Towards a Sustainable Future,

K-Smart City

Ministry of Land, Infrastructure and Transport
The Republic of Korea

Korea Research Institute for Human Settlements

Smart City Association

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Towards a Sustainable Future,

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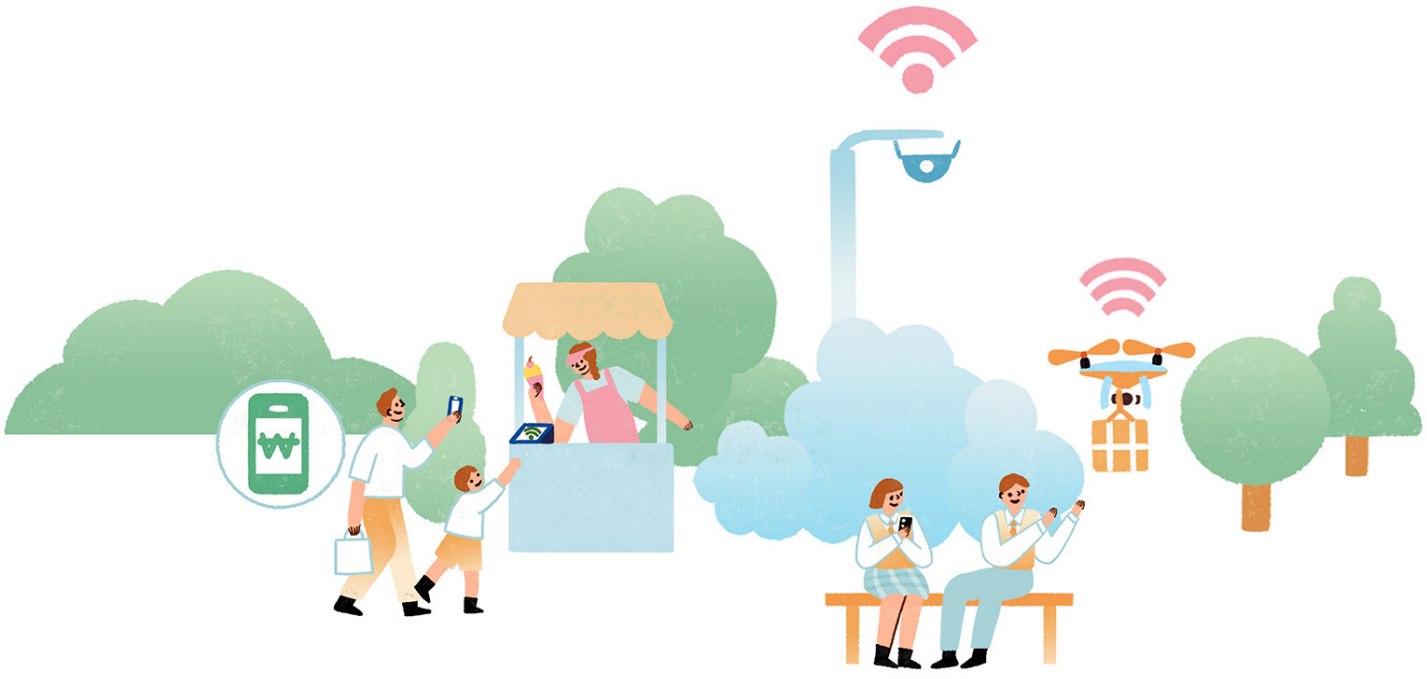
Contents

CHAPTER

1



Smart City Policies in Korea

01 Overview of Smart City Development

Since the early 2000s, South Korea has been a leader in smart city development. This advancement is attributed to the country's strong network infrastructure, innovative technologies from both the private and public sectors, and proactive reforms in its legal system. Korea's smart city solutions, including public transportation, information systems, pedestrian safety measures, and intelligent CCTV networks, have become a model for global benchmarking.

The development of smart cities in Korea can be divided into three key phases:

1. Planning and establishing smart city infrastructure
2. Integrating smart city platforms
3. Expanding smart city solutions to create innovative urban environments

Leveraging its world-class high-speed internet, Korea has established the foundational infrastructure necessary for smart cities, enabling seamless nationwide data collection. Since 2014, the government has prioritized integrating urban data across various sectors, such as transportation, environment, and safety. As part of this initiative, cities across the country have been encouraged cities to adopt smart city integrated platforms nationwide to ensure smooth implementation and promote interoperability and standardization for optimal utilization.

In Korea, the central government creates a Comprehensive Plan for smart cities, while local governments implement regional plans based on this framework. The central government consistently supports local governments in building smart cities by enhancing legal and institutional frameworks and offering grant programs to provide financial assistance to cities with limited budgets. Additionally, a regulatory sandbox system has been in-

	1Phase Construction of U-City('~13)	2Phase System Linkage('14~'17)	3Phase Smart City Development('18~)
Goal	Fostering New Growth in Convergence Innovation of Construction and Information Telecommunication Industry	Low-cost High Efficiency Service	Solve Urban Problems Foster Innovation Ecosystem
Info	Vertical Data Integration	Horizontal Data Integration	Multilateral, Bidirectional
Platform	Closed-type (Silo-type)	Closed-type + Open-type	Closed-type + Open-type (Expansion)
System	U-City Act 1st U-City Comprehensive Plan	U-City Act 2nd U-City Comprehensive Plan	Smart City Act Smart City Development Strategy
Main Body	Federal Government (MOLIT)	Federal Government (Separately) + Local Government (Partially)	Federal Government (Collaboration) + Local Government (Expanded)
Target	New Town (Over 1,650,000㎡)	New Town + Existing Cities (Part)	New Town + Existing Cities (Expanded)
Project	Development of Physical Infrastructure such as Integrated Control Center, Communications Network	Public Integrated Platform and Ensure Compatibility and Standardize	Development of National Pilot Cities Implementation of Various Public Contest Projects

Source: Ministry of Land, Infrastructure and Transport. 2022. p.6

troduced to foster innovative technologies in urban settings by easing regulations for emerging solutions.

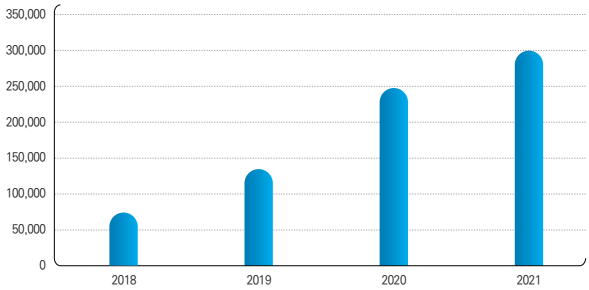
Korea's Comprehensive Plan is updated every five years, with the first plan introduced in 2009. Initially, the first two plans were known as the Ubiquitous City Comprehensive Plan, the brand Korea used before transitioning to the term "smart city."

The vision of the first Comprehensive Plan was to "create an information city that enhances citizens' quality of life and urban competitiveness," reflecting Korea's early emphasis on people-centered cities. The second Comprehensive Plan (2014-2018) aimed to "build a safe, happy, and advanced creative city." During this period, Korea made significant progress in developing smart infrastructure.

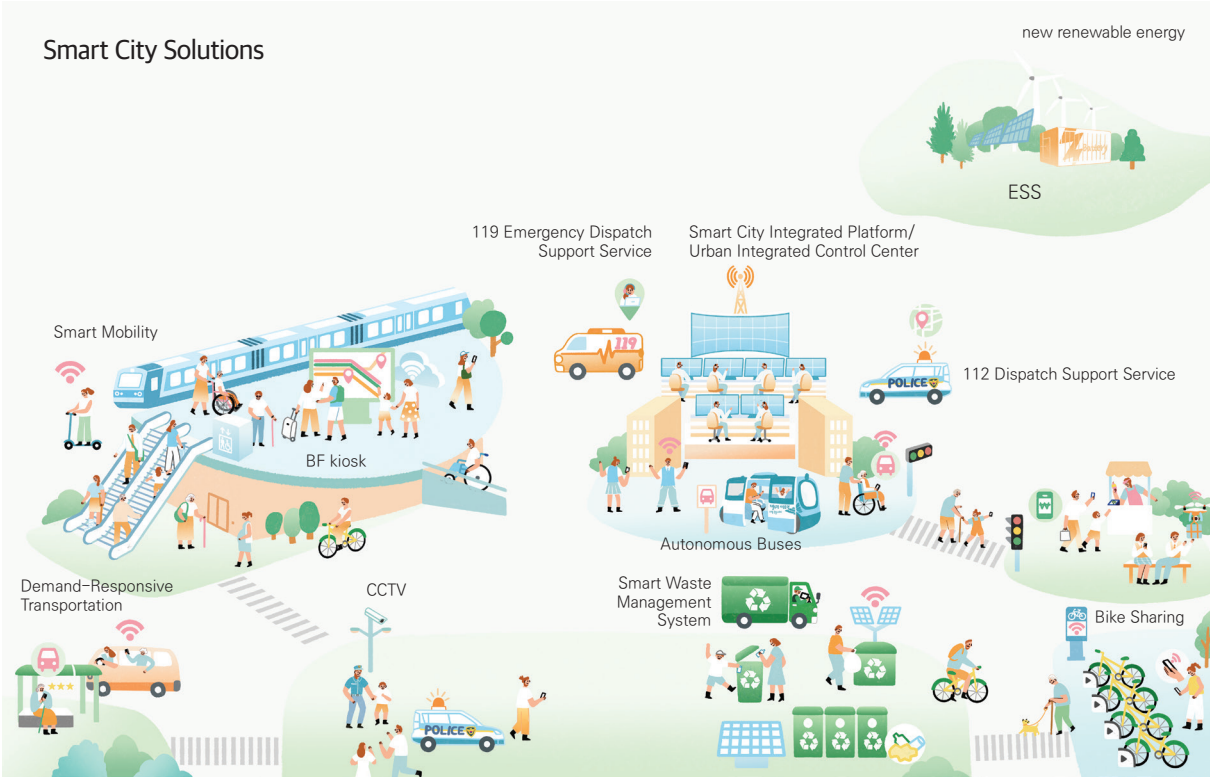
A major shift occurred with the third plan, introduced in 2019 when Korea officially adopted the term "smart city." The third plan (2019-2023) sought to "transform citizens' daily lives through an innovative platform," reflecting Korea's evolving vision of becoming an advanced innovation hub. Under this Plan, Korea has actively promoted the development of smart city solutions using its existing ICT infrastructure. Smart city integrated platforms have been distributed to cities to consolidate various CCTV systems used for traffic management, crime prevention, and environmental monitoring. Additionally, regional smart city operation centers have been established to facilitate coordinated responses among local governments, police, and fire departments. With the implementation of the third comprehensive plan, the central government's budget for smart cities increased nearly 60-fold, rising from approximately 4.5 billion KRW in 2017 to about 290 billion KRW in 2021. During this same period, the number of local governments engaged in smart city projects grew from 50 in 2018 to 150 in 2023, accounting for around 60% of the 243 local governments nationwide. Additionally, over 400 smart city solutions have been developed across more than 60 categories, including administration, transportation, and safety, significantly contributing to the growth of Korea's smart city industry.

Meanwhile, beginning in 2024, the fourth Comprehensive Plan aims to develop a data hub that connects regional smart city platforms and enhances the use of artificial intelligence.

Smart City Budget Trends



Source: National Assembly Budget Office. 2023. Unit: 1,000,000 KRW



	'09~'13	'14~'18	'19~'23
	The 1st Ubiquitous City Comprehensive Plan	The 2nd Ubiquitous City Comprehensive Plan	The 3rd Smart City Comprehensive Plan
Vision and Goals	**Realization of a high-tech information city that improves the quality of life of citizens and urban competitiveness** • Efficiency of urban management • Nurturing as a new growth engine • Advancement of city services	**Safe & Happy Realization of a high-tech creative city** • U-City Expansion • Revitalization of the Creative Economy U-City Industry • Strengthening support for entering overseas markets	**Changing the daily lives of citizens Smart City, a Platform for Innovation** • Solving various urban problems • Creating an Inclusive Smart City • Strengthening global cooperation through the establishment of an innovation ecosystem
Strategies	• Establishment of institutional foundation • Core Technology Development • Support for U-City Industry Promotion • Creation of U-service for the people	• Establishment of a public safety net for the realization of a safe city • Expansion of U-City and development of related technologies • Support for private companies for the realization of creative economy industries • Strengthening support for entering overseas markets through international cooperation	• Create a customized model for each stage of growth • Establishment of a foundation for the spread of smart cities • Creation of a Smart City Innovation Ecosystem • Strengthening global initiatives 
Key Result	• Establishment of infrastructure such as integrated operation center and private network • Establishment of institutional foundations such as completion of relevant guidelines • Integrated Platform Development • Convergence Human Resource Development	• Establishment and expansion of an integrated platform and 5 linked service-centered national safety nets • Securing governance among public institutions 	• Intro. of bottom-up demonstration projects for new cities and existing cities • Expanding citizen and private enterprise involvement • Laying the foundation for urban information utilization such as data hub development • Introduction of innovative systems such as regulatory sandboxes • Expanding Overseas Cooperation

Source: Ministry of Land, Infrastructure and Transport

02 Smart City Policies and Projects

During the third Comprehensive Plan era, Korea implemented significant reforms to its legal systems, including the enactment of the Smart City Act. The government also initiated various smart city projects, such as the National Pilot City Projects, Smart City Challenge Projects, and Data Hub Projects.

National Pilot City Project: Building a City from Scratch

The National Pilot City Project extends from the new town development initiatives that began with Ubiquitous Cities. While Ubiquitous Cities primarily focused on establishing information and communication infrastructure and CCTV systems, the National Pilot City aimed to create hubs for cutting-edge infrastructure and innovative industries.

In January 2018, the Korea's Smart City Special Committee selected Sejong 5-1 Living Zone and Busan Eco-Delta City as the sites for national pilot cities. These projects involve collaboration between private firms, experts, and central and local governments, which formed a special purpose corporation (SPC) to oversee the initiatives. Special provisions were added to the Smart City Act to ensure the SPC could build and operate advanced services like drones and self-driving cars.

The National Pilot City is undergoing rapid transformation into a center for innovative technology. A master plan has been established, and in Busan, a smart village with 56 households has been constructed as part of the pilot project. This village serves as a testing ground for cutting-edge technologies.

Smart Challenge, Projects for Existing Cities

Korea's smart city development has shifted focus towards finding innovative solutions to urban challenges. Recognizing the limitations of previous top-down approaches, the Smart City Challenge promotes collaboration between local governments and private companies to identify and solve urban issues.

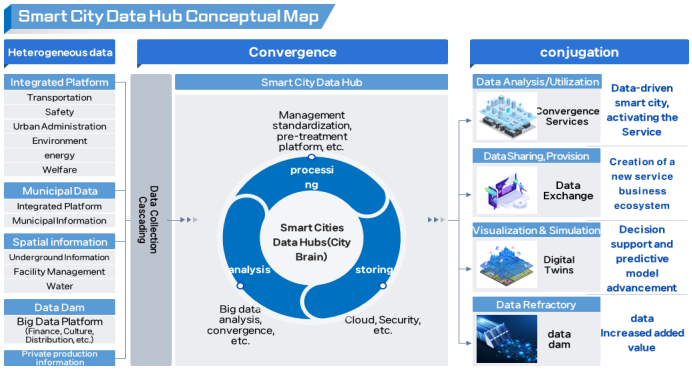
A key example of this approach is inspired by the Smart City Challenge in the United States, where local governments partner with the private sector to develop creative solutions. Additionally, Korea's Smart City Challenge emphasizes collaboration and local insights, seeking to improve citizens' quality of life by addressing practical urban problems beyond technological advancements.

Data Hub Project: Driving Smart City Innovation Engine R&D

The Smart City Innovation Growth Engine R&D aims to build data-driven city models for urban digital transformation. The project consists of three main projects with 13 sub-projects.

1. Developing Core Technologies: This project focuses on developing essential technologies such as a data hub model, Massive IoT, and digital twins.
2. City-Level Problem Solving: Daegu City was selected as the testbed for improving traffic safety using big data and artificial intelligence (AI).
3. Addressing Environmental, Energy, and Healthcare issues: Siheung City was chosen to explore solutions based on Living Labs and data analytics.

This extensive R&D effort, which ran from 2018 to 2022, had a total investment of 130 billion KRW (with 84.3 billion KRW from national funds) and involved about 150 research institutions and 1,200 researchers.



Smart Challenge Initiatives: Transforming Cities and Driving Expansion Efforts

The Smart City Challenge project in Korea is divided into two phases: Phase 1 preliminary project and Phase 2 main project. In the first stage of the preliminary project, each local government partners with companies to submit a solution plan aimed at addressing urban problems. The selection of local governments for the preliminary projects is done through written and presentation evaluations. At this stage, each selected local government receives 1.5 billion won in government funding.

In the second stage of the main project, proven solutions and services will be evaluated based on the results of the preliminary project. The aim is to implement these solutions and services in other areas of the city. Three local governments that performed exceptionally well in the preliminary project will be chosen. Each local government will receive 10 billion won in government funding for the three-year main project. Furthermore, local governments and companies will also contribute more than 10 billion won each, resulting in a total budget of over 20 billion won for each local government.

