

# Optimizing ICT Infrastructure for Smart City Development in Karawang

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## Abstrak

*Dengan semakin pesatnya perkembangan teknologi dan urbanisasi, kota-kota di seluruh dunia menghadapi banyak tantangan multidisiplin, termasuk permasalahan lingkungan, sosial dan ekonomi. Untuk menjawab tantangan tersebut, diperlukan solusi inovatif dan cerdas melalui konsep pengembangan smart city yang didukung oleh information and communication technology (ICT). Penelitian ini bertujuan untuk mengeksplorasi potensi penggunaan arsitektur teknologi modern untuk mendukung pengembangan kota pintar di Kota Karawang, khususnya dalam hal infrastruktur TI. Metode yang digunakan dalam penelitian ini adalah deskriptif dengan pendekatan kualitatif, dimana data dikumpulkan melalui penelitian dokumen dan wawancara. Hasil penelitian menunjukkan bahwa penggunaan infrastruktur TI yang efektif, jika dipadukan dengan partisipasi aktif warga, dapat mendukung pengelolaan yang lebih baik dan meningkatkan kualitas pelayanan publik di Kota Karawang. Melalui penerapan konsep kota pintar, Kota Karawang berpotensi menciptakan lingkungan yang lebih efisien, berkelanjutan, dan inklusif bagi seluruh warganya. Pemerintah Kota Karawang harus terus memperbaiki rencana pembangunan kota pintar ini. karena peta jalan ini berfungsi sebagai siklus pedoman yang dapat digunakan untuk membangun ekosistem terbaik untuk pembangunan kota cerdas.*

**Kata kunci**— Smart City, Infrastruktur TIK, Tata Kelola Pemerintahan, Pelayanan Publik

## Abstract

*With the rapid development of technology and urbanization, cities around the world are facing many multidisciplinary challenges, including environmental, social and economic issues. To answer these challenges, innovative and smart solutions are needed through the concept of smart city development supported by information and communication technology (ICT). This research aims to explore the potential use of modern technology architecture to support smart city development in Karawang City, particularly in terms of IT infrastructure. The method used in this research is descriptive with a qualitative approach, where data is collected through document research and interviews. The results show that effective use of IT infrastructure, when combined with active citizen participation, can support better management and improve the quality of public services in Karawang City. Through the implementation of the smart city concept, Karawang City has the potential to create a more efficient, sustainable and inclusive environment for all its citizens. The Karawang Regency Government must continue to improve this smart city development plan. because this roadmap serves as a cycle of guidelines that can be used to build the best ecosystem for smart city development.*

**Keywords**— Smart City, ICT Infrastructure, Governance, Public Service

## 1. INTRODUCTION

It is inevitable that people turn to urban living environments as the world's population increases (“World Urbanization Prospects: The 2018 Revision,”2019). The level of urbanization can have an impact on urban social, economic and environmental issues (Hidayat, 2020). Among the problems cities face are waste management, resource scarcity, air pollution, traffic congestion, inadequate roads, deteriorating infrastructure, and public safety (Anggraini & Iqbal, 2020). As a result, cities face

many complex and important issues when trying to meet sustainable energy and environmental needs. This means that every city must adapt and change the way government and society interact with each other by using information and communication technology (ICT) when building a smart city (Anggraini & Iqbal, 2020). In addition, it was mentioned that the concept of smart city is often used to indicate the use of ICT in the context of the city of the future (Fadli & Sumitra, 2019).

The urban concept called smart city aims to solve the problem of managing complex urban life and

find multidisciplinary solutions in an innovative and intelligent way (Kozłowski & Suwar, 2021). The smart city concept emerged as a solution that considers the sustainability of the city as a whole (Kasznar et al., 2021). The (Eniyati, Santi, Retnowati, Mulyani, & Martha, 2017) states that smart cities can manage and combine human resources, natural resources, infrastructure, and government resources by optimizing the use of ICT. This allows the city to reduce costs, time, and energy and increase people's independence, well-being, happiness, and participation. It is expected that the implementation of smart cities will help overcome the constraints of conventional urban development models and enhance the sustainability and resilience of cities (Patrão, Moura, & de Almeida, 2020). However, in recent years, the topic of smart cities has been widely discussed in the scientific literature (Kasznar et al., 2021; Putra Utama, Akiong Manishe, & Andreswari, 2023) and in international policy (National Institute of Standards and Technology, 2018; Patrão et al., 2020). However, there are three main barriers that stand in the way of deploying robust and effective smart city solutions (National Institute of Standards and Technology, 2018).

