includes the use of the IoT, geographic information systems (GIS), smart sensors, and various digital platforms to manage urban environments. The implementation of smart city initiatives has positively impacted the quality of life for residents by providing easier access to transportation, more efficient waste management, enhanced security, and improved health services.

Empowering communities in decision-making and using technology is the key to the success of a smart city. Active participation of the community in giving feedback can also strengthen the effectiveness of implementation. Despite the opportunities and potential for progress, there are still challenges in infrastructure that need to be overcome, such as the availability of equitable internet access, budget limitation, and the development of physical infrastructure to support smart city. Furthermore, the need for data security and privacy, especially in protecting personal data and information security is an important concern in developing systems and applications of smart city in Indonesia. This underscores the need for collaboration among different stakeholders including government, private sectors, academicians, society, and related parties for the successful implementation of Indonesian smart city.

Strong partnerships can ensure sufficient resources, sustainability, and continuous innovation in the development of smart city. This study provides a deeper understanding regarding the implications of smart city initiatives in Indonesia. It also gives guidance to policy developers, practitioners, and academicians to keep improving and optimizing the implementation of smart city. Further studies are needed related to measuring the effectiveness of different smart city programs and innovations that have been implemented in Indonesia. There is also a need to analyze the challenges faced and effective solutions that can be implemented in different regions.

In general, smart city initiatives in Indonesia lead to policy implementation, especially in increasing the level of local government capacity. The implementation requires regional readiness in terms of natural resources, structure (government human resources, community human resources, and budget), infrastructure (physical, digital, and social), superstructure (policies and institutions), and community culture. Regional preparation will determine the success of implementing smart city. The inequality of access and digital infrastructure between urban and rural areas shows the need for affirmative policies to ensure equal distribution of connectivity and digital literacy. Therefore, several recommendations for initiating smart city in Indonesia, include 1) Strengthening national regulations that foster the integration of smart city with the SDGs, 2) Increasing the readiness and capacity of local governments, and 3) Increasing digital literacy.

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#### References

- Ali., U. and Calis, C. (2019). Centralized Smart Governance Framework Based on IoT Smart City Using TTG-Classified Technique. 2019 IEEE 16th International Conference on Smart Cities: Improving Quality of Life Using ICT & IoT and AI (HONET-ICT), Charlotte, NC, USA, 2019, pp. 157-160, doi: 10.1109/HONET.2019.8908070.
- Allam Z, Bibri SE, Chabaud D, Moreno C (2022a). The Theoretical, Practical, and Technological Foundations of the 15-Minute City Model: Proximity and Its Environmental, Social and Economic Benefits for Sustainability. *Energies* 15.

- Amira, H., Hadda, B.E., Lamia, C.F. (2024). A sustainable smart IoT-based solid waste management system, *Future Generation Computer Systems*, Volume 157, Pages 587-602, <https://doi.org/10.1016/j.future.2024.03.056>.
- Anthopoulos, L. G. (2015). Understanding the smart city domain: A literature review. *Transforming city governments for successful smart cities*, 9–21.
- Arulkumar V., Kavin F., Arulkumar D., Bharathiraja N. (2024). IoT Sensor Data Retrieval and Analysis in Cloud Environments for Enhanced Power Management. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, 38(1), 77–88. <https://doi.org/10.37934/araset.38.1.7788>
- Ataman, C., Tuncer, B. (2022). Urban Interventions and Participation Tools in Urban Design Processes: A Systematic Review and Thematic Analysis (1995 – 2021), *Sustainable Cities and Society*, Volume 76, ISSN 2210-6707, <https://doi.org/10.1016/j.scs.2021.103462>.
- Bappenas. (2024). Final Draft RPJPN 2025-2045. Bappenas.
- Bibri, S. E. (2021). Data-driven smart sustainable cities of the future: An evidence synthesis approach to a comprehensive state-of-the-art literature review. *Sustain Futur*, 3, Article 100047. <https://doi.org/10.1016/j.sfr.2021.100047>.