The Smart City Challenge project was a success, leading to the inclusion of various smart city projects. This initiative also gave rise to the Town Challenge Project, which focuses on small and medium-sized cities, and the Campus Challenge Project, tailored for universities. These diverse projects aim to develop and promote smart solutions suited to their unique characteristics.

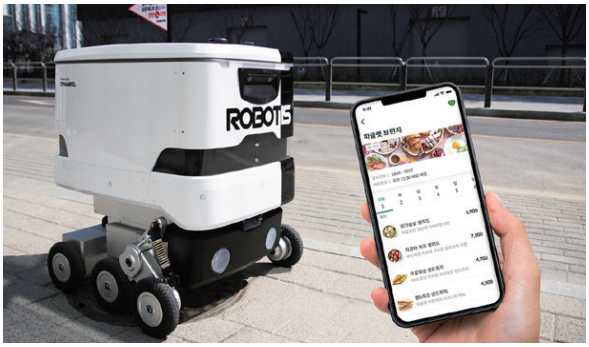
In 2022, the Smart (City) Challenge project transformed into a smart city creation and expansion initiative. Unlike the previous project, the new one skips the preliminary stage. Under this new initiative, two locations are chosen for smart city projects, and the government provides 20 billion won in funding. The local government matches this amount, resulting in a total budget of over 40 billion won for the three-year project.

The small-scale smart city project was created to address the climate crisis, a major global issue, and to combat regional extinction, which is a national problem in Korea. These changes signify a shift towards enhancing the efficiency of smart city projects and making more targeted efforts to tackle important social and environmental issues.

	Creating a Hub	Small-Medium Sized Smart City	Spread of Smart City Solutions
Objectives	Creating a smart city hub that can derive regional competitiveness and the spread of smart cities	Creating a leading city with specialized solutions to ensure the ability to respond to changes such as climate crisis and regional extinction.	Enhance the national perception of smart cities by implementing effective distribution solutions in a packaged format nationwide.
Applicant	Local government-led (Joint application possible with companies, universities, etc)	Local government-led (Joint application possible with companies, universities, etc)	Local government application only
Project Target	Special City, Metropolitan City, Special Autonomous City, Province, City, County	Cities/counties/districts with less than one million population	Cities/counties/districts with a population of 300,000 or less
Number of Places	Ulsan, Goyang	Mokpo, Pyeongtaek, Taean, Asan	Pocheon, Yangpyeong, Jeongseon, Jecheon, Jeupyeong, Dangjin, Buyeo, Yeongam, Muan, Uiseong
Project Period	3 years(2023~2025)	2 years(2023~2024)	1 year
Project Budget	40 billion (national budget 20 billion/ local budget 20 billion)	24 billion (national budget 12 billion/ local budget 12 billion)	4 billion (national budget 2 billion/ local budget 2 billion)

Source: Ministry of Land, Infrastructure and Transport 2023

Fostering an Innovative Smart City Ecosystem and a Regulatory Sandbox



Startup and Matchup

The Korean government is making significant efforts to create an innovative ecosystem to revitalize smart city industries. One of the main strategies is supporting smart city startups through programs such as establishing an online solution marketplace to facilitate connections between local governments and companies. The government is also improving procurement practices to make it easier for innovative solutions to enter the market. In addition, the creation of a local government council and a smart city alliance promotes collaboration between the central government, local governments, and businesses. These efforts have promoted smart city innovation and industrial growth.

Regulatory Sandbox

Among the various policies fostering smart city innovative ecosystems, the introduction of a regulatory sandbox is one of the most impactful. In Korea, regulatory constraints often hinder new projects or lack sufficient institutional support. The regulatory sandbox was introduced to address these challenges.

Launched in February 2020, the smart city regulatory sandbox is designed to accelerate innovation by providing a flexible regulatory environment for high-tech industries and smart cities. Managed by several government ministries-including the Ministry of Land, Infrastructure, and Transport (MOLIT), the Ministry of Science and ICT, the Ministry of Trade, Industry and Energy, the Ministry of SMEs and Startups, and the Financial Services Commission- the regulatory sandbox supports the testing of emerging solutions through three special provisions:

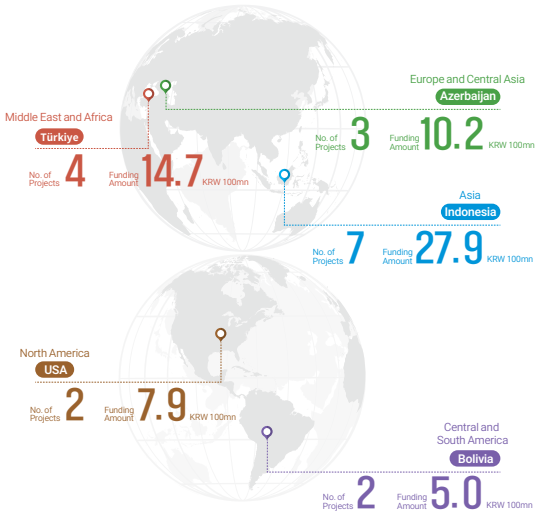
1. **Expedited Confirmation**: Companies receive a response within 30 days about whether regulations exist or if specific permissions are required for new technologies or businesses.
2. **Temporary Permission**: If a product is proven safe and innovative but cannot enter the market due to unclear regulations, the sandbox grants temporary permission for it to be launched.
3. **Law Exemption**: For services blocked by restrictive laws, the sandbox allows legal exemptions for a specified period, facilitating testing and development.

The regulatory sandbox applies for up to four years, with a possible extension of two additional years. Currently, 51 regulatory sandboxes are in progress within MOLIT's smart city sector, covering solutions like intelligent robot crime prevention, demand-responsive buses, and transportation analysis.

Building a Global Network and Strengthening International Cooperation

Korea has been actively exporting its smart city solutions worldwide. The K-City Network (KCN) Global Cooperation Program supports the government in establishing a smart city master plan or feasibility study necessary for the construction of smart cities in overseas cities based on cooperation, or supports the pilot construction of smart services necessary to solve urban problems, and operates a capacity building program together. Since its inception in 2020, KCN has grown into a global cooperation program that drives the sustainable growth of cities in each country by establishing partnerships with 26 countries by 2024.

Additionally, MOLIT hosts the World Smart City Expo (WSCE), the largest smart city event in the Asia Pacific region, attracting experts from governments, businesses, and academia worldwide. Held annually since 2017 during the first week of September, the expo serves as a platform for sharing smart city policies, projects, and technologies through conferences, exhibitions, and networking opportunities. It fosters global collaboration by allowing stakeholders to discuss sustainable urban development and innovative solutions. The WSCE has become a key venue for shaping the future of smart cities and advancing the global.



Most cooperative countries, number of cooperation cases, and amount of support by region.

Projects of KCN Global Cooperation Program

Year	Project
'20 (12)	Smart City Project for **Indonesian** New Capital City (Basic Plan Development)
	Development Project of priority development zone in **Dala New Town, Myanmar** (Feasibility Study Development)
	Kota Kinabalu Malaysia Smart City Project (Master Plan Development)
	Smart City Development Project for **Astete Airport Area, Peru** (Master Plan Development)
	Russia Bolshoy Kamen Smart City Concept on the Example
	Vietnam Mekong Delta Smart City Pilot Program Pre-Feasibility Study
	Colombia Bogota Establishment of Expressway Traffic Control Center Master Plan
	Thailand Khon Kaen Smart Mobility Master Plan
	Mongolia Ulanbaatar Smart Mobility Platform Pre-Feasibility Study
	Türkiye Gaziantep Smart City Integrated Platform Demonstration
	Laos Vientiane Drainage System Improvement Master Plan
	Türkiye Ankara Disaster Prevention and Coordination System
'21 (11)	Feasibility Study of **Clark Smart City Philippines** Development Project
	Establishment of Basic Plan and Feasibility Study for Sustainable Smart Public Official Housing in **Indonesia New Capital City**
	Master planning and Pre-feasibility Study for Smart City in Southern **Tashkent Uzbekistan**
	Kenya Nairobi Railway City for Smart City Development Proposal and Feasibility Study
	Vietnam Hai Phong Master Plan for Construction Traffic Management System
	Bolivia Santa Cruz Master Plan for Smart Waste Collection and Waste to Energy
	Azerbaijan Baku Master Plan for Smart City Platform Establishment
	Bulgaria Kazanlak Master Plan and Feasibility Study on Integrated Monitoring and Control Center
	Turkiye Gaziantep Smart City Integrated Platform Demonstration Project
	USA Baltimore Waste Management Smart City Solution Demonstration Project
	Spain Santander Smart City Integrated Platform Demonstration Project
'22 (10)	Basic Plan and Pre-Feasibility Study for **Issyk-Kul** Smart City in **Kyrgyzstan**
	Mongolia New Zuunmod Smart City Development Project
	Master planing and Pre-Feasibility Study for the Regeneration of **Klang Malaysia** into a Smart Heritage City
	Bangladesh Khulna Smart City Basic Plan
	Azerbaijan Zangilan Smart City Basic Plan
	Indonesia Jakarta Preliminary Feasibility Study on Digital Twin and 3D Land Ownership Register
	Vietnam Ho Chi Minh Master Plan for Smart Transportation System Considering Construction of MRT line 1, 2, 5
	Bolivia Warnes Plan and Preliminary Feasibility Study on Hydrogen Mobility and Carbon Credit
	Thailand Mukdahan Hybrid Drone Base Smart City Integrated Platform Demonstration Project
	Indonesia Madiun Smart Street Lighting Demonstration Project
'23 (8)	**Ukrane Uman** Smart City Master Plan
	Smart City Master Plan for **Badr, Egypt**
	Urban Data Platform Master Plan for **Karabakh Economic Region, Azerbaijan**
	Feasibility Study for Smart City Integrated Command Control Center in **IKN, Indonesia**
	Indonesia Banyumas Smart City Integrated Platform Service Demonstration Project
	Bangladesh Rangpur Integrated Smart City Platform Demonstration Project
	Türkiye Sakarya Integrating High-Sensitivity Sensors and Machine Learning for Advanced Slope Failure Prediction Solution Demonstration Project
	Vietnam Haiphong Artificial Intelligence Traffic Counting and Risk Recognition Alert Smart Solution Demonstration Project
'24 (8)	**Ha Nam Red River Area** Smart City Development Plan, **Vietnam**
	Design-level Diagnosis for SSAC Digital Transformation(DX) Plan, **Kuwait**
	Italy Verona ITS Road Traffic Supervision System Demonstration Project
	Vietnam Hue 3D Digital Transformation for Underground Spaces Using Smart Pin Solution Demonstration Project
	Indonesia Jakarta Digital Twin-based Smart City 3D Space Rights Solution Demonstration Project
	Philippines Puerto Princesa Smart Disaster/Safety Management Service Demonstration Project
	U.S.A New Jersey AI-Audio based Road Hazard Information System Demonstration Project
	Cambodia Siem Reap Base Smart Mobility Sharing Service Demonstration Project

03 The 4th Smart City Comprehensive Plan and the Future of Korean Smart Cities

Korea continues to push toward its smart city initiatives. In 2024, the government introduced the 4th Smart City Comprehensive Plan (2024-2029), envisioning cities that enhance connections between places and people. This plan emphasizes the active participation of local governments in addressing global challenges such as achieving carbon neutrality, responding to the climate crisis, and promoting digital inclusivity.

The plan also focuses on addressing regional issues, including population decline, aging communities, and the risk of disappearing local neighborhoods. Korea aligns its strategy with the United Nations' global agenda on people-centered smart cities.

One of the key strategies of the 4th Comprehensive Plan is the establishment of a Smart City AI Data Hub, which will integrate and analyze data from various urban management systems to help predict and solve urban challenges. The strategy also incorporates AI and digital twin technology to improve the use of urban data. Moreover, it aims to expand existing data hubs and develop new AI-based solutions to enhance connectivity across different administrative regions.

National Smart City Vision and Strategy (2024~2028)

Vision

Smart Cities that connect people and places to promote sustainable growth

Objectives

- **Cutting-edge digital space** where everyone can access anytime, anywhere
- **Innovation space** led by the private sector and supported by the public sector
- **Smart space** that serves as a model for the world

Strategies

Sustainable & Inclusive Cities	Urban infrastructure based on AI and data	Private sector-friendly industrial ecosystem	International Cooperation
Actions			
1 Platform City implementation	1 Environment for promotion of Data Hubs	1 Revitalization of specialized tech-based urban complexes	1 Strengthening international cooperation network
2 Responding to the climate crisis and enhancing digital inclusion	2 AI-based Data Hub advancement	2 Strengthening governance and regulatory innovation	2 Global expansion of K-Smart Cities
3 Provision of smart solutions for each region	3 Smart cities based on Digital Twin technology	3 Private sector-led industrial ecosystem	
4 Completion of the national pilot city projects		4 Support for smart city-related industries	

Source: Ministry of Land, Infrastructure and Transport. 2024b. p.11

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CHAPTER

2

Seoul

01 Seoul: A Representative Smart City

Seoul, the capital of South Korea, is the nation's hub for politics, economy, society, and culture. It is the largest city in Korea, with a population of about 9 million spread over 605 square kilometers. Including the greater metropolitan area, the population reaches about 26 million.

Seoul's population first surpassed 1 million in 1942 and then 10 million in 1990, leading to a variety of urban challenges. These include traffic congestion, population decline in the downtown area, overcrowding in densely populated regions, low birth rates, and an aging population. Meanwhile, there are different urban problems in Seoul, such as overcrowding in some areas, rising real estate prices, and population decline in others.

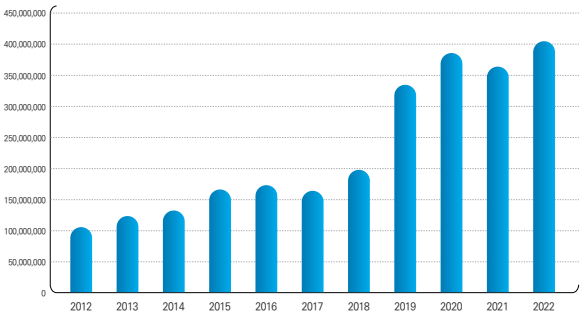
Historically, Seoul has solved urban problems in the same way by building houses like high-rise apartments and expanding roads. However, since the early 2000s, with advancements in information and communication technology (ICT), the city has shifted its focus towards solving urban challenges through digitalization.

Seoul aims to become a leading smart city under the vision of a "Future Smart Standard City Leading Digitization." The city is pursuing six core values and has developed nine major strategies outlined in its "Smart Seoul Vision Framework."

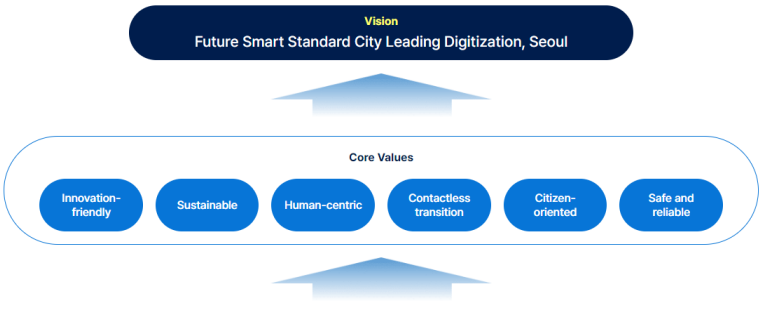
Each year, Seoul allocates approximately 1% of its budget to smart city projects annually. In 2012, it invested 100 million USD (around 0.57% of the total budget of 16.6 billion USD) in Smart Seoul initiatives. By 2022, this amount had quadrupled, representing 1.2% of the city's total budget.

As of 2023, Seoul ranked 4th globally in smart city rankings (according to Juniper Research) and 16th in the International Institute for Management Development (IMD)'s Smart City Index Report. These rankings position Seoul as Korea's leading smart city and reinforce its status as the top city in Korea for smart city development.

Smart Seoul Budget



Source: Seoul Metropolitan Government. 2022. p.3 tabulated (Unit: USD)



Promotional strategies	9strategic tasks
Creation of the foundation for innovative future smart city	• Expanding the world's best smart city infrastructure • Acceleration of digital-based administrative innovation • Creating an open big data city
Implementation of people-centered smart city	• Expanding digitally-mediated services • Achieving a smart inclusive city • Achieving a cyber-safe city
Providing citizen-friendly city services	• Establishing a smart mobility base • Provision of safe city services • Supporting revitalization of digital economy

Smart Seoul Vision and Strategies[1)]

02 Urban Digital transformation and Smart City Infrastructure

Smart cities address urban issues through digital transformation and the integration of ICT, focusing on the development of both physical and virtual infrastructure. Seoul is at the forefront of this movement, actively promoting the deployment of smart city infrastructure. The city aimed to install 50,000 IoT sensors to collect data on urban phenomena and citizen behavior, which would then be analyzed using AI to solve a variety of urban issues.

Seoul has created an ecosystem that enables citizens to play a role in developing essential services by accessing public data. Key components of this smart city infrastructure include:

- S-Net: The core information and communication infrastructure
- S-Dot: A network of city data sensors
- S-Data: A platform for big data integration
- S-Security: The Seoul Safety Center
- S-Map: A 3D virtual model of the city
- S-Brain: An AI-based chatbot

In addition, Seoul is implementing projects such as establishing an open big data city, integrating transportation big data through the T-data.seoul.go.kr portal, and enhancing the Seoul Tourism Knowledge Information System to enable big data-driven analysis and service delivery. These efforts aim to improve urban living standards and further Seoul's status as a leading smart city.