Most publications look at smart cities from a technological innovation perspective, while others look at them from a social innovation perspective (Patrão et al., 2020). Recent literature on smart city infrastructure shows that digitalization and technology-especially the Internet of Things (IoT) are essential to optimize their ability to address various problems faced in urban areas and provide technical and social solutions (Fadli & Sumitra, 2019; Kasznar et al., 2021). Several studies used fuzzy methods, social media analysis, frameworks (Achmad, Nugroho, Djunaedi, & Widyawan, 2018; Fadli & Sumitra, 2019), e-readiness approaches (Anggraini & Iqbal, 2020), and discussions on implementation to assess the readiness of smart city programs.

Hardware, software, data and storage, networking, and security are some of the technologies that cities need today, so technological infrastructure is considered the core of the organization (Asniati, Ali, Djunid, & Novandri, 2019). It is possible to say that the most fundamental component of a smart city is infrastructure. According to (Anggraini & Iqbal, 2020), information technology infrastructure (ICT) consists of software, hardware, communication technology, data, and applications, as well as humans as supporters. ICT is also defined as an infrastructure that supports technology resource centers with human components, namely specialized expertise, commitment, values, norms, and knowledge, to provide reliable services. In addition, utilizing and updating resilient infrastructure can help governments build smart cities that improve equality, education,

health, and quality of life for everyone (Kasznar et al., 2021).

Several major cities in Indonesia, such as Jakarta, Bandung, Yogyakarta, Denpasar, Surabaya, and Yogyakarta, are starting to implement the smart city concept (Eniyati et al., 2017; Firmansyah, 2019). Karawang City, which is part of West Java Province, is also striving to become a smart city by utilizing advances in information technology (ICT) to support its vision and mission. Tourism, marine, fisheries, agriculture and industry are the main sectors targeted in the vision and mission of the Karawang City Government. The geographical condition of Karawang City, which mostly consists of the northern coastal plain composed of marine sedimentary rock deposits and volcanic alluvium, supports the four potentials it offers. Geographically, climatically and culturally, the southern region is more similar to Jonggol, Bogor, but in the north there are cool hills with Mount Sanggabuana ( $\pm 1,291$  meters above sea level), which is an overflow from Jonggol District.

Mentioned in (Fadli & Sumitra, 2019) that the digital transformation of smart cities supported by good information technology management has the ability to change the way public policies organize urban planning, so that the bureaucratic system becomes easier and more efficient. This requires continuous planning, resource allocation, supervision and control (Kasznar et al., 2021). Therefore, to improve public services, especially in urban areas, the central and local governments should give full attention to the development of smart cities as an innovative and solutive solution to problems. Thus, through collaborative planning and participation, the Karawang City government can incorporate ICT into urban management by using its supporting infrastructure and components in a technology-based smart city governance design (Bouskela, Bassi, Facchina, De Luca, & Casseb, 2016). Integrated and sustainable smart city development is expected to improve the lives of Karawang residents by increasing innovation, competitiveness, and resilience.

This study aims to provide an overview of smart city technology architecture. The research mainly focuses on smart city infrastructure, i.e. the potential and opportunities of currently available information technology. The results can be used as a reference for smart city planning and development projects, particularly with regard to building, managing, maintaining and operating infrastructure. Next, an analysis was conducted of the ICT infrastructure elements used in Karawang City. This analysis was carried out by conducting observations and interviews with people responsible for the field in the Communication and Informatics Office of the Karawang City Government. The results of this analysis are then used as a basis for presenting

recommendations for infrastructure technologies that are possible and feasible to implement to advance the development of Smart City Karawang City in the future.