- Burns, R., Fast, V., Levenda, A., & Miller, B. (2021). Smart cities: Between worlding and provincialising. *Urban Studies*, 58(3), 461–470.
- Castells, M. (1989). *The Informational City: Information Technology, Economic Restructuring, and the Urban-Regional Process*. Oxford: Basil Blackwell.
- Castells, M. (1990). *The Informational City: A New Framework for Social Change*. Research Paper 184: The City in the 1990s Series Lecture 3. Lecture delivered in the series The City in the 1990s: Livable for Whom? Centre for Urban and Community Studies University of Toronto
- Chung, N., Lee, H., Ham, J., & Koo, C. (2021). Smart tourism cities' competitiveness index: A conceptual model. *Information and communication technologies in tourism 2021* (pp. 433–438). Springer.
- Clement, J., Ruyschaert, B., Crutzen, N. (2023). Smart city strategies – A driver for the localization of the sustainable development goals?. *Ecological Economics* 213. <https://doi.org/10.1016/j.ecolecon.2023.107941>
- Cocchia, A. (2014). Smart and digital city: A systematic literature review. *Smart city*, 13–43.
- Corcuera, R.S., Marcos, A.N., Solance, J.S., Jayo, A.B., Mulero, R., Zulaika, U., Azkune, G., Almeida, A. (2019). Smart cities survey: technologies, application domains and challenges for the cities of the future. *Int. J. Distributed Sens. Netw.* 15. <https://doi.org/10.1177/1550147719853984>.
- Databoks. (2022). Sebanyak 56,7% Penduduk Indonesia Tinggal di Perkotaan pada 2020. <https://databoks.katadata.co.id/datapublish/2021/08/18/sebanyak-567-penduduk-indonesia-tinggal-di-perkotaan-pada-2020> accessed on June 10, 2024.
- D'Auria, A., Tregua, M., & Vallejo-Martos, M. C. (2018). Modern conceptions of cities as smart and sustainable and their commonalities. *Sustainability*, 10(8), 2642.
- Debertin, D. L. and Goetz, S. J. (2008). Social Capital Formation in Rural, Urban and Suburban Communities. *Social Capital*, vol. 1, pp. 60–90.
- De Jong, M., Joss, S., Schraven, D., Zhan, C., & Weijnen, M. J. JoCP. (2015). Sustainable-smart-resilient-low carbon-eco-knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization. 109, 25–38.
- Dowling, R., McGuirk, P., Maalsen, S., & Sadowski, J. (2021). How smart cities are made: A priori, ad hoc and post hoc drivers of smart city implementation in Sydney, Australia. *Urban Studies*, 58(16), 3299–3315, 0042098020986292.
- Eck, N. J. v. and Waltman, L. (2014). Visualizing bibliometric networks. Springer, p. 285–320.
- Evita, N., Mukhaer, A.A. (2019). Evaluasi Komunikasi dan Literasi Digital Warga Jakarta dalam Implementasi Society 5.0. *Jurnal Riset Komunikasi*, Volume 5 Nomor 2.
- Han, M.J.N and Kim, M.J. (2024). A systematic review of smart city research from an urban context perspective. *Cities*, Vol. 150. <https://doi.org/10.1016/j.cities.2024.105027>.
- Handayani, D.W., Syafarudin, Muflihah, L. (2021). Problem Realisasi Kebijakan Smart City di Indonesia: Kasus Kota Bandar Lampung. *JISPO Jurnal Ilmu Sosial dan Ilmu Politik*, Vol. 11, No. 1: 35-62.
- Hassan, A.H., Ahmed., E.M., Hussien, J.M., Sulaiman, R., Mansoor, A., Kahtan, H. (2025). A cyber physical sustainable smart city framework toward society 5.0: Explainable AI for enhanced SDGs monitoring., *Research in Globalization*, 10.