S-Net: The Backbone of Smart Seoul

The most crucial component of any smart city is its IT infrastructure, which enables efficient and convenient city operations. Network infrastructure is especially vital in this regard. In 2003, Seoul established the world's first high-speed local government communication network along subway lines, expanding its administrative information distribution system, which led to more transparent and efficient public services.

As smart city services expanded, so did the demand for communication infrastructure. To address this, Seoul connected various institutions' communication networks, reducing the need for overlapping construction and lowering the cost of leasing lines from telecommunications companies. This initiative resulted in the creation of the Smart Seoul Network, or S-Net.

In 2003, Seoul introduced e-Seoul Net, a first-generation local government communication network that connected the city hall and the 25 districts of Seoul. By 2013, this network had been upgraded to u-Seoul Net, a second-generation system that extended to community centers.

Thanks to these advancements, Seoul ranked first in the e-government evaluation of the world's top 100 cities for seven consecutive years and saved approximately 173.5 billion KRW in communication costs compared to leased networks.

As mobile device usage and wireless data traffic have surged, communication services have become an essential public utility. To address this growing need, Seoul provides free public Wi-Fi in major streets, traditional markets, public squares, parks, welfare facilities, public buildings, buses, and bus stops. The city has installed 21,426 public Wi-Fi access points (APs) across Seoul, offering free internet at more than 12,000 locations to reduce communication costs and bridge the digital divide across regions and income levels.

Digital Infrastructure in Seoul

Digital Twin S-Map[2)]

Open Data & Big Data Campus: Empowering Smart City Innovation in Seoul

Seoul has made significant strides in leveraging public data to enhance transparency, citizen participation, and urban problem-solving. Initially, public data on transportation, environment, culture, and tourism were only accessible through requests, limiting widespread use by the general public, companies, and researchers. A notable example is from 2009 when a high school student developed a real-time bus information app but faced challenges due to restricted access to the city's data. This sparked public debates, and dissatisfaction grew, highlighting the need to make public data more accessible.

In response, Seoul launched its Open Data initiative, allowing citizens, businesses, and organizations to utilize public data freely. The platform offers data in formats like Open APIs, charts, graphs, and Excel files, facilitating the creation of services, apps, and visualizations. By January 2023, over 7,392 datasets were available through the platform, leading to over 17.5 billion views of this data. This openness has spurred the development of more than 150 app services and 70 infographics, empowering citizens to play an active role in service creation and content development.

Big Data Campus: A Hub for Urban Analytics

Seoul further supports urban problem-solving through its Big Data Campus, which provides a space for the analysis of a wide array of datasets from both the public and private sectors. This initiative allows for the integration of de-identified data across over 4,100 datasets, including 42 types of big data (e.g., credit card transactions and public transport statistics) and 473 types of geographic information.

Since its inception, the Big Data Campus has facilitated more than 350 data analyses across key areas like education, health, transportation, and safety. Analyses of data on credit card sales patterns, optimal business locations, and fine dust levels have helped identify trends and address urban challenges such as gentrification and environmental issues. By fostering collaboration between the public and private sectors, Seoul can find more efficient and effective solutions to its urban challenges.

Digital Twin S-Map: A 3D Model for Smarter Urban Management

Seoul's Digital Twin S-Map is a platform combining digital twin technology, IoT sensors, and big data analytics to offer a comprehensive 3D visualization of the city. This real-time digital model integrates spatial and temporal data, enabling the city to address complex urban challenges more effectively.

The S-Map plays a crucial role in city operation by simulating natural disasters to minimize damage, optimizing traffic flow using real-time data, and improving citizens' living conditions by analyzing environmental factors such as noise and air quality. It provides city planners and administrators with a cutting-edge tool for proactive decision-making, helping to drive administrative innovation and create a more livable urban environment.

Metaverse Seoul: A Virtual Innovation Hub

Metaverse Seoul project is a groundbreaking initiative that uses extended reality (XR) metaverse technology to create an immersive virtual city, allowing citizens to access a variety of administrative services and other conveniences in a virtual space. This digital platform enhances citizen participation and communication, making government services more accessible. In 2022, TIME magazine recognized Metaverse Seoul as one of the best inventions.

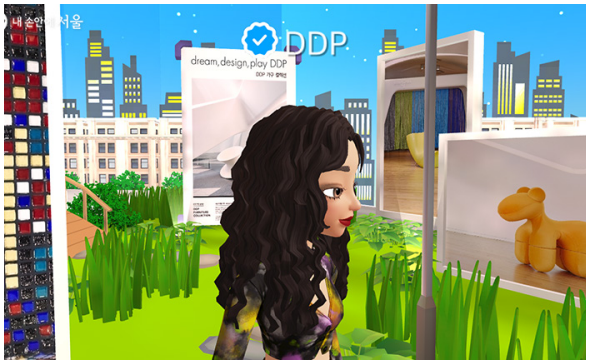
Through the Open Data initiative, Big Data Campus, Digital Twin S-Map, and Metaverse Seoul, Seoul has positioned itself as a global leader in smart city innovation, continuously enhancing urban life and addressing both present and future challenges.

Metaverse Seoul

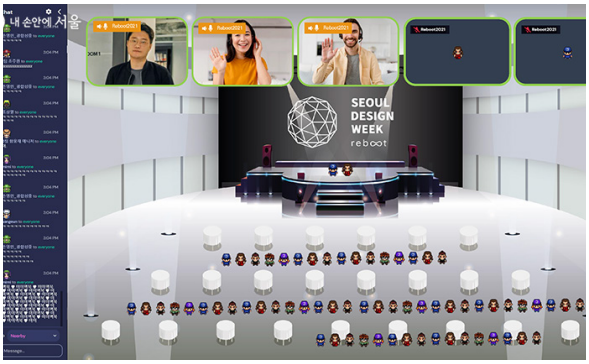
Source: Seoul Metropolitan Government. 2022b. p.138

Digital Twin S-Map

Source: Seoul Metropolitan Government. 2022b. p.190



DDP in Metaverse Seoul[3)]



Gather Town in Metaverse Seoul

03 Smart City Solutions to Solve Urban Challenges

Smart Mobility: Transforming Transportation in Seoul

The smart mobility sector is one of the most advanced areas in Seoul's smart city initiatives. Seoul initially addressed traffic congestion by expanding infrastructures, but as it became increasingly difficult to build new roads, the city shifted its focus to a smart transportation system, including the development of an Intelligent Transportation System (ITS) in 2000. In 2004, Seoul introduced an integrated transfer discount system, encouraging the use of public transportation by offering discounted fares when transferring between buses and subways. Additionally, the city operates TOPIS (Transport Orientation & Information Service), a comprehensive traffic control center that utilizes CCTV. It also participates in the personal mobility sector through shared bicycle services such as Ttareungi.

TOPIS, Comprehensive Traffic Control Center

TOPIS collects and analyzes public transportation information from various agencies, including Seoul Traffic Broadcasting, the Seoul Metropolitan Police Agency, and the Korea Expressway Corporation through transportation cards and CCTV. With this collected information, TOPIS monitors bus operations, public transportation usage, traffic density, speed, accidents, protest situations, highway conditions, and personal traffic to reduce congestion and respond to traffic incidents in real-time.

Ttareungi, the Shared Bicycle

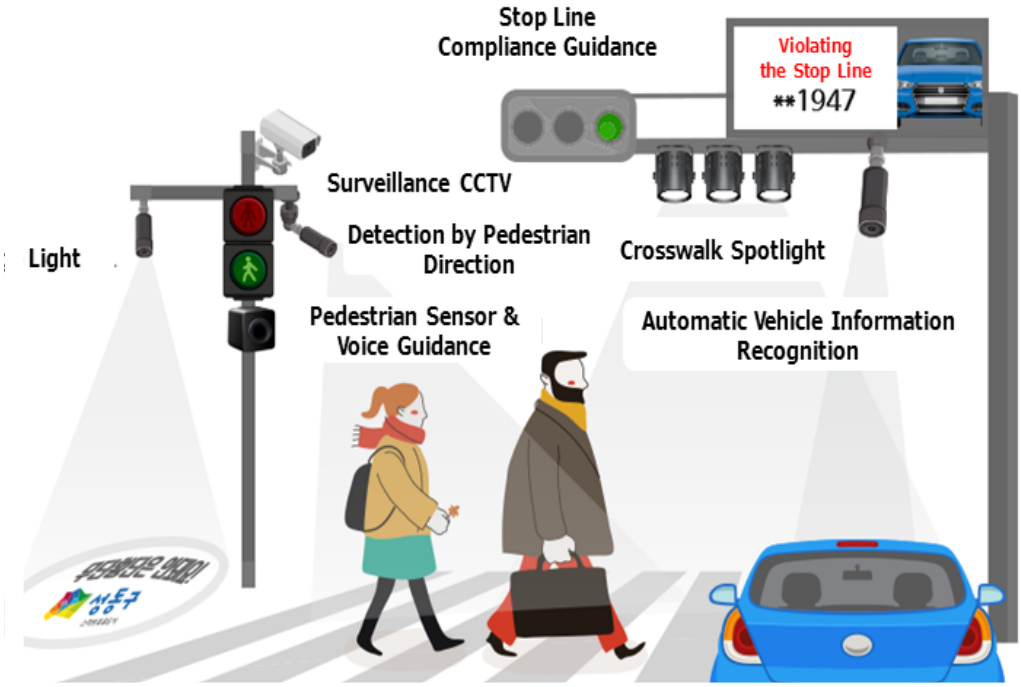
Since its launch in 2015, Ttareungi has helped transform Seoul into a bicycle-friendly city, promoting health, cleanliness, and green growth. The service allows users to rent and return bicycles 24/7 via a smartphone app at unmanned stations throughout the city. Using big data analysis, rental stations, and bicycle racks have been strategically placed in high-demand areas, such as densely populated regions and near public transit hubs. Currently, 25,000 bicycles are available at 1,540 stations spaced approximately 500 meters apart in Seoul. In 2020, the QR-type "New Ttareungi" was introduced, featuring a smart lock system with a QR terminal that utilizes IoT technology to improve user convenience. By 2022, the Ttareungi service has gained 410,000 members and logged 40 million rides.

QR type new Ttareungi[4)]

Late-night self-driving Buses and Autonomous Vehicles

Seoul introduced the world's first late-night self-driving bus, connecting the sub-center and the city center. Starting in 2023, the bus, with route number Late Night A21, operates along a 9.8 kilometer section of the central bus lane between Hapjeong Station and Dongdaemun Station. This route includes university districts and large shopping malls. Seoul also conducts autonomous driving demonstration services in the known areas of Sangam, Yeouido, and Cheonggyecheon.

Autonomous Bus[5)]



Smart crosswalk service concept diagram[6]

Smart Safety

Seoul CCTV Safety Center

CCTV-based control centers for urban safety are widely implemented smart city solutions in South Korea. Seoul has 25 districts, each equipped with an integrated operation center and a smart city integrated platform. As of 2023, the city operates 176,371 CCTV cameras for various purposes, including crime prevention, child protection, city park security, waste management, traffic enforcement, and traffic information collection and analysis.

To integrate video data from different agencies, Seoul established the Seoul Safety Center, which serves as a hub for various smart city services and devices, including public Wi-Fi and IoT sensors. This initiative strengthens the role of the Seoul government as a wide-area CCTV integrated control tower. By centralizing the management of CCTVs at the integrated control center, the city has achieved shared equipment utilization, increased

Late night self-driving bus[7]

Smart crosswalk spotlight[8]

operational efficiency, reduced maintenance and management costs, and prevented duplicate investments by different departments. Furthermore, Seoul is actively promoting the introduction of an intelligent screening control system to enhance monitoring efficiency by applying AI video analysis technology to CCTV, addressing the challenge of insufficient monitoring personnel.

Smart Crosswalk

To reduce pedestrian fatalities from traffic accidents occurring at crosswalks, Seoul introduced a smart crosswalk, which integrates several features to enhance safety. These include voice guidance, LED-embedded floor traffic lights, jaywalking prevention announcements, and high-intensity lighting. These innovations aim to reduce accidents and prioritize pedestrian safety.

Smart Green City

Tackling Waste Issues with Smart City Technology

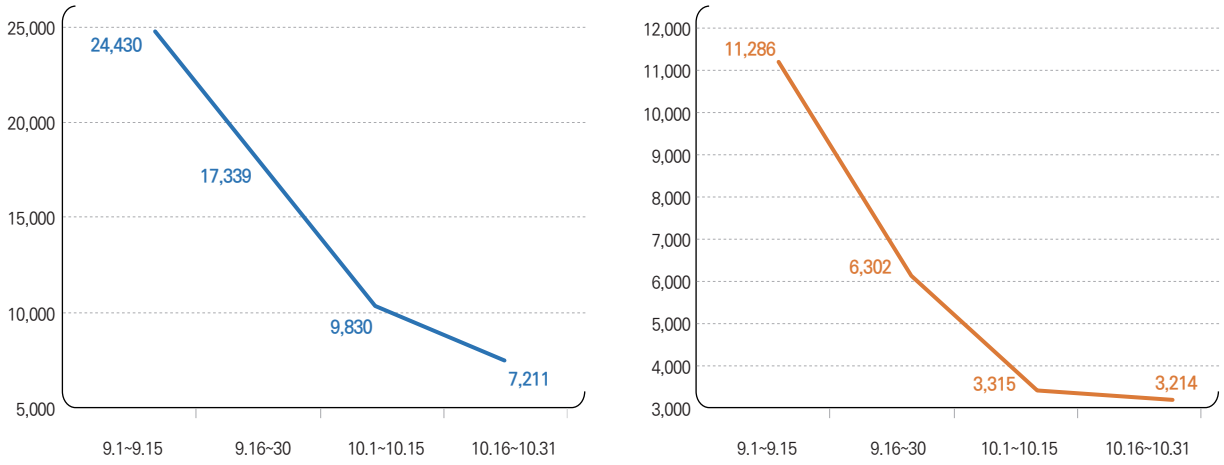
To reduce waste, raising awareness that waste is a valuable resource that can be recycled is essential. In line with this, Gangdong-gu, located in eastern Seoul, has been increasing the recycling rates since 2019 by introducing AI- and IoT-powered recycling bins known as Nephron. Nephron automatically sorts and compresses cans and PET bottles deposited into it, rewarding users with points that can be converted into cash. This initiative received a positive response from residents, with over 100,000 cans and PET bottles collected in its first year alone.

In addition, regular collection bins for pay-as-you-go waste bags are also becoming smarter. Equipped with detection sensors and GPS, these bins provide real-time waste load information to sanitation workers, helping prioritize routes and optimize waste collection efficiency.

Efforts to reduce food waste have also evolved. Following the Ministry of Environment guidelines, Seoul introduced a new approach in 2012, shifting away from flat-rate fees for food waste. In 2013, RFID-based food waste measurement devices were installed in apartment complexes in Geumcheon-gu, Yeongdeungpo-gu, and Seocho-gu in Seoul. Each household received a Radio-Frequency Identification(RFID) card to use when disposing of food waste, allowing the system to measure the amount and charge fees based on usage. This system is now being rolled out nationwide.

Air Pollution Information & Energy Information Map

Seoul has launched several various smart environmental programs to address issues such as fine dust. One key initiative is the Advanced Provision of Atmospheric Environment Information System, which provides citizens with air quality data using a network of air pollution measurement stations and integrated environmental information. The city has established a real-time monitoring system that links the city's operation center with 45 measurement networks. Additionally, a system has been introduced to send air pollution forecasts and warnings automatically



Number of Vehicle Stop Line Violations (Seongdong-gu Pilot Operation: 9/1~10.31)[9]

Process and status of introducing volume-based waste fee system

In the past, waste in Seoul was disposed of in regular bags and then landfilled or incinerated, regardless of type. The Nanjido landfill was used from 1978 to 1992, where 92 million tons of waste were buried and later transferred to the metropolitan landfill. Since 1995, a volume-based waste fee system has been implemented nationwide, including Seoul, to address the waste problem. The purpose of this system is to reduce waste and promote the collection of recyclable waste by making people accountable for the cost of handling waste. Seoul classifies waste by type and processes it into volume-based plastic, recycling, food, and industrial waste, which has helped to increase the recycling rate. However, despite these efforts, waste emissions in Seoul continue to increase. Presently, Seoul generates 3,200 tons of waste daily, with 1,000 tons buried in landfills in the metropolitan area. Direct landfilling of household waste in the metropolitan area is set to be prohibited from 2026, and Seoul is planning a new regional resource recovery facility.

Seoul Energy Information[10)]

to citizens.

S-DoT (Smart Data of Things), part of the 6S initiative, enhances Seoul's smart air environment management. S-DoT installed Internet of Things (IoT) devices throughout the city to collect meteorological and environmental data, including noise, fine dust, temperature, humidity, wind direction, wind speed, and ultraviolet rays every two minutes. By collecting and analyzing this data, Seoul can convert heat waves and ultraviolet radiation into spatial information, providing customized insights to citizens.

To encourage reductions in energy use and greenhouse gas emissions in response to the climate crisis, Seoul offers energy status updates and statistical information for local governments within the city, along with an energy information map to help citizens manage their energy consumption effectively.