## 2. METHOD

This research was carried out using a descriptive method that aims to provide a clear and detailed description of the problem under study. This method is combined with a qualitative approach that allows researchers to explore and understand phenomena that occur in depth, focusing on a particular context (Thabroni, 2022). This type of research seeks to describe the problem at hand by collecting and analyzing data objectively, in order to obtain a comprehensive understanding of the research subject. The data used in this research is divided into two types, namely primary data and secondary data. Primary data was obtained through direct observation in the field and semi-structured interviews with parties who play an important role in the management of information and communication technology (ICT) infrastructure, such as leaders and network managers at the Karawang City Government Communication and Informatics Office. These interviews were designed to obtain in-depth information on the current state of the infrastructure, challenges faced, and strategies used in the development of smart city (Wahyuni et al., 2023).

In addition, secondary data was collected from various relevant sources, such as literature studies, previous planning documents, study reports, and other written sources related to ICT and smart city development in Karawang. This data serves as supporting material that complements the results of observations and interviews.

The data analysis technique in this research was conducted in stages (Anugerah Ayu Sendari, 2019). The first stage was data collection from various sources, both primary and secondary. Next, the researcher identified the main problems found during the research. Based on these problems, the researcher then offered a suitable design or solution for smart city development. The final stage is to provide practical recommendations that can be implemented by the local government to improve the effectiveness of ICT infrastructure and smart city governance in Karawang (Zakariah, Afriani, & KH. M. Zakariah, 2018).

## 3. RESULT AND DISCUSSION

Information and Communication Technology (ICT) enables changes in the intelligence of cities. Through the use of information technology supported by community participation, the government can optimize smart city development

because the high connectivity of mobile devices has become part of the daily life of urban communities. According to (Bouskela et al., 2016), the first step in starting a smart city project is to understand the main components of technological solutions and discover their various potentials.

### Concept of Smart City

Smart cities aim to utilize technological advances to make cities and their inhabitants smarter. Although there is no agreed standard definition for the smart city concept (Patrão et al., 2020), various institutions provide several definitions (Patrão et al., 2020):

1. A smart city is defined as “a place where traditional networks and services are made more efficient by the use of digital and telecommunications technologies for the benefit of its residents and businesses”, according to the European Commission (EC).
2. “Smart cities bring together technology, government, and society where technology is seen as a driver for a better quality of life and environment”, according to IEEE.
3. The UN describes smart cities as “innovative cities that use ICTs and other tools to improve quality of life, efficiency of urban operations and services, and competitiveness, while ensuring that they meet the needs of current and future generations with regard to economic, social, environmental, and cultural aspects”

A high-tech urban area that combines people, data and technology to improve the quality of life and welfare of the community is known as a smart city. According to (Iloke & Okoro, 2018), smart city consists of smart governance, smart economy, smart mobility, smart environment, smart living, and smart people. In addition, Internet of Things, Internet of Data, People, and Internet of Services are the technology and infrastructure components supporting smart cities. Figure 1 shows the overall elements of a smart city.



Figure 1. Key Components of Smart City

The Smart City Commission, CISCO, the European Union, and IEEE have created a framework for smart city development (Fadli & Sumitra, 2019). The focus of the Smart City Framework is to realize standards for the use of smart city technologies that are

easy to operate and environmentally friendly. In addition, a global initiative known as the IoT Enabled Smart City Framework (IES-City Framework) emerged (National Institute of Standards and Technology, 2018). It offers a frame of reference for architecture development, particularly with regard to IoT-enabled smart cities.

To embark on smart city implementation, a city must assess its capacity and potential to better target development priorities. In addition, it is necessary to conduct a city readiness assessment, or a more commonly used term to describe smart city readiness (Fadli & Sumitra, 2019). Some of the key components of smart city preparation include:

1. Interactions, habits and innovations are part of nature.
2. Structure includes capital, management, and people.
3. Social, digital and physical infrastructure.
4. Structure includes organization, institutions, and policies.
5. Resources, life, and ecosystems are components of culture.