- Ilyas, M. (2021). IoT Applications in Smart Cities. 2021 International Conference on Electronic Communications, Internet of Things and Big Data (ICEIB), Yilan County, Taiwan, 2021, pp. 44-47, doi: 10.1109/ICEIB53692.2021.9686400.
- Iyengar, S. (2017). *Asia's Cities: Necessity, Challenges, and Solutions for Going Smart*. Springer.
- Jin, J., Gubbi, J., Marusic, S., and Palaniswami, M. (2014). An Information Framework for Creating a Smart City Through Internet of Things, *IEEE INTERNET OF THINGS JOURNAL*, vol. 1, no. 2, pp. 112-121
- Kemenkominfo Press Release. (2023). Kemenkominfo Press Release No. 549/HM/KOMINFO/12/2023 Lewat Inisiatif Smart City, Kominfo Kembangkan Potensi Digitalisasi Daerah. [https://www.kominfo.go.id/content/detail/53448/siaran-pers-no-549hmkominfo122023-tentang-lewat-inisiatif-smart-city-kominfo-kembangkan-potensi-digitalisasi-daerah/0/siaran\\_pers](https://www.kominfo.go.id/content/detail/53448/siaran-pers-no-549hmkominfo122023-tentang-lewat-inisiatif-smart-city-kominfo-kembangkan-potensi-digitalisasi-daerah/0/siaran_pers)
- Khanna, P., Kumari, J., & Karim, R. (2024). Human-Centric PHM in the Era of Industry 5.0. 8th European Conference of the Prognostics and Health Management Society.
- Kim, C., & Kim, J. (2021). Urban sprawl and leisure time physical activity. *Sport management review*. Advance online publication.
- Knopf, J. (2006). Doing a Literature Review. *PS: Political Science & Politics*, 39(1), 127-132. doi:10.1017/S1049096506060264.
- Kong, L. and Woods, O. (2021). Scaling smartness, (de)provincialising the city? The ASEAN Smart Cities Network and the translational politics of technocratic regionalism. *Cities*. Volume 117. <https://doi.org/10.1016/j.cities.2021.103326>.
- Mensah, I.K., Luo, C., Abu-Shanab, E. (2021). Citizen use of e-government services websites: a proposed e-government adoption recommendation model (EGARM). *Int. J. Electron. Govern. Res.* 17 (2), 19–42, <https://doi.org/10.4018/IJEGR.2021040102>.
- Ministry of PUPR. (2014). *Kajian Pengembangan Smart City di Indonesia*. Jakarta: Direktorat Jenderal Penataan Ruang Kementerian Pekerjaan Umum.
- Mishra, N., Singhal, P., and Kundu, S. (2020). Application of IoT Products in Smart Cities of India. 2020 9th International Conference System Modeling and Advancement in Research Trends (SMART), Moradabad, India, 2020, pp. 155-157, doi: 10.1109/SMART50582.2020.9337150.
- Mora, O.B., Rivera, R., Larios, V.M., Beltrán-Ramírez, J.R., Maciel, R., and Ochoa, A. (2018). A Use Case in Cybersecurity based in Blockchain to deal with the security and privacy of citizens and Smart Cities Cyberinfrastructures. 2018 IEEE International Smart Cities Conference (ISC2), Kansas City, MO, USA, pp. 1-4, doi: 10.1109/ISC2.2018.8656694.
- Nasir dan Yuslinaini. (2024). Membangun Smart City di Indonesia Tantangan dan Peluang: Studi Kasus di Kota Bada Aceh. *Jurnal Manajemen dan Teknologi*, Vol. 1No. 1. <https://doi.org/10.35870/jmt.vxix.774>

- Nath, N., Nitanai, R., Manabe, R., Murayama, A. (2023). A global-scale review of smart city practice and research focusing on residential neighbourhoods. *Habitat International* 142.