Climate Card[11)]

Climate Card

In response to the climate crisis, cities around the world are cutting down on car use, encouraging public transportation, and creating pedestrian-friendly environments. South Korea is no exception, and Seoul has introduced various policies to create walkable cities and promote public transit. One standout initiative is the Climate Card, launched in 2024. This card allows unlimited use of public transportation (subway, bus) and shared bicycles like Ttareungi for a monthly fee of 65,000 KRW.

Available as either a smartphone app or a physical card, the Climate Card has gained popularity since its release on January 27, 2024, with over 1 million cards sold. Efforts are ongoing to simplify the sign-up and application process further.

The Climate Card is expected to reduce car usage by around 13,000 vehicles annually and cut greenhouse gas emissions by 32,000 tons each year. Furthermore, it is anticipated that the card will help over 500,000 citizens save more than 340,000 KRW in annual transportation costs, alleviating the burden of rising fares and living expenses.

04 Inclusive Smart City

Smart cities play a crucial role in addressing urban issues cost-effectively through ICT. However, these technologies may pose challenges for socially disadvantaged individuals, such as the elderly or disabled. In its efforts to promote smart city initiatives, Seoul is working to bridge the digital divide and enhance accessibility for all citizens.

Smart City Service Training for the Elders

Elders often struggle to adapt to smart city services. For instance, they find it challenging to use food-ordering kiosks and make smartphone reservations for train tickets. In response to these issues, Seoul implemented a project named It's Okay to Take It Slow. This initiative aims to foster a culture of social consideration, allowing people to use non-face-to-face services, such as kiosks, ATMs, and movie ticket machines, without feeling pressured by others.

In 2022, this campaign was ranked 3rd among the top 10 news selected by citizens. Furthermore, Seoul operates the Digital Companion Plaza, a physical space where senior citizens can receive direct education on using smart city services. This plaza, located in Yeongdeungpo-gu and Eunpyeong-gu, was chosen based on public transportation accessibility and the density of seniors. It offers tailored education, including instruction on using digital devices and engaging in digital hobby activities.

Eung-Dap-So (Citizen's Response Center)

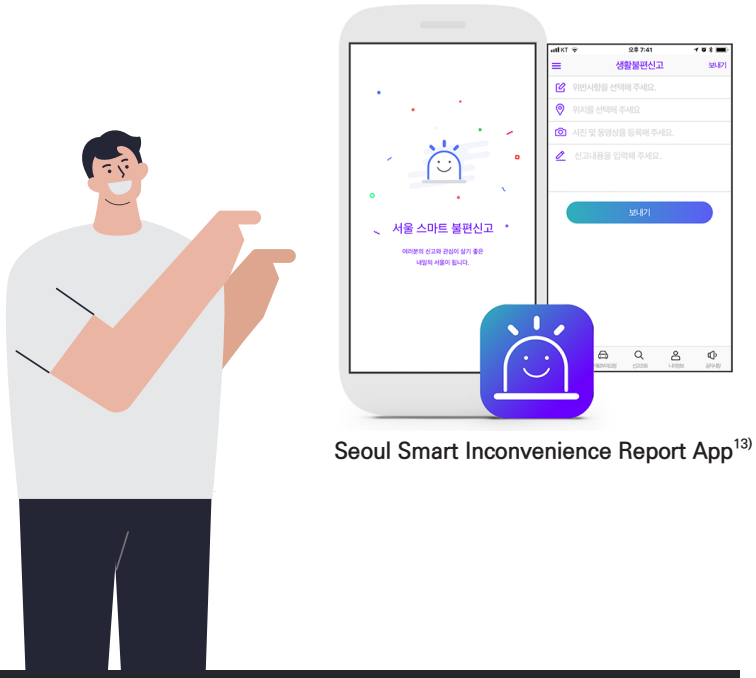
The Eung-Dap-So is an online system that integrates and manages all civil complaints in Seoul. It is a service that processes civil complaints filed through the Internet, mobile, or phone regardless of business field and promptly informs citizens of the results.

It's Okay to Take It Slowly Promotional Material[12)]

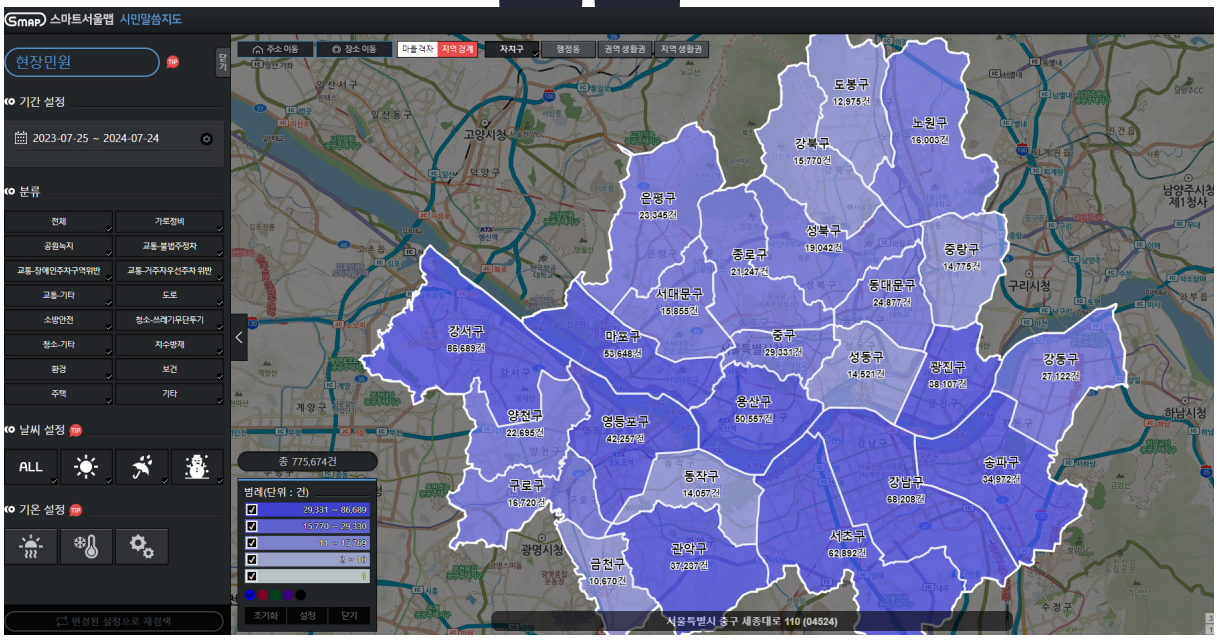
Source: Seoul Metropolitan Government. 2022. p.116

Smart Compliant Reporting Service

Citizens can use a service to report inconveniences such as illegal parking, damage to sidewalk blocks, unauthorized trash, or safety hazards via smartphones. These reports are received by Seouls120 Dasan Call Foundation and promptly processed by the relevant department. Citizens can use the app to check the processing status and results of their reports.



Seoul Smart Inconvenience Report App[13)]



Number of on-site complaints from citizens' voice[14)]

Sangam Digital Media City (DMC), Seoul's Representative Smart City District

From Landfill to a State-of-the-Art DMC

Once known for its abundance of orchids and oeishi mushrooms, this area became a massive landfill by the early 1960s, accumulating household and construction waste until it towered 100 meters high and stretched 2 kilometers long. In 1998, the Sangam New Millennium New Town Plan was introduced, aligning with the New Seoul Town development policy. This marked the beginning of the transformation of Sangam Digital Media City (DMC) into a cutting-edge industrial hub focused on digital media.

Following the Seoul Metropolitan Government Ordinance in January 2002, the DMC Project Execution Strategy (May 2002) and the Digital Media Street (DMS) Basic Plan (July 2002) were adopted to guide the area's redevelopment.

Phased Development of DMC

Development began in May 2002 when the public sector started supplying land for the first phase of DMC. Over time, land was gradually provided for essential facilities and attractions. In

DMC Roles by Job

By Job	Seoul	Seoul Business Agency	Seoul Housing & Communities Corporation
Policy Formulation & Planning	• DMC Ordinance management/ guidelines management • DMC planning/operation of the working committee • DMC policy planning/ development strategy establishment	-	-
Land Supply	• Establishment of land supply plan, land supply (Business briefing, reception, selection, contract, payment collection)	-	• Infrastructure construction, • Housing land supply support(appraisal, announcement, briefing session, reception, contract, payment collection, etc.)
Management of designated use and development deadline	• Deregulation and guidance management • Land use consent and construction consultation • KGIT center, landmark building, etc. • Designated use and development period	• Support for checking the status of resident companies(Inspection of compliance with designated use)	-
Support Facility Management (DMC Industry-Academic Cooperation Research Center, DMC Advanced Industry Center, DMC Promotion Center, DMS, etc.)	• Establishment of supporting facilities and public facilities • Establishment of support facility operation plan • Establishment of a support project plan for resident companies and budget support	• Management of Support facilities • Resident selection • Collection of tenant levy • Promotion of support projects for resident companies	-
Complex Activation	• DMC homepage operation • Establishment of culture opening plan • Establishment of tourism function revitalization plan • Establishment of cornet operation plan	• Promotion of tourism • Resident business council and cornet operation	-

Source: Seoul Metropolitan Government

Land Supply Strategy

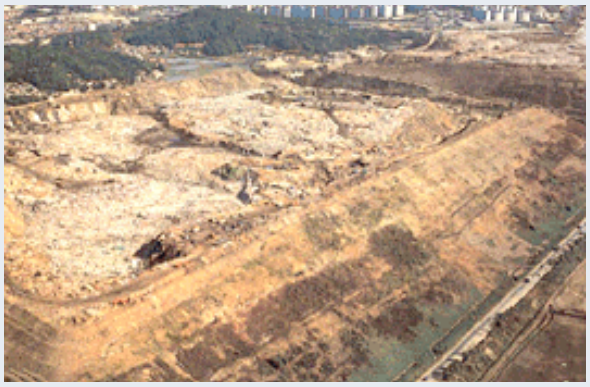
	Key Facilities	Recommended Facilities	General Facilities
Eligibility	• Designated facilities (public institutions) – Overseas education and research facility – Public support facilities: Culture content agency • Non-designated facilities – Broadcasting facilities: Attracting public broadcasting stations – Education & Research facilities: Media research institute – Industry-Academia-Research facilities: IT Basic research related	• Developer Company (actual consumer)	• Designated facilities – Hotel, residential-commercial complex, commercial entertainment, religious facilities, public facilities (public medical complex) • Non-designated facilities – Individual companies by parcel, etc.
Supply Price	• Designated Facilities: Composition Cost • Non-designated facilities: Appraisal price	• Appraisal price	• Successful bid price • Construction cost or appraisal price (urban factory) • Cost of construction (public facilities)

July 2000, a DMC Promotion Team was established in Seoul to oversee the project, attract IT companies, and secure foreign investments. Seoul Housing (SH) Corporation, tasked with land development, also launched the Information City Promotion Team to support this vision.

To establish DMC as a global digital media hub, facilities were planned to attract businesses in broadcasting, games, animation, music, and ICT services, with gradual development to ensure long-term success. The Seoul Metropolitan Government, along with the central government, focused on providing public facilities first, ensuring a strong foundation for this media-driven industrial ecosystem.

A Gradual Approach to Business Development

Rather than selling large plots of land at once, as in traditional projects, Seoul took a more measured approach. Land was sold



Nanjido garbage mountain[15)]

Grabage trucks rushing into Nanjido

Nanjido covered in garbage

Nanjido residents collecting scrap

in stages, focusing on attracting businesses in the media and entertainment sector. This method linked business performance with land supply, creating a sustainable ecosystem for the digital media industry by providing companies with the right space at the right time.

What was once a landfill is now Millennium Park, where nature and urban development coexist. DMC in Sangam-dong, Seoul, has evolved into a rare and successful media city project, becoming a hub for digital media and K-culture in Sangam-dong, Seoul.

A Thriving Media City

Today, DMC is a media-centered urban industrial complex, home to over 1,000 companies and more than 50,000 skilled professionals. The area houses major broadcasting stations, new media companies, IT startups, and large corporations. It offers a competitive ecosystem for education, research, and development (R&D), production, and sales across media, games, film, and entertainment industries. DMC generates over 100 billion KRW in annual tax revenue, more than three times the investment made by the government.

DMC has positioned itself as a global leader in digital media production, aiming to become the premier hub for the information media industry in Northeast Asia. The district features smart infrastructure such as IoT, monitoring systems, and wireless LAN, supporting its development as a smart city. Additionally, DMC integrates industrial, business, cultural, and green infrastructure, further promoting innovation and sustainability.

Nanjido turned into a park[16)]

DMC[17)]

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CHAPTER

3

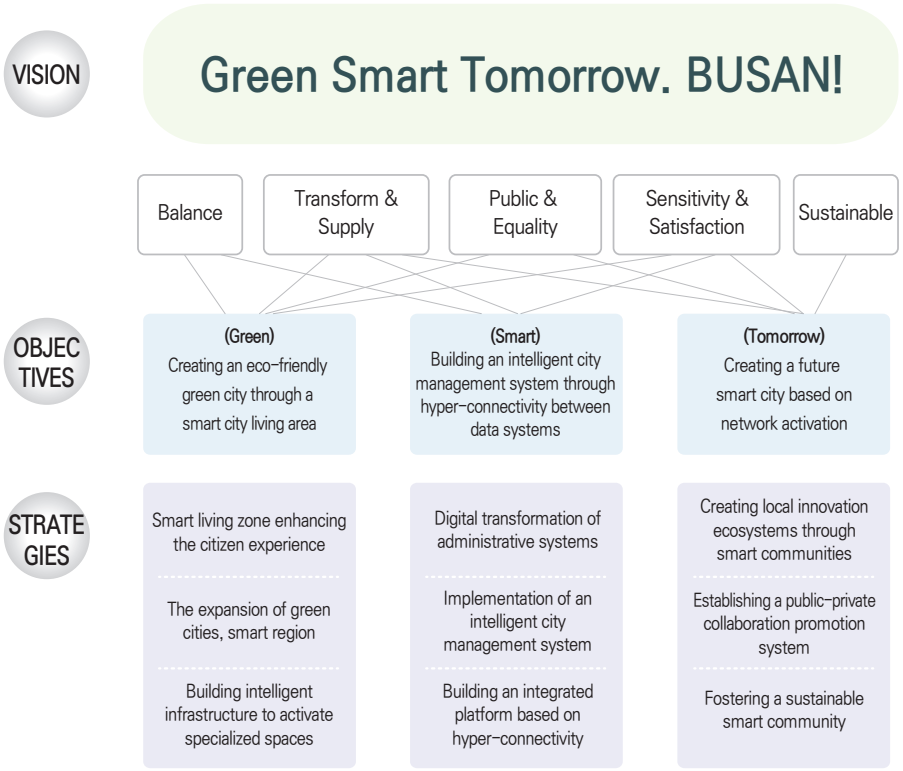
Busan

01 — 01 Green, Smart, Tomorrow, Busan

Busan, with a population of 3.3 million and an area of 770 square kilometers, is South Korea's second-largest city and the southernmost global marine city in Korea. The Port of Busan ranks as the fifth-largest port in the world, with its docks bustling with import and export containers.

During the Korean War, refugees settled in Busan. The Nakdong River (the river that runs around the border of Busan) was a protective shield and established itself to foster economic growth. Despite the mountainous terrain, these refugees developed Busan, and high-rise buildings have been constructed over the years.

Busan's smart city policy emphasizes a "green smart" approach. In line with this, the city has adopted the vision of "Green Smart Tomorrow, Busan." This vision's core values include balanced development, digital transition and supply, public equity, sensitivity and satisfaction, and sustainability. Busan has outlined three goals and strategies to realize its smart city vision, as illustrated in the figure below.