### Smart City Technology Architecture

Smart city solutions always require processes, technologies and individuals, regardless of their benefits (Bouskela et al., 2016). In this case, smart city development depends on technology, especially ICT. ICT allows various devices or devices to communicate and share information in an electronic and digital smart city (Iloke & Okoro, 2018). According to (National Institute of Standards and Technology, 2018), the ICT architecture level consists of:

1. Sensor/actuator is a term that refers to physical devices that have sensing, actuation, control, and monitoring capabilities.
2. Data is a set of data that is collected, stored, and analyzed.
3. Applications are the development of intelligent systems that make it possible to monitor, control, make decisions, and predict what will happen.
4. User interface (GUI) is the term for a graphical display that facilitates interaction and use of the system.

Adequate resources and infrastructure are required to support smart city technologies. In other words, ICT infrastructure must be planned, built, and managed in a way that enables the government to ensure the availability of services that meet the needs of urban communities. According to (Fadli & Sumitra, 2019), some of the essential requirements for smart city development include the availability of an urban computer network; the availability of a Network Operations Center (NOC) or Data Center;

and the availability of a City Operations Center (COC) control room integrated with sensors spread throughout the city. However, according to (Bouskela et al., 2016), there are four main elements that make up the smart city technology architecture:

1. To enable data transmission and reception, the communication network infrastructure consists of a broadband internet network, which can be accessed via wired or wireless.
2. Sensors or mobile devices capture environmental changes and transmit them to computers in the city's control center via the network.
3. The unified operation and control center has computers and applications that receive, process, and analyze the data sent by the sensors.
4. Communication interfaces send and receive information from the public and relevant stakeholders. It consists of services, web portals, and mobile applications.

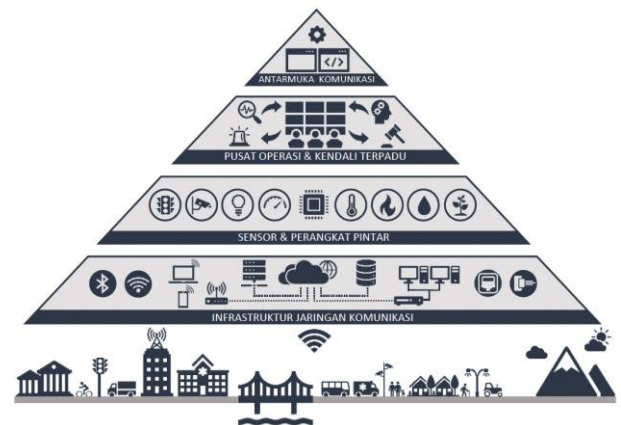


Figure 2. Smart city technology architecture layer

### Smart City Implementation in Karawang City Strategy Smart Governance

Smart governance strategies are grouped into three sub-dimensions, namely strategies related to public services, bureaucratic efficiency, and policies. Strategies in this dimension focus more on public services than on bureaucracy and policy design. The majority of public services are oriented towards convenience, speed and integration. This is evident by the presence of the most strategies in this target.

### Strategy Smart Branding

Smart branding strategies are grouped into three sub-dimensions, namely strategies related to tourism, business competitiveness, and city face. Strategies in this dimension rely on the tourism sector. This is evident in most of the strategies designed to support tourism.

### ***Strategy Smart Economy***

The smart economy strategy is grouped into three sub-dimensions, namely strategies related to the industrial ecosystem, community welfare, and the financial transaction ecosystem. The strategy in this dimension focuses more on community welfare, especially the agricultural sector based on local wisdom. This strategy is very much in line with the condition of Karawang City, which is characterized as a national rice granary producer that mostly still uses the traditions of the local Sundanese community.

### ***Strategy Smart Living***

Smart living strategies are grouped into three sub-dimensions, namely strategies related to spatial harmonization, health, and transportation. Strategies in the dimensions are mostly based on the health sector. This is due to the many activity programs organized by the health department and because of the pandemic in 2020.