- Pangestu, D. K. and Anggraini, W. (2022). Strategi pemerintah daerah dalam mengembangkan kota cerdas (Smart City) melalui smart government di kota serang. *PRAJA: Jurnal Ilmiah Pemerintahan*, 10(2), 130-141. <https://doi.org/10.55678/prj.v10i2.660>.
- Rachmawati, R. (2019a). Toward better city management through smart city implementation, *Human Geographies* 13 (2), 209-218, <https://doi.org/10.5719/hgeo.2019.132.6>.
- Rachmawati, R. (2019b). ICT-Based Innovation in the Smart City Masterplan and Its Relation to Regional Planning. The 4th International Conference in Planning in the Era of Uncertainty IOP Publishing Vol 328 No 1, October 2019ISSN: 17551307.
- Rachmawati R., Haryono E., Rohmah A. A., Permatasari F. D., Fathurrahman R. (2021a). Smart Strategies of the Regional Preparation for the Plan of Moving the New Capital in the Regency of Kutai Kartanegara, International Conference on ICT for Smart Society (ICISS), 1-7, <https://doi.org/10.1109/ICISS53185.2021.9533249>.
- Rachmawati, R., Haryono, E., Ghiffari, R. A., Reinhart, H., Permatasari, F.D., Rohmah, A. A. (2021b). Best Practices of Capital City Relocation in Various Countries: Literature Review. *E3S Web of Conferences*, 325, 07004. <https://doi.org/10.1051/e3sconf/202132507004>.
- Rachmawati, R., Anjani, D.F., Rohmah, A.A., Nurwidiani, T., Almasari, H. (2022). Electronically-based governance system for public services: implementation in the Special Region of Yogyakarta, Indonesia, *Human Geographies-Journal of Studies and Research in Human Geography*, 6 (1), pp. 71-86 (2022).
- Rachmawati, R., Mei, E.T.W., Haryono, E., Reinhart, H., Ghiffari, R.A., Rohmah, A.A., Saralah, T., Pradipa, H., Nurani, I.W., Petre, A.A. (2023). Smart City Approaches to Public Spaces and Services during and after COVID-19: Case Studies in Four Capital Cities. *Indonesian Journal of Geography* Vol 55, No 3 (2023): 443-455. DOI: 10.22146/ijg.84578 website: <https://jurnal.ugm.ac.id/ijg>.
- Rachmawati, R., Reinhart, H., Rohmah, A.A., Sensuse, D.I., Sunindyo, W.D. (2024a). Smart Sustainable Urban Development for The New Capital City of Indonesia. *Journal of Urban and Regional Analysis*, 16-1, pp. 85-113, <https://doi.org/10.37043/JURA.2024.16.1.4>.
- Rachmawati, R., Haryono, E., Ghiffari, R.A., Reinhart, H., Fathurrahman, R., Rohmah, A.A., Permatasari, F.D., Sensuse, D.I., Sunindyo, W.D., Kraas, F. (2024b). Achieving Sustainable Urban Development for Indonesia's New Capital City. *International Journal of Sustainable Development and Planning*, 19 (2): 443-456. <https://doi.org/10.18280/ijstdp.190204>.
- Rachmawati, R., Ananda, M., Haris, N.A., Rohmah, A.A., Wicaksana, I.W., Nibras, D.H., Wijaya, S.L., Maghfirah, Y.A., Elias, M.A., Athipanha, T., Ardan, D., Aditya, A., Trenbath, M. (2024c). *Innovations In Enhancing Smart Cities In Southeast Asia*. Yogyakarta: Deepublish
- Rhee, S. (2016). Catalyzing the Internet of Things and smart cities: Global City Teams Challenge,” 2016 1st International Workshop on Science of Smart City Operations and Platforms Engineering (SCOPE) in partnership with Global City Teams Challenge (GCTC) (SCOPE - GCTC), Vienna, Austria, 2016, pp. 1-4, doi: 10.1109/SCOPE.2016.7515058.