Source: Busan Metropolitan City. 2024

02 Barrier Free (BF) Transportation

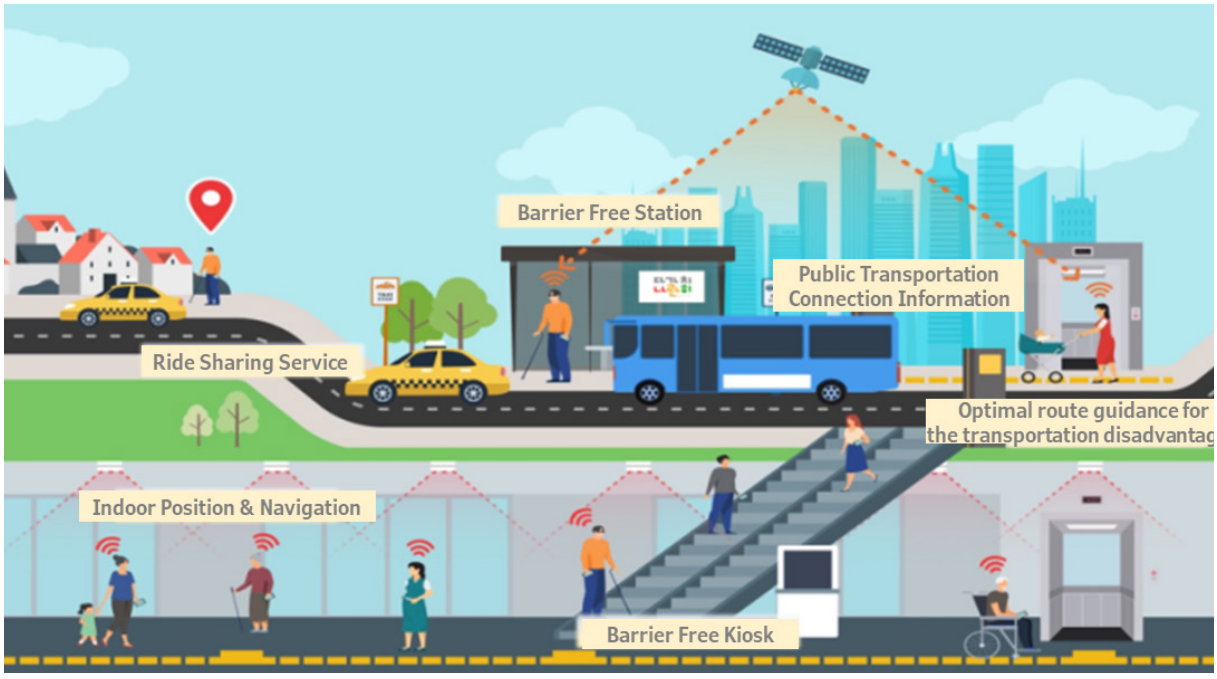
According to the Ministry of the Interior and Safety, transportation disadvantaged individuals, such as people with disabilities, the elderly, and pregnant women, take an additional 10 to 20 minutes to transfer compared to the general public. Particularly for individuals with disabilities, the lack of appropriate transportation information can result in using urban rail systems taking over four times longer than for those without disabilities.

To support transportation-disadvantaged individuals, Busan applied for the Smart City Challenge project in 2020 and has established services such as "BF Navigation," "BF Station," and a "Ride-Sharing Platform" to assist these users.

BF Navigation

The BF Navigation Service is designed to provide navigation assistance inside subway stations for transportation-disadvantaged individuals. The service includes real-time navigation technology for areas where GPS signals are unavailable and the installation of kiosks tailored to the needs of transportation-vulnerable individuals. The kiosks installed at Busan subway stations are equipped with braille guidance for the visually impaired and sign language for the hearing impaired, as well as height adjustment functions so that both the general public and wheelchair users can use them.

Digital twins of the subway stations have provided intuitive navigation through kiosks and mobile apps, benefiting various individuals with transportation challenges. As a result, Busan has enhanced the accessibility and inclusivity of its urban environment.

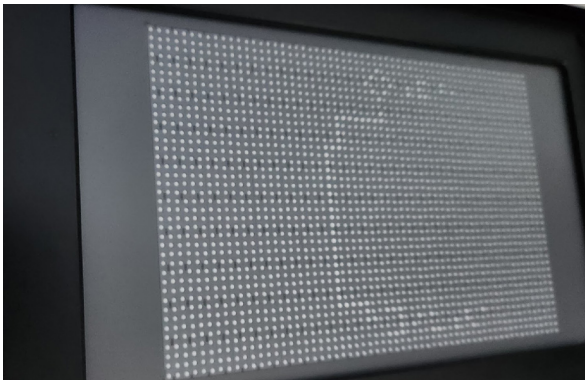


BF navigation service linkage scenario

Source: Busan Metropolitan City·Busan Information Industry Promotion Agency. 2024. p.27

Automatic Height Adjustment

Tactile Map and Keypad for the visually impaired



BF kiosk features and smart phone app screen

Source: Busan Metropolitan City·Busan Information Industry Promotion Agency. 2024. p.30, p62, p.123

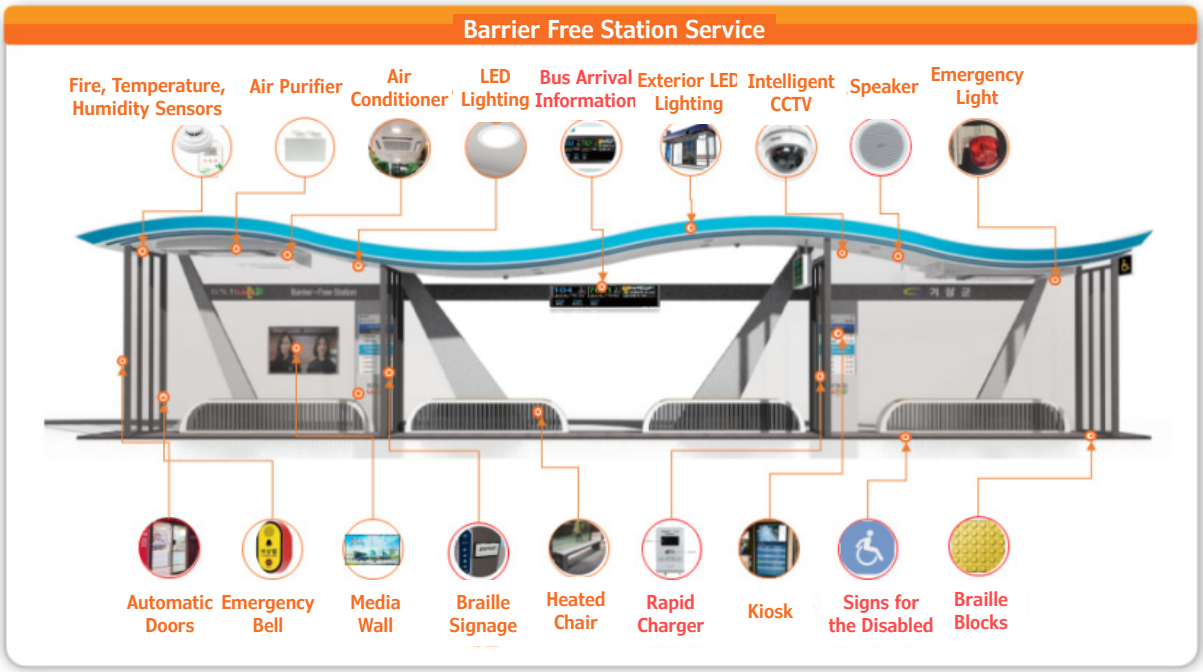
Ride-Sharing Platform

Busan has hilly areas and regions that are not easily accessible by public transportation for people with special needs. There is also a shortage of large taxis for the disabled. This leads to transportation-disadvantaged individuals having to pay additional transportation costs due to physical limitations, which puts a financial burden on local government budgets. Thus, the city provides various transportation options, such as Duribal, JabiCall, and demand-responsive buses managed through an integrated platform.

BF Bus Station,

Due to the climate crisis, individuals with transportation challenges have become more susceptible to recent climate change; 40% of the survey respondents identified weather as the most inconvenient aspect of public transportation. To provide better services, Busan has built BF Bus stations.

The stations are designed to be accessible for individuals with physical impairments and aim to offer convenient public transportation services for all citizens. These stations provide shelter and amenities like air conditioning and heated seating, alongside safety, health, and convenience features. These include smart CCTV, emergency call buttons, healthcare services, and public Wi-Fi. BF Bus Stations are remotely managed through an integrated



BF Station Concept

Source: Busan Metropolitan City·Busan Information Industry Promotion Agency. p.82

BF Station

control system, which also helps reduce operating costs.

Citizen Participation and Governance

To ensure the project's smooth operation, a public-private consortium was established. Busan promoted the Living Lab in various ways, including forming the Living Lab Advisory Committee, User Verification Group, and College Student Supporters to carry out a citizen-centered smart city project.

The Living Lab aimed to identify transportation issues affecting people with disabilities and develop solutions through public participation. The Living Lab Advisory Panel comprised approximately 30 individuals, including representatives from organizations, companies, experts, and stakeholders in the transportation sector. Additionally, the Disability Advisory Group included four deaf individuals, four blind individuals, six individuals with physical disabilities, two individuals with brain injuries, and one individual with intellectual disabilities. The user verification panel included around 50 participants, encompassing the vulnerable population, the elderly, pregnant women, and caregivers of infants and children.

Approximately 45 college students attended the event to support the BF Challenge. They provided surveys and feedback after using BF navigation and ride-sharing platforms. The BF Challenge aimed to raise awareness and address transportation issues for vulnerable populations, utilizing social media to engage people nationwide, with 23,920 participants.

Key Achievements

The Barrier Free project enhanced transportation for disadvantaged individuals, securing their travel rights. Their commuting time has been reduced from 51 minutes to 29 minutes. The expansion of the BF Navigation service has increased the usage of urban railways. At the same time, customized route guidance and transportation cost reductions have decreased average walking time from 9 minutes and 41 seconds to 4 minutes and 40 seconds. BF Bus stations were built in areas with the most needed areas with high population density, further securing mobility rights. Based on these achievements, it has expanded into Gyeonggi Province.

Smart City Challenge Living Lab

Source: Busan Techno Park. 2023 p19~20

03 Digital Twin Smart City Lab Demonstration Complex

When developing new ICT-based smart city services, having an experimental area is crucial to test emerging technologies and services, ensuring safety and effectiveness. Busan aims to create a virtual testing space by 2025, establishing a smart city lab and a digital twin-based testbed while promoting smart city services to foster innovation and develop an industrial ecosystem through collaboration with domestic and international companies and research institutions.

In the smart city lab demonstration complex, a digital twin testbed environment enables data visualization and simulation based on 3D spatial information. This allows for the validation of new smart city services in both the digital twin testbed and simulated urban settings, facilitating their pilot application and commercialization in real cities. In 2022, five services, including smart park services and an indoor flow population monitoring system for disaster safety response, were demonstrated. In 2023, the focus shifted to demonstrating five additional services, such as mobile city lab services and body care systems, with plans to continue supporting demonstration projects through 2025.

The smart city lab demonstration complex will serve as a hub for gradually implementing services in virtual, simulated, collaborative residential, and real-life environments, contributing to the activation of the Busan industry. A key facility within the demonstration complex, the smart city lab center, will create a simulated urban environment similar to real cities, such as roads and residential areas, to distribute and test verified services before commercialization. This facility is scheduled for completion in December 2024. It will provide an open lab environment that allows for both virtual tests and field tests of new technologies and services, offering spaces for research, office use, and simulated urban environments. The center will enable various developments and R&D activities, including automated 3D modeling of spatial objects, AIoT-based digital twin platform design, and the development of digital twin simulations.

Bird's eye view of the Smart City Lab Demonstration Complex

Source: Busan Metropolitan City. 2023

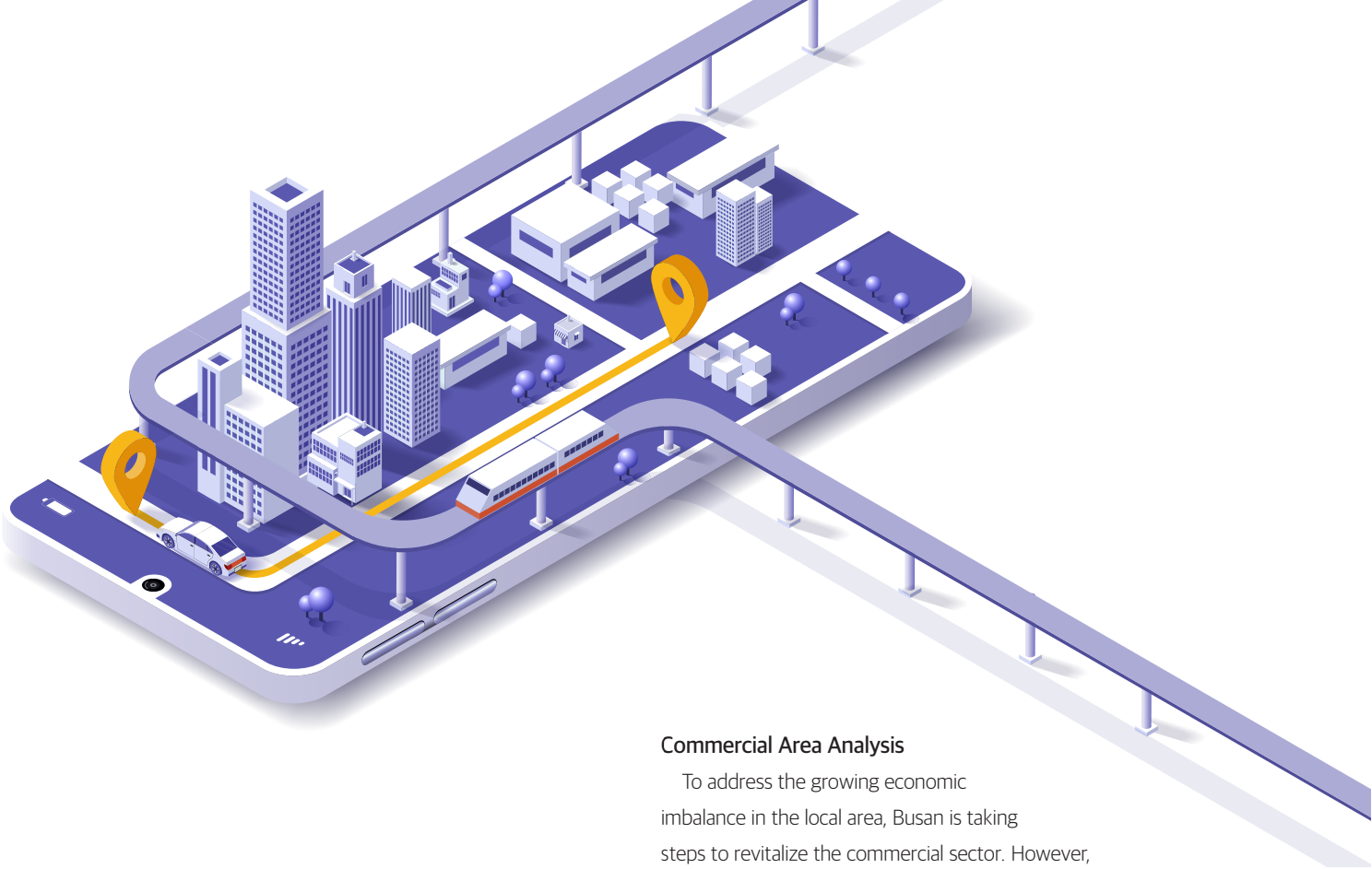
04 Utilization of Data Hub

Urban issues like energy, transportation, and safety problems occur daily. Transitioning to a smart city, based on data, is essential for solving them. In the smart city, data is being collected through various data centers. However, since urban data is largely composed of unstructured data such as IoT, sensors, and images, data exchange technology with standards for information transmission that includes not only simple structured data but also other data types is required, and the construction of a smart city data hub that reflects this is necessary.

The Smart City Data Hub Project, led by the Ministry of Land, Infrastructure, and Transport, is a project to promote smart city operation by supporting the systematic collection, management, and utilization of large-scale urban data. In connection with this project, Busan is promoting the construction of an intelligent city data hub and implementing two services to verify this in 2024 to establish a nationwide common standard and joint utilization of urban data. The data hub is being constructed nationwide at the metropolitan level so it can share and utilize standardized data, and it will enable the free exchange of data between neighboring cities and organic decision-making.

Busan is an international tourist city that hosts large-scale events for natural landscapes, fireworks, international film festivals, and concerts. However, due to the recent influx of tourists after the COVID-19 pandemic, urban problems (urban safety) have occurred. In Korea, crowded places have

Fireworks and crowds



continuously been looked out due to high density. Additionally, the ongoing economic recession raises concerns that the Busan economy may stagnate. This stagnation is attributed to the continuous decline in sales for small businesses and the unchecked intensification of competition within the same industry, which could lead to the deterioration of commercial districts. To solve these urban problems, the city is promoting the development of two types of services utilizing the Busan Smart City Data Hub in 2024.

Clustering Area Risk Analysis

For events like fireworks festivals and drone shows organized by administrative agencies, there are instances where the number of participants exceeds the number of staff managing the event. This shows the need for an efficient crowd management plan. Busan is currently developing a service that can analyze the risk of overcrowding in real-time, which will help prevent accidents.

The service will analyze and predict the real-time population risk by identifying population clusters based on time and location, estimating the size of the pedestrian population, and analyzing movement patterns. Additionally, it can predict the population crowdedness for 12 hours in 5-minute intervals, allowing for prompt action according to the level of risk. Busan also aims to establish an emergency sharing system with local emergency services to ensure the safety of the events.

Commercial Area Analysis

To address the growing economic imbalance in the local area, Busan is taking steps to revitalize the commercial sector. However, these measures have been somewhat fragmented. The city plans to develop a tailored algorithm for evaluating commercial area solvency by defining specific types of commercial areas that are suitable for Busan's circumstances. This will be based on consumption sales data and predictive analysis. By providing accurate insights into the causes of insolvency for different business areas, this analysis will serve as a valuable tool for preparing proactive strategies and policies to boost the local economy through data-driven industry competition and increased sales.

Expected Outcome

The Smart City Data Hub will play a crucial role in cultivating a growing and evolving smart city ecosystem. It will achieve this by gathering, analyzing, and utilizing extensive data from industries, administration, infrastructure, and services within the urban environment. This initiative aims to enhance the quality of life for citizens by ensuring efficient urban system operation. The Busan City Data Hub, beyond being just a platform, will catalyze urban policies and technological development strategies. It will also facilitate the creation of enhanced urban convergence services and improve city operation efficiency by centralizing diverse city data and integrating it with other cities in the future, ultimately developing into a collaborative utilization system.