### ***Strategy Smart Society***

The smart society strategy is grouped into three sub-dimensions, namely strategies related to communities, learning ecosystems, and public safety. Karawang Regency still has to add strategic targets, especially related to the learning ecosystem. Because this sub-dimension is very important in increasing learning motivation and collaborative concepts.

### ***Strategy Smart Environment***

The smart environment strategy is grouped into three sub-dimensions, namely strategies related to environmental protection, waste and waste management, and energy governance. In this dimension, each sub-dimension has the same proportion of strategies. But there is one strategy that is interesting compared to other cities or regions, namely waste management combined with education and tourism elements.

The applications that have been launched are generally of a service nature, to facilitate the people of Karawang City in accessing and obtaining services that are faster, more efficient, and transparent.

1. Smart Governance: Edukcapil New Generation and Sorabi.
2. Smart Branding: DEWIKa.
3. Smart Economy: Check PBB Karawang and Info Loker Karawang.
4. Smart Living: SijariEmas and Dumas Achievement.
5. Smart Society: Karawang Pintar (Wi-Fi) and Dukcapil Ada Untukmu (DAU).
6. Smart Environment: Waste Bank and Baraya Runtah.

Currently, most community operations and public services in various fields in Karawang City depend on information technology. Therefore, to support the implementation of smart cities, the Karawang City government must have ICT readiness (Anjani, Suprpto, & Herlambang, 2019). In Smart City Readiness (Achmad et al., 2018; National Institute of Standards and Technology, 2018), not only things related to technology, such as hardware and software, but also things related to non-technology, such as brainware. This is reinforced by the statement made by (Anggraini & Iqbal, 2020), which states that human resources are responsible for managing and mobilizing other resources in smart cities. The success of urban transformation is greatly influenced by their skills, knowledge, motivation, and willingness to accept technological change (M. Khairul Anam, Tri Putri Lestari, Latifah, Muhammad Bambang Firdaus, & Sofiansyah Fadli, 2021).

Therefore, the government apparatus must be upgraded to prepare reliable experts to manage and operate smart city infrastructure. On the other hand, citizens should be educated about the digitization of public services to increase their knowledge and confidence. To assess the performance of the smart city program in Karawang City, a smart city assessment tool should be used. This will enable Karawang City to participate in smart city rankings organized by various institutions around the world to attract public attention and encourage healthy competition.

## **4. CONCLUSION**

Although it used to be the granary of West Java, Karawang is now the largest industrial area in Indonesia. The Karawang City Government is looking to enhance the potential and competitiveness of the region through smart city development on six pillars: smart governance, smart branding, smart economy, smart living, smart society, and smart environment. To achieve the overall goal of smart city development, the government must pay attention to managing information technology (ICT) infrastructure using the latest technology. Optimization should include all technical devices and equipment used to ensure city connectivity is available, such as fiber optic devices, network devices, sensors, servers, data centers, and additional hardware and software. The command center, which is responsible for processing city information using various technologies, should improve data integration and collaborate with SOPD and other agencies involved in the smart city development program. In addition, systems and applications are required as communication interfaces for smart city implementation. To support the running of digital services that are interconnected and easy to use, the

government, community, and related stakeholders must work together. Karawang City is expected to realize effective, efficient, communicative, and responsive governance and community services through the utilization of ICT infrastructure in smart city planning and development, accompanied by citizen empowerment.

The Karawang Regency smart city action plan and roadmap are based on the RPJMD vision and mission, smart city vision and mission, and smart city strategic goals. Finally, the action plan and roadmap should enable all targeted smart city initiatives and innovations to be implemented. In addition, due to the highly changing national and global environment, this smart city master plan should be monitored and evaluated regularly. Each OPD can submit proposals to the Smart City Council to enable new innovations or changes to already targeted innovations. The Karawang Regency Government should continue to improve this smart city development plan as this roadmap serves as a cycle of guidelines that can be used to build the best ecosystem for smart city development. In the process of creating a smart city plan, the Karawang district government continues to try to overcome problems that may arise.

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