- Rohmah, A.A., Rachmawati, R., Mei, E.T.W. (2023). Smart City Achievement through Implementation of Digital Health Services in Handling COVID-19 Indonesia. *Smart Cities*, 6, 639-651. <https://doi.org/10.3390/smartcities6010030>.
- Salma, D.N. and Rachmawati, R. (2022). The Role of Online Food Delivery Services in the Competitiveness of the Yogyakarta Culinary Industry during the Covid-19 Pandemic. *Indonesian Journal of Geography* Vol.54 , No. 1, 2022 (147 – 153). DOI: <http://dx.doi.org/10.22146/ijg.68508>.
- Savaget, P., Geissdoerfer, M., Kharrazi, A., & Evans, S. (2019). The theoretical foundations of sociotechnical systems change for sustainability: a systematic literature review. *Journal of Cleaner Production*, 878-892.
- Sensuse, D. I., Putro, P. A. W., Rachmawati, R., & Sunindyo, W. D. (2022). Initial Cybersecurity Framework in the New Capital City of Indonesia: Factors, Objectives, and Technology. *Information*, 13(12), 580. <https://doi.org/10.3390/info13120580>.
- Shiroishi, Y., Uchiyama, K., & Suzuki, N. (2018). Society 5.0: For human security and well-being. *Computer*, 51(7), 91-95. <https://doi.org/10.1109/MC.2018.3011041>
- Sinergi. (2016). *Mewujudkan Kota Cerdas Berkelanjutan*. Jakarta: BPIW
- Suryawan, I. W. K., & Lee, C.-H. (2023). Citizens' willingness to pay for adaptive municipal solid waste management services in Jakarta. *Indonesia. Sustain Cities Soc*, 97. <https://doi.org/10.1016/j.scs.2023.104765>
- Susilowati, A.P.E., Rachmawati, R., Rijanta, R. (2025). Smart village concept in Indonesia: ICT as determining factor. *Heliyon*, 11. <https://doi.org/10.1016/j.heliyon.2025.e41657>
- Tehupeiory, A., Mulyana, R., Sianipar, I. M. J., et al. (2023). The environmental challenges of urban living: Why willingness to pay for apartments matters. *Environ Challenges*, 100766. <https://doi.org/10.1016/j.envc.2023.100766>.
- Tranos, E., & Gertner, D. (2012). Smart networked cities?. *Innovation. The European Journal of Social Science Research*, 25 (2), 175-190
- T'oth, A., Nagy, L., Kennedy, R., Bohu's, B., Abonyi, J., & Ruppert, T. (2023). The human- centric Industry 5.0 collaboration architecture. *MethodsX*, 11. <https://doi.org/10.1016/j.mex.2023.102260>
- Ulya, A., Susantoa, T.D., Dharmawan, Y.S., Subriadi, A.P. (2024). Major Dimensions of Smart City: A Systematic Literature Review. *Procedia Computer Science* 234, pp/ 996-1003.
- Wang, H., Tong, L., Takeuchi, R., & George, G. (2016). Corporate social responsibility: an overview and new research directions: thematic issue on corporate social responsibility. *Academy of Management Journal*, 534-544.
- Van Zanten, J.A., & van Tulder, R. (2021). Towards nexu-based governance: Defining interactions between economic activities and Sustainable Development Goals (SDGs). *International Journal of Sustainable Development and World Ecology*, 28 (3).
- Wei, S., Yu, C., Liao, X., Wang, S. (2024). Smart infrastructure design: Machine learning solutions for securing modern cities, *Sustainable Cities and Society*, Volume 107,2024 <https://doi.org/10.1016/j.scs.2024.105439>.
- Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. *Journal of Planning Education and Research*, 39(1), 93-112. <https://doi.org/10.1177/0739456X17723971>.
- Zhu, S., Li, D., & Feng, H. (2019). Is smart city resilient? Evidence from China. *Sustainable Cities and Society*, 50, Article 101636, 1-14