Busan National Pilot Smart City

The National Pilot Smart City in Busan Eco-Delta City (EDC) is located in the Semulmeori District (2.8 square kilometers) in Gangseo-gu, Busan. It was designed to accommodate 8,500 people (3,380 households). This city is a water-friendly waterfront city constructed in the Nakdong River estuary area, making it suitable for implementing innovative technologies related to water resources and the environment. Additionally, it is expected to facilitate the development of the western mountain region and the industrial belt in the southeast region of Busan. The Eco-Delta Smart City aims to serve as a model for sustainable development and environmental preservation in Busan.

Vision and Strategies

Busan National Pilot Smart City has a vision of being a global innovative growth city where people, nature, and technology meet to advance future life. To foster the 4th industrial revolution technology and improve the quality of life of citizens, Busan National Pilot Smart City introduced three specialized strategies and seven core contents to embody smart city strategies. In the basic direction, Busan National Pilot Smart City promotes three projects: a new technology testbed, urban problem-solving, and an innovative industrial ecosystem.

Unlike existing smart cities, EDC is designed to serve as a platform for smart services in the city itself. This makes it easy for various technologies and services to be integrated and developed. To achieve this, Busan EDC aims to present a structural model of the future city by introducing three major platforms: a data platform, an augmented reality platform, and a robot platform.

The specific implementation plan for the Busan National Pilot Smart City includes three specialized strategies:

1. An innovative industrial ecosystem city
2. A city specializing in eco-friendly water
3. A city where imagination becomes a reality.

The seven core contents are:

1. People-centered smart city design
2. A city created by citizens
3. A Living Lab hub and network
4. A R&D plug-in city
5. Regulatory sandboxes
6. Open big data,
7. Innovative technologies for citizens

Through these strategies and contents, Busan is introducing innovative technologies, inducing citizen participation, and pursuing sustainable development. Cities with innovative industrial ecosystems evolve into high-tech and industrial clusters. Cities specializing in eco-friendly water enhance water management and environmental protection, while cities that turn imagination into reality use cutting-edge technology to improve citizens' quality of life. In addition, people-centered smart city design creates a user-friendly urban environment, and cities created by citizens solve urban problems through resident participation. The Living Lab hub and network promote innovation through various experiments and research, and the R&D Plug-in City provides infrastructure for R&D. Regulatory sandboxes create an environment where new technologies and services can be freely experimented, while open big data facilitates the sharing and utilization of data to foster innovation. Ultimately, innovative technologies enhance the services that citizens can experience directly.

10 Innovation Services

The Busan National Pilot Smart City is promoting ten innovative services. Key services include robotic services for life innovation and smart water services, with the Korea Water Resources Corporation leading.

The Busan National Pilot Smart City has established a special purpose company (SPC) to promote projects for efficient city operation and a new industry ecosystem through public-private collaboration. The selected SPC will review the national pilot

10 Innovation Services

Category	Promotion Direction
Robot-Utilization Life Innovation (City-bot)	- Creating a world-class robot city by using robots to support citizens' daily lives (childcare, education, medical care, etc.) and the vulnerable and the young. - Introduction of home AI assistant robots, delivery robots, rehabilitation robots, robot testbeds, etc.
Learn-Work-Play (LWP)	- Create a multi-functional hub space where learning, work, and play take place in one space and create community-based jobs - LWP Center (Library, Smart Work Center, Makerspace, etc.) infrastructure establishment and program operation
Urban Administration· Intellectualization of Urban Management	- Provides user-centered urban administration services based on the integrated city operation and management platform, and maximizes the efficiency of city management based on artificial intelligence - Urban administration using augmented cities, urban maintenance using robots, citizen self-government administration, etc.
Smart Water	- By applying smart water management technology to the entire process of urban water circulation (rainfall-river-purification-sewage-reuse), creating a city specialized in water that the public can trust - Introduction of urban rainfall data, smart water purification plant, sewage reuse, etc.
Zero Energy City	- Reduce greenhouse gas emissions by utilizing renewable energy provided by nature such as water and solar power and achieve 100% energy self-sufficiency through eco-friendly energy - Hydrogen fuel cell, thermal energy supply using hydrothermal and renewable heat, introduction of zero-energy housing demonstration complex
Smart Education & Living	- Use the entire city as a smart technology training center, and introduce citizen experience-type contents such as smart home and smart shopping to provide a convenient life - EdTech, City App introduction, smart home, smart shopping center introduction, etc.
Smart Healthcare	- Introducing a healthcare cluster to check health management methods that suit individual characteristics and create a city that helps citizens live a healthy life in their daily lives. - Introduction of real-time health monitoring system, healthcare cluster (university hospitals, research facilities, etc.)
Smart Mobility	- Creating the most efficient, eco-friendly, and fastest city to reach your destination with the least cost - Providing a total mobility solution that links smart road-vehicle-parking-personal mobility
Smart Safety	- Establishment of an integrated safety management system using the 4th industrial technology to predict intelligent disasters and disasters and provide quick and accurate citizen safety services - Optimization system for emergency response, evacuation guidance system in building, introduction of intelligent CCTV, etc.
Smart Parks	- By combining human-centered 'Smart Tech' and 'Design', the park is planned to provide a healthier nature and environment and to experience 'smart technology' in everyday life. - Smart technology experience park such as solving urban problems (fine dust reduction, water reuse), and new and renewable energy

smart city services by dividing them into mandatory, optional, and free services. It will then proceed with establishing and operating the smart city service projects. The funding consists of government finances and revenue from the development of leading districts.

The Busan National Pilot Smart City has established a SPC to promote projects for efficient city operation and a new industry ecosystem through public-private collaboration. The selected SPC will review the national pilot smart city service by dividing it into mandatory, optional, and free services. It will then proceed with the establishment and operation of the smart city service project. The funding consists of government finances and revenue from the development of leading districts.

Smart Village, Living Lab

The Smart Village of the Busan National Pilot City is a testbed where visitors can experience future smart city technology. Actual residents live in the village, which consists of 56 households and serves as a Living Lab for them to experience new smart technologies and provide feedback.

The village features zero-energy housing utilizing renewable energy sources such as photovoltaic, solar, geothermal, hydro-thermal, and fuel cells. Energy use monitoring and remote management can be done through the smart home platform. Additionally, the village has introduced a distributed water purification plant to enable efficient water supply using multiple water sources. The village has also achieved a 70% reduction in energy costs compared to single-family houses nationwide by creating the nation's first energy-efficient 1+++ and zero-energy first-class housing complex. Furthermore, the Urban Tech House accommodates 26 startups, industry, academia, and research institutes, allowing them to participate in the Living Lab program to demonstrate innovative technologies and discover business models. Smart Village is an innovative city with a specialized industrial ecosystem focused on eco-friendly water services. It is a place where the vision becomes a reality, and its main features include innovative life and the use of robots for smart water services. Since January 2022, Smart Village has been home to over 200 residents who provide technology experience and feedback. It is becoming an important stepping stone for Busan EDC as it progresses toward becoming a globally innovative city.

Smart Village Data Platform Center

The Busan National Pilot City Smart Village Data Platform Center serves as a hub for innovative smart technologies. The center oversees the operation and management of the Smart Village and supports the introduction and demonstration of various smart technologies and solutions.

Specifically, the center enables remote control of smart home

Busan EDC Smart Village

Source: Korea Water Resources Corporation. 2024. p.10, p.12

Busan Eco Delta Smart Village Platform Center

Source: Provided by KRIHS

Busan Smart Village Living Lab

Source: Korea Water Resources Corporation. 2024. p.14

devices and monitors energy usage while efficiently managing water supply and quality through a distributed purification plant. Additionally, the center continually improves smart technology based on residents' feedback and operates a Living Lab program to discover new business models.

The center's role is vital in supporting the demonstration of new technologies to 56 households in the smart village, and it presents an innovative urban management model as the core infrastructure of Busan's smart city. The operation of the management center is a significant contribution to the growth of the Busan National Pilot City into a global smart city.

Living Lab

The operating system of the Busan National Pilot City Smart Village is configured through collaboration between the public and private sectors. Private firms develop and provide smart technologies and solutions to support the operation of various services in smart villages. Residents experience smart technology while actually living in it and provide feedback to verify and improve the effectiveness of the technology. The facilitator, which is the management generation of the smart village, is in charge of Living Lab topics including water, environment, energy, transportation, life and safety, robots, and smart farms, and leads the introduction and operation of technology. At the same time, the management center oversees the entire operation and supports efficient city operation through data collection, analysis, and smart home device management. Through this system, Busan Smart Village is realizing an innovative smart city model.

As a leading district of the national pilot smart city, the smart village can be said to be meaningful in that it can verify the direction, plan, and solutions of the national pilot smart city in advance by testing smart city solutions before building a national pilot smart city in earnest.

	Management Generation	Special Generation	General Household	Experience Generation
Number of HHs	6 HHs	12 HHs	36 HHs	2 HHs
Composition	Introducing technology	Socially disadvantaged	HH types	Always-on operation
	① Water/Environment ② Energy ③ Transportation ④ Living/Safety ⑤ Robot ⑥ Smart Farm	① Youth Share (2nd generation) ② Youth household (2 generations) ③ Newlyweds (4th generation) ④ Disabled people (2nd generation) ⑤ Senior (2nd generation)	① Households of 2-3 people (7 households) ② Households with 4 or more people (25 households) ③ Multi-person household (4 households)	For visitors Smart technology experience area (used as a guest house)

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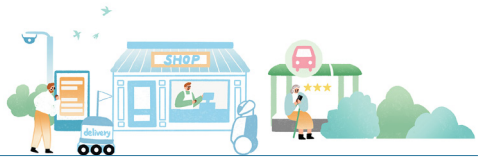
4

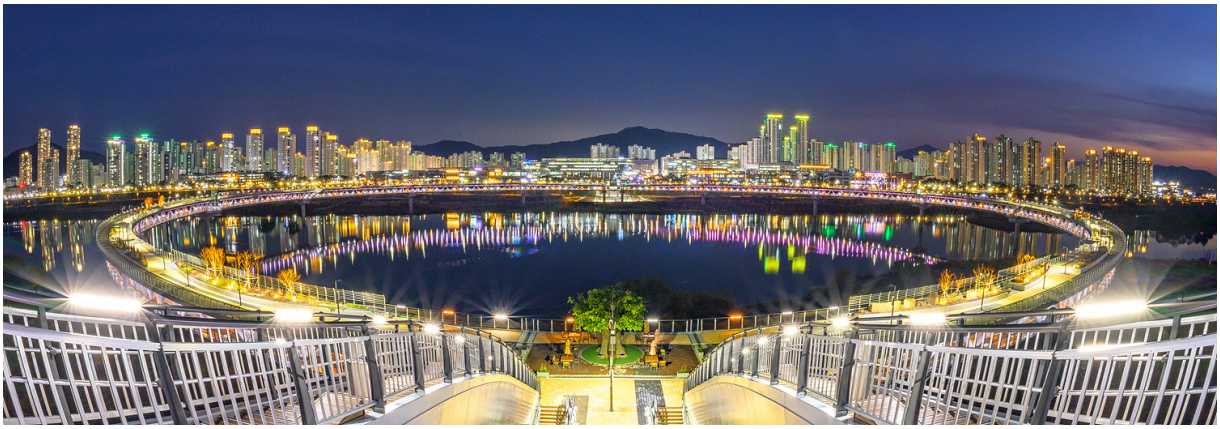
Sejong

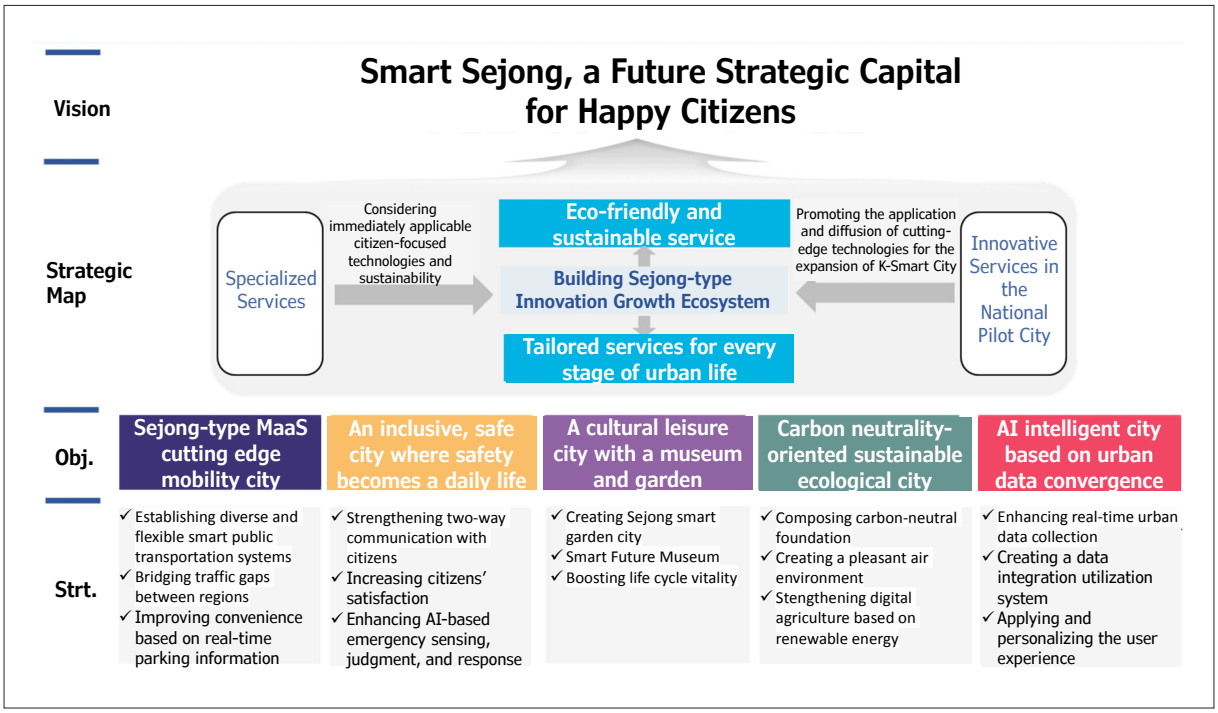
01 Sejong, Smart New Administrative Capital



Sejong was created to address the challenges of overcrowding and centralization in Seoul. Sejong includes the Administrative City and its surrounding areas. Currently, Sejong covers a total area of 465 square kilometers and has a population of around 390,000. The Administrative City area alone spans 73 square kilometers and has a population of approximately 300,000, with a target population of 500,000. Sejong aims for an overall population of 800,000.

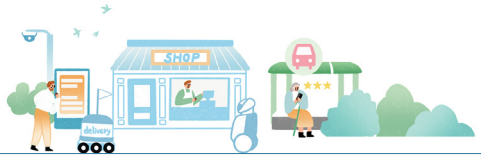
Sejong is working towards becoming a smart city and a strategic capital that prioritizes the well-being of its citizens. Its goals include developing cutting-edge mobility, creating an inclusive and safe environment, promoting culture and leisure, and focusing on sustainability and AI-based urban development.





Source: Provided by Sejong City

02 The Process of Development of Sejong



Discussions about establishing a new administrative capital in Korea began in the 1970s, driven by the overcrowding issues in Seoul. Additionally, concerns regarding security due to tensions with North Korea were also considered. This initiative aimed to address both overcrowding and security challenges, and was referred to as the "white plan," as it involved a comprehensive review and reconsideration of all relevant aspects.

However, at that time, the plan to relocate the administrative capital was not implemented, and it was carried out in earnest in 2003 in order to bridge the growth gap between regions and to develop a balanced country. The New Administrative Capital Construction Promotion Planning Group and support groups were launched on April 17, 2003. Professional research institutes such as the Korea Research Institute for Human Settlements (KRIHS) studied the Basic Urban Concept and prepared Site Selection Standards.

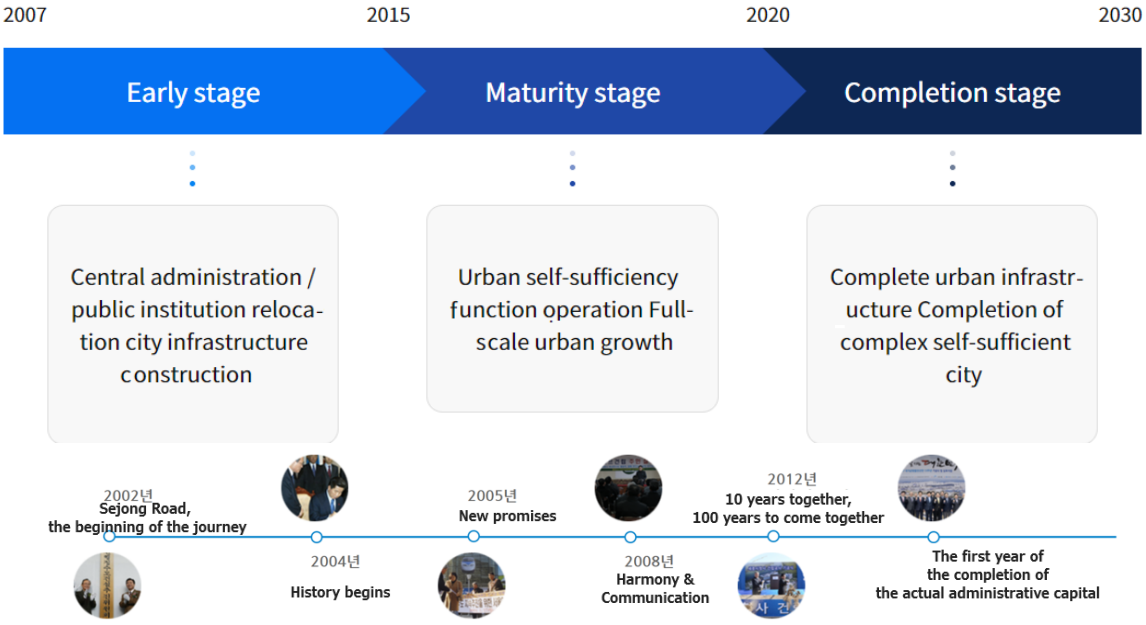
In 2004, the Special Act on the Construction of Administrative City was enacted to provide a legal basis for constructing a new administrative capital. The construction basic plan was established on August 10, 2004. To select a site for the new administrative capital, an evaluation support group was formed around the KRIHS, and four regions were recommended as candidate sites. The Candidate Site Evaluation Committee evaluated factors such as the effect of balanced national development, domestic and international accessibility, impact on the surrounding environment, natural conditions, urban development costs, and economic feasibility. After public hearings and consultation, the Yeongi-Gongju region, or the current Sejong, was selected on August 11, 2004.

New City Concept: Two-Ring Structure

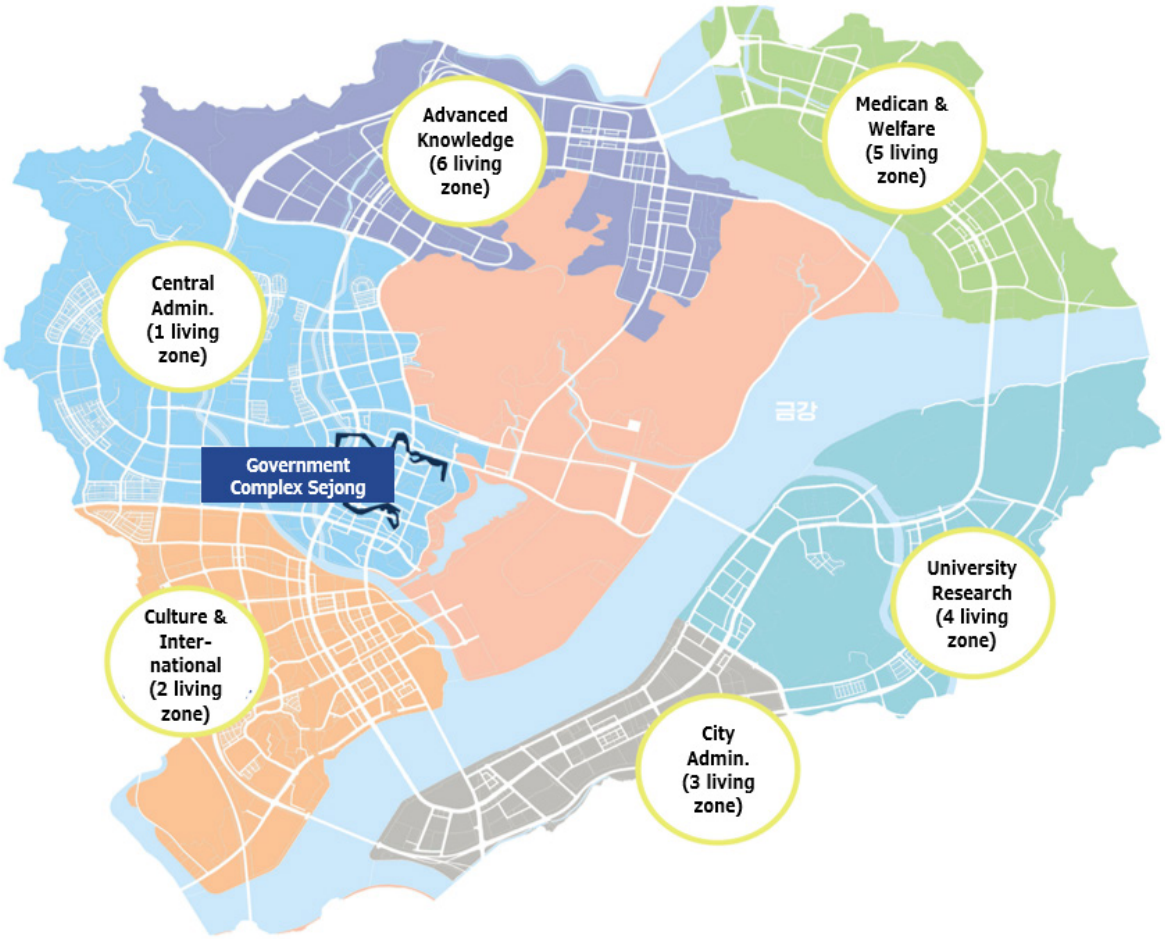
The Administrative City is a significant project aiming to relocate central administrative agencies to local areas and construct a new city spread over 72.91 square kilometers of land. The project plans to create a city equipped with industry, education, culture, and international functions, setting a new standard in land management. To design the future city, an international competition was held, starting with an announcement on May 27, 2005. Participants were registered from June 1 to July 11, and submissions were accepted from October 18 to 25. The KRIHS reviewed the submissions from November 11th to 14th and selected five teams on November 15th. One of the proposed ideas was a circular road network structure centered on ring roads, creating an efficient transportation system. This design was adopted, resulting in the world's first two-ring urban structure. Additionally, the city features a large-scale green space at its center, serving as the city's lungs. The city is divided into 6 living zones and 21 basic living zones as part of a district-level plan.

City Size	Population	500,000 people	A comfortable , medium-low-density new city
	Development Area	66 to 83 Million ㎡	
Construction Period	Phased development until 2030		
Construction cost	A total of 45.6 trillion won is expected to be spent. (Total cost of 11.3 trillion won is planned to be used for transportation facilities, public facility construction, etc.)		

Source: Administrative city Construction Agency . 2017. p.70



Administrative Complex City Promotion Process[1)]



1 Living Zone — Comprehensive Welfare Type
Comprehensive Social Welfare Center
(Comprehensive facilities to support early residents)

2 Living Zone — Family welfare type
Healthy Family Support Center, Youth Club Room, Day Care Center, Silver Sharing Workplace, Women's Organizations Association, Multicultural Family Support Center, etc.

3 Living Zone — Health and Welfare Information Type
Senior Employment and Employment Center, Child Counseling Center and Child Welfare Center, Women's Service Integration Center, Disabled Person Support Center

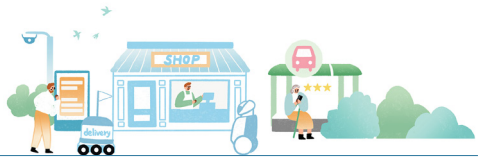
4 Living Zone — Disabled welfare type
Facilities for the disabled (welfare centers for the disabled, workplaces for the disabled, etc.), health and medical facilities (Health Living Support Center, Dementia Relief Center, etc.)

5 Living Zone — Medical rehabilitation Type
Senior Welfare Center, Senior Recreation Center, Nursing Home, Mental Health Center, Physical Therapy Room, Lecture Room, Auditorium, Education Room, Sports Room

6 Living Zone — Youth welfare type
Youth Culture House, Youth Training Center, Youth Campground, Counseling Guidance Room, Youth Protection Center, Seminar Room, Book Cafe, Lecture Room, Gym, etc.

District unit plan of administrative city[2)]

03 Sejong as a State-of-the-art Smart City



Sejong, in conjunction with the Administrative City, is implementing a range of smart city services and projects to transform the entire Sejong into a smart city. Key services include a CCTV control center, a shared bicycle system, an integrated app, autonomous driving tests, and more. While these services are typically focused in the Administrative City, Sejong is striving to identify and promote suitable solutions in areas outside of the Administrative City. Through this effort, smart city technology is being utilized in non-urban areas to enhance the quality of life and support more balanced urban development.

Creating a Smart City Innovation Ecosystem

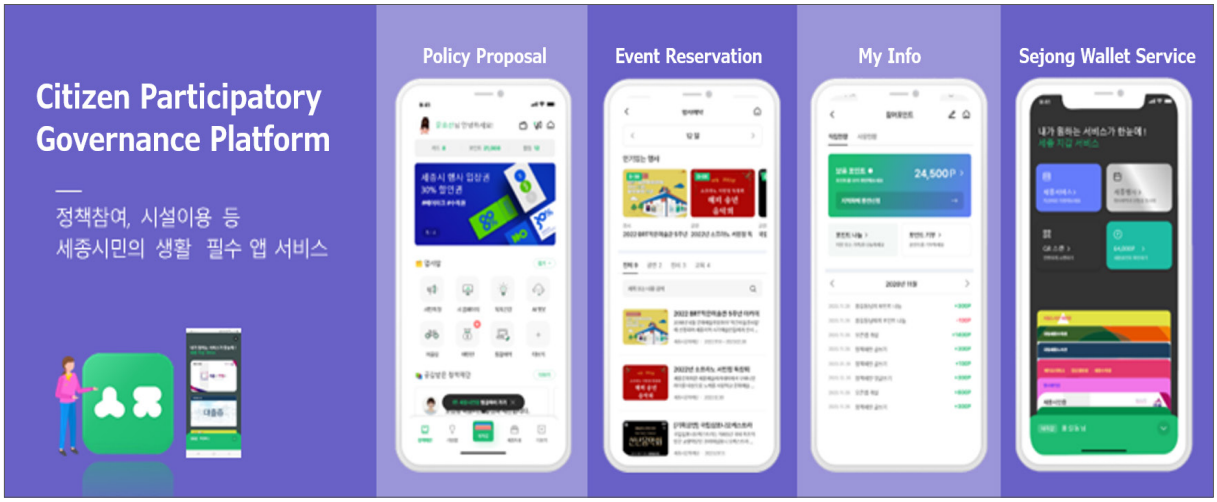
Sejong's main focus is to establish a smart city innovation ecosystem, with an emphasis on the 5-1 living zone, designated as a national pilot smart city. As a National Pilot Smart City, it aims to show various cutting-edge innovative technologies in the designated areas. Sejong provides an urban environment conducive to disseminating the outcomes of such demonstrations. Sejong is promoting demonstrations and expansions of innovative service models, autonomous driving, drone technology, and cooperative regional growth projects to embrace the innovative technologies of the 4th Industrial Revolution. It also encompasses various detailed projects to expedite digital transformation and counter cyber threats, while also grooming essential talent to enhance capabilities in new growth industries.

Since 2019, Sejong has been granted status as an autonomous driving demonstration regulation-free special zone by the Ministry of SMEs and Startups, actively nurturing the autonomous vehicle industry. Notably, it has been lauded for possessing a transportation infrastructure suitable for autonomous vehicle operation. Currently, Sejong is conducting a demonstration on the Osong Station - Sejong Bus Terminal - Banseok Station route in collaboration with the Ministry of Land, Infrastructure, and Transport. In 2019, Sejong was certified as a domestic pilot smart city, and in 2018, it became the first city worldwide to obtain international smart city certification based on ISO standards from the British Standards Institute (BSI). Furthermore, it was chosen as one of the top five smart city pilot cities globally, alongside Cambridge (UK), Moscow (Russia), Melbourne (Australia), and Dubai (UAE). In 2020, it attained Level 4 (Leading) status.

Note: Korea's first wide-area self-driving bus[3]

Note: Leading the future car industry with an autonomous driving big data control center[4]

Sejong Smart City obtains world's first ISO international certification[5)]



City App , citizen participatory governance platform

Source : Sejong Special Self-Governing City. 2023. p.28

Digital Transformation

Sejong City App

Sejong is developing and distributing the Sejong City App to citizens to implement data-based open administration. Through this app, citizens can actively participate in city policies using their mobile devices. The main functions of the Sejong app include the ability to propose policies desired by Sejong, vote on the proposals, and participate in the Living Lab for citizen communication. Additionally, the app allows users to conveniently receive and use 56 types of mobile electronic certificates for daily work, such as resident registration certificates and health insurance qualification certificates. Moreover, participating citizens receive points as incentives, which can be exchanged for Yeominjeon, the local currency. This system is expected to encourage active citizen participation and contribute to revitalizing the local economy.

SejongN (en)

Sejong has launched a new app called SejongN (en), which is a combination of Sejong and e (en), meaning place and time in Korean. The app was introduced in December 2022 and has gained 16,458 users as of January 2024. It offers a range of valuable features, including information on crime prevention, transportation, cultural events, administration, precise bus arrival times, a fine dust map, emergency SOS, tourist attraction

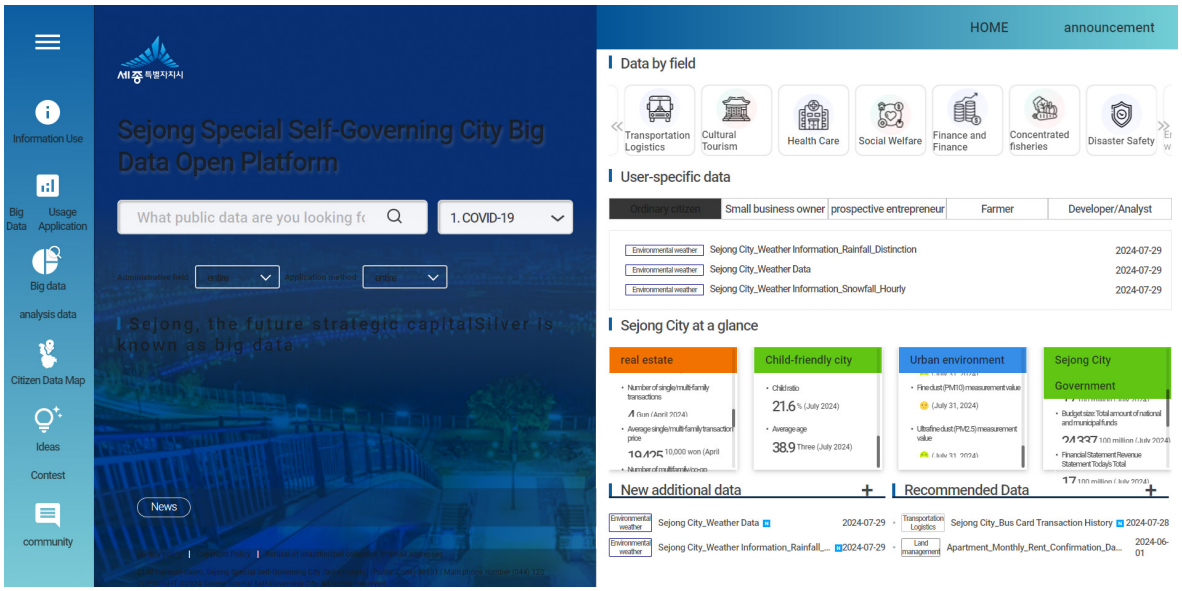
SejongN and COVID-19

The SejongN project has had a significant impact in the wake of the COVID-19 outbreak. As the virus spread, there was a surge in demand for masks, leading to long lines and many people being turned away due to stock shortages. To address this challenge, Sejong utilized ICT in three ways. First, they developed a map with information on mask availability, then they incorporated personal GPS data with consent, and finally, they made public data accessible to citizens through Open API.

Thanks to these efforts, Sejong was able to provide real-time updates on mask sales through Sejong N. They also made the “5-day stock and out-of-stock time trend” public for the first time in the country, addressing citizens’ inconvenience. With these changes, information shifted from text to image, allowing users to easily check details such as mask arrival time, inventory levels, and stock trends at nearby stores based on their current location when accessing Sejong N.

Furthermore, Sejong N played a crucial role in the National Assembly elections. Given citizens’ reluctance to vote due to concerns about infection at polling places, real-time updates through Sejong N informed people about the number of individuals waiting to vote, enabling them to select a less crowded time slot. This helped create a fast and safe voting environment, leading Sejong to achieve the second-highest voter turnout in the country.

In the wake of the COVID-19 crisis, it has become evident that city information not only enhances convenience but also significantly impacts the lives and safety of citizens.



Open Big Data Platform

Source: https://www2.sejong.go.kr/bigdata/

information, and the ability to reserve public facilities. The app serves as a platform for communication between citizens as well.

Data-driven City

Sejong aims to achieve a data-based smart city by making big data accessible. The city collects various information through a big data open platform and shares the analysis results with citizens to improve data accessibility. Furthermore, citizens can add value by downloading data from the open platform, processing and analyzing it as needed, and using it for technology development, research, and economic activities.

Smart Services for Citizens

Sejong provides services that citizens can directly experience. These services include Eoulling (a shared bicycle service), Smart Health App, Automatic Clean Net (an underground waste collection device), and Shucle (a demand-responsive bus service).

Shard Bicycle Service Eoulling

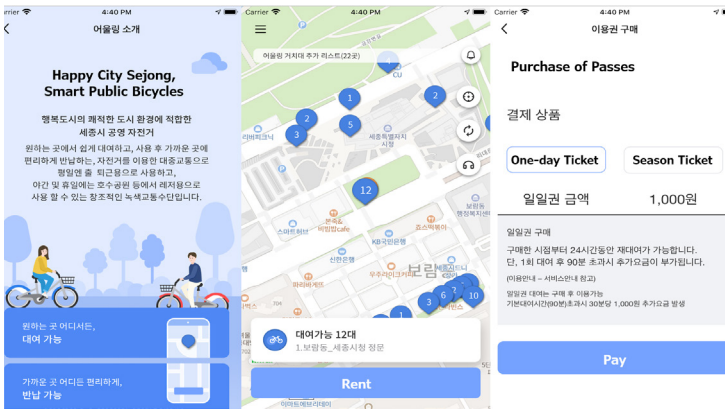
Eoulling is a public bicycle service in Sejong aimed at creating a pleasant urban environment within the administrative complex. It provides convenient and easily accessible bicycle-based public transportation. Users can rent a bicycle from any location and return it to a nearby spot after use. Primarily, Eoulling serves as a green transportation option for commuting to work on weekdays while also being available for leisure activities during the evenings and on weekends. By enhancing mobility within the city, Eoulling supports Sejong's green transportation policy as an environmentally friendly mode of transport.

Sejong Smart Health App

Sejong Smart Health app allows citizens to conveniently record and manage their health information, such as the number of daily steps, blood pressure, blood sugar, weight, and calories consumed. This app provides a customized health management service that integrates into citizens' lives by offering health challenges and providing health-related news and information. Individual health data is measured and accumulated by using Smart Health Zones, which are installed in 9 locations in the district (Hansol, Dodam, Areum, Jongchon, Saerom, Boram, Bangok, Hamil, Jochiwon-eup), to measure blood pressure, stress, height, weight, body composition, and physical strength. The app also offers health coach services to manage and provide accurate health information and knowledge. Additionally, it organizes health challenges such as walking missions and blood pressure measurement recording missions and rewards participants with health points, which can be exchanged for Yeominjeon, the local currency.

Eoulling

Source: Provided by KRIHS



Eoulling App[6]

Sejong Smart Health App[7]

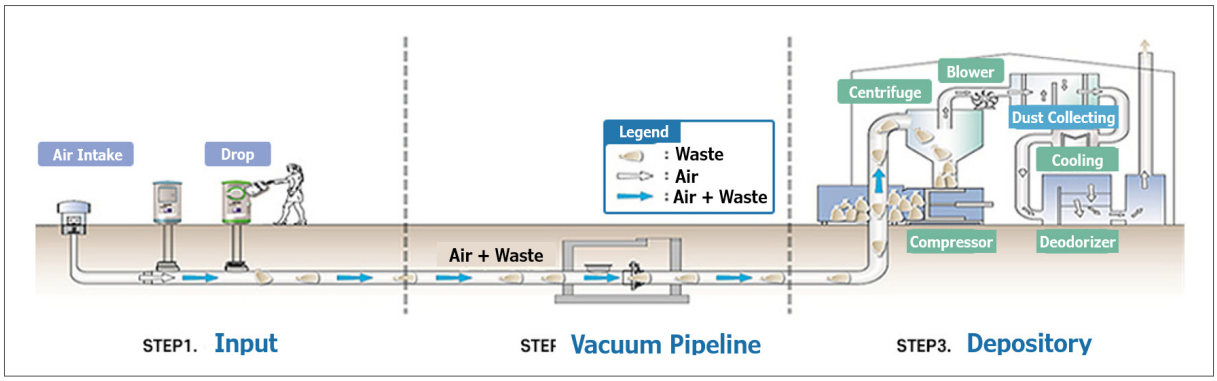
Auto Clean Net

Sejong Auto Clean Net is an automatic waste transfer system that is installed in homes and commercial buildings and collects household waste through underground pipes.

Auto Clean Net performs three key functions. First, it enhances efficiency and reduces environmental pollution by automatically collecting household waste. Food waste is directed to the Water Quality Restoration Center, where it is converted into resources, while general waste is sent to a waste-to-fuel facility to be used as an energy source. Second, the automated system addresses odor and aesthetic concerns commonly associated with waste collection. Third, Sejong continuously maximizes the system's efficiency through regular maintenance.

Auto Clean Net operates using smart technology to ensure citizens' convenience. For instance, each collection site processes waste using centrifuges and compressors purifies the air with deodorizers and cooling facilities, and discharges clean air outdoors. These systems play a crucial role in maintaining a clean and comfortable urban environment.

Through this initiative, Sejong is advancing environmental protection, promoting resource circulation, and reinforcing its identity as a smart city. The successful operation of Auto Clean Net is making a significant contribution to Sejong's development as a sustainable city.

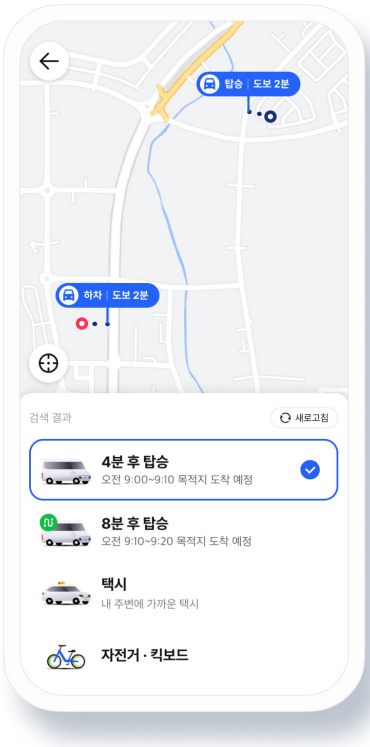


Sejong Auto Clean Net[8)]

Auto Clean Net

Sejong garbage collection center[9)]

Source: Provided by Sejong City



Shucle App[10)]

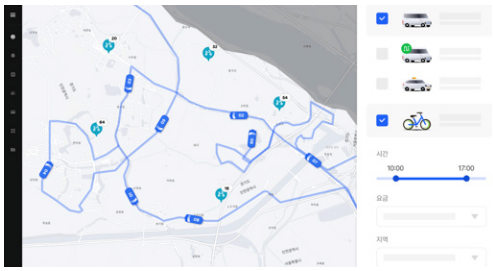
DRT (Demand Responsive Transport)

1) Shucle, AI-based Demand-Responsive Bus Shuttle

Shucle is a community mobility service that combines the words shuttle and circle. Using artificial intelligence (AI), the service optimizes shared routes for demand-responsive buses, reducing wait times and helping passengers reach their destinations faster than regular buses. Currently, there are 28 Shucle buses in operation. Since its introduction, Shucle has contributed to reducing traffic congestion and increasing accessibility by reducing private car use frequency by 42.1% and non-vehicle travel time by 70.3%. The service focuses on improving transportation efficiency and reducing environmental impact while providing a more convenient means of transportation for Sejong citizens.

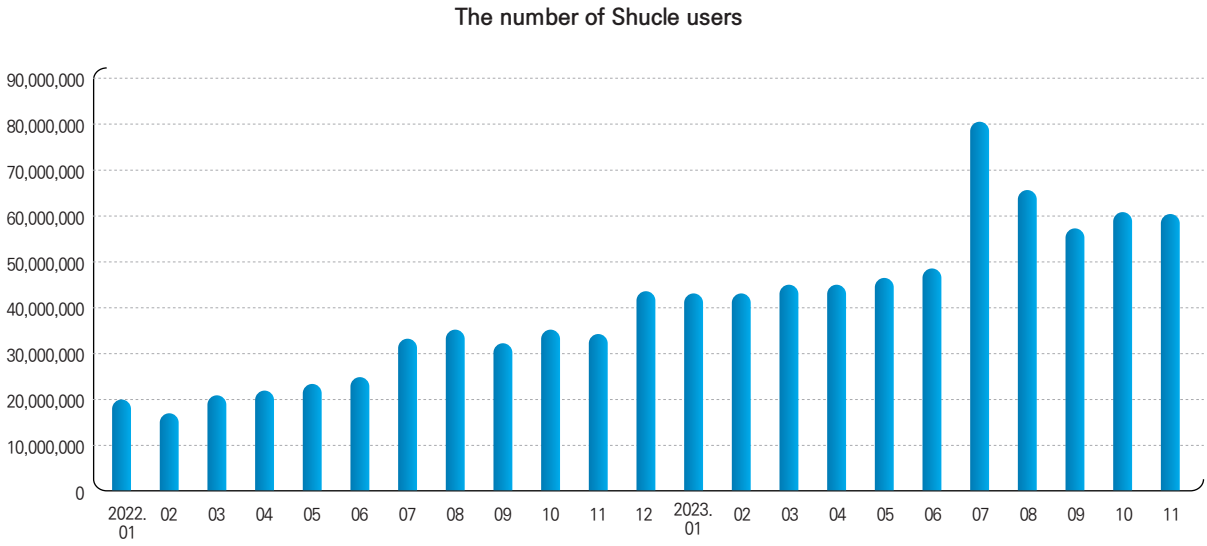
2) Duruta Bus, a call-based DRT

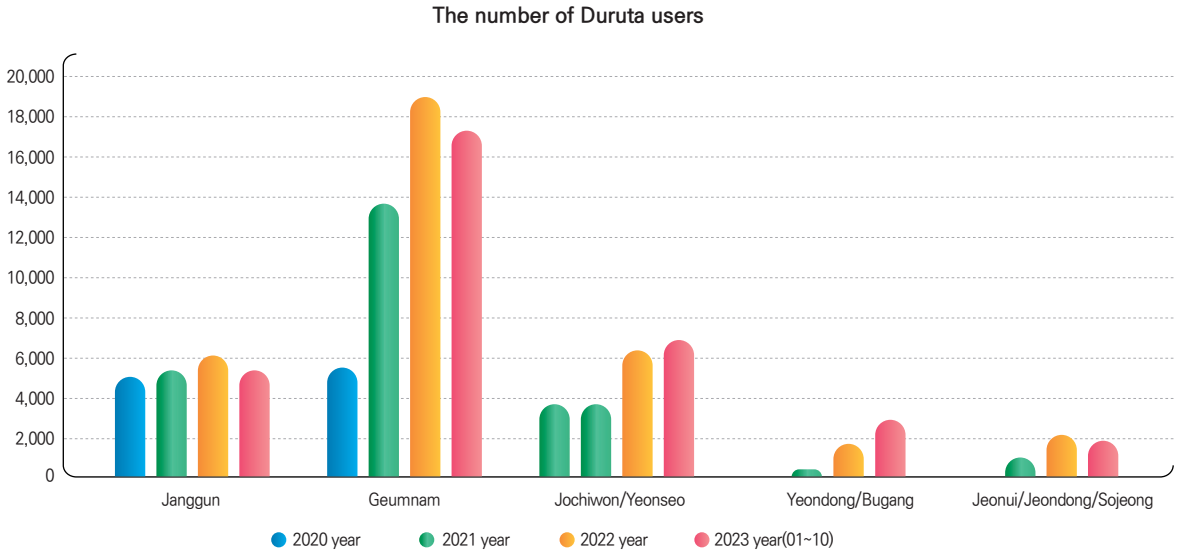
Duruta Bus is call-based DRT in Sejong. It mainly serves towns and villages with a high population of elderly people who have difficulty using smartphones. To use the service, passengers can reserve the ride through the app or by calling the designated call center at least 1 hour in advance. The bus operates in nine towns and villages in Sejong.



Shcule Bus Location Map

Shucle app and bus[11)]





Source: Provided by Sejong City

Year	Total	Control Performance by Type										
		Violence Prevention	Fire Prevention	Guidance for Drunkards	Missing	Littering	Traffic Accident	Citizen Safety	Theft	Facility Damage	Youth Misconduct	Etc
2020	210	11	19	0	0	5	11	100	1	51	1	11
2021	195	10	42	0	0	0	9	71	0	50	1	12
2022	242	11	36	0	0	0	18	108	1	51	1	16
2023	234	7	39	0	0	1	14	68	0	41	3	61
2024	54	1	15	0	0	0	10	16	0	9	0	3

Source: Provided by Sejong City

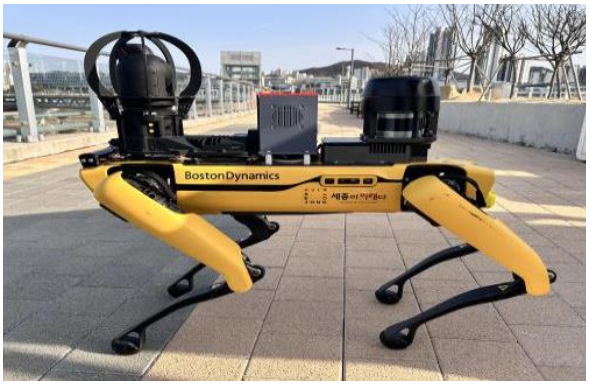
Smart Safe City

Urban Integrated Information Center

The Urban Integrated Information Center provides services related to 112, 119, and disaster management (NDMS), as well as services for the socially disadvantaged. These services include video analysis and monitoring to protect the lives and property of citizens in the event of an emergency. In order to benchmark the Urban Integrated Information Center, 767 foreigners visited the center in 2023.

Spot, the Patrol Robot Dog

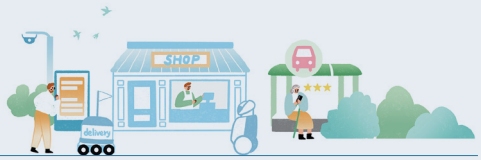
Sejong is the first city in the country to deploy Spot, a robot dog manufactured by Hyundai Motor Company's Boston Dynamics, for autonomous patrol. This four-legged robot began operating at Ieung Bridge, a tourist attraction in Sejong, starting in October 2023. Spot is equipped with artificial intelligence (AI) and various cameras, enabling it to perform autonomous walking patrols 24 hours daily. It can also use CCTV and sensors to perform tasks such as detecting fallen people and fires. The video captured by Spot is transmitted in real-time to the Urban Integrated Information Center, allowing the controller to monitor and respond to the video promptly.



Spot, an autonomous patrol robot

Source: Provided by Sejong City

Sejong National Pilot Smart City Project



The Sejong National Pilot Smart City aims to enhance the quality of life by leveraging artificial intelligence (AI) and cutting-edge technologies. This city will transform all phenomena, movements, and citizen behaviors into data, creating a highly connected and intelligent urban environment. Located in the 5-1 living zone of Sejong, the project is being developed with an investment of 3.1 trillion KRW and will serve as a testbed for future technologies.

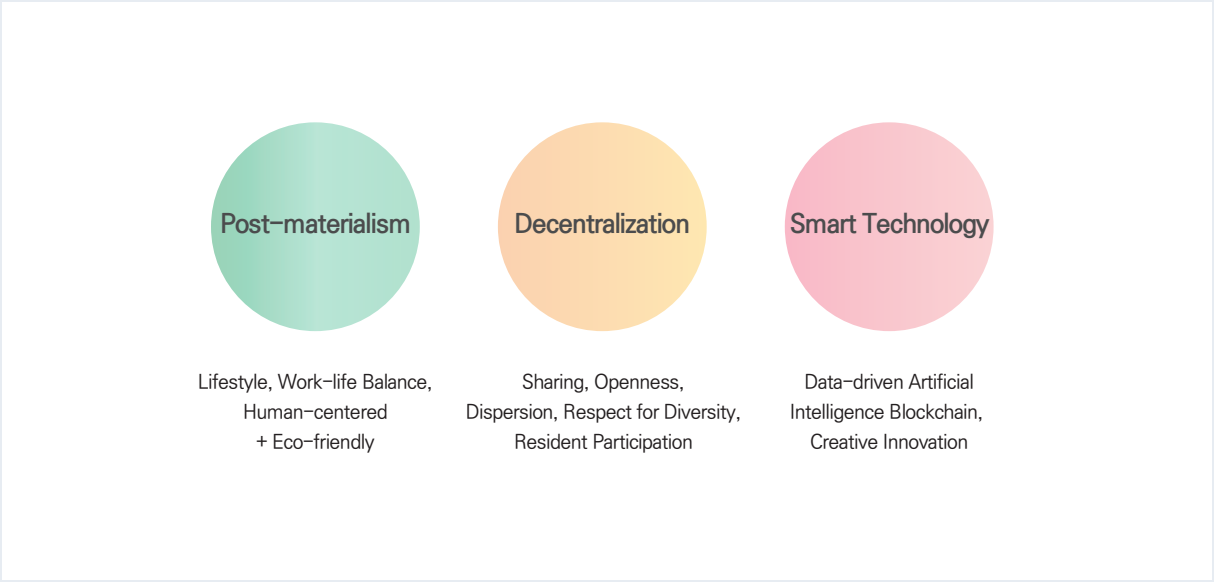
The city's infrastructure, including mobility and energy systems, is being designed to strongly focus on citizen well-being and happiness. The goal is to establish a world-class smart city built on advanced technologies, positioning Sejong as a platform for urban experimentation, domestically and internationally, through innovative applications of the 4th Industrial Revolution technologies.

The Sejong National Pilot Smart City project was selected on January 26, 2018, with its basic plan announced on July 16. An implementation plan was established on December 27, 2018, with construction commencing on June 30, 2020. The Special Purpose Company (SPC) was officially established on May 26, 2022.

Sejong National Pilot Smart City pursues happy citizens, a sustainable city, and creative values as core values based on the philosophy of 'a city as a sustainable platform that enhances citizen happiness and provides creative opportunities'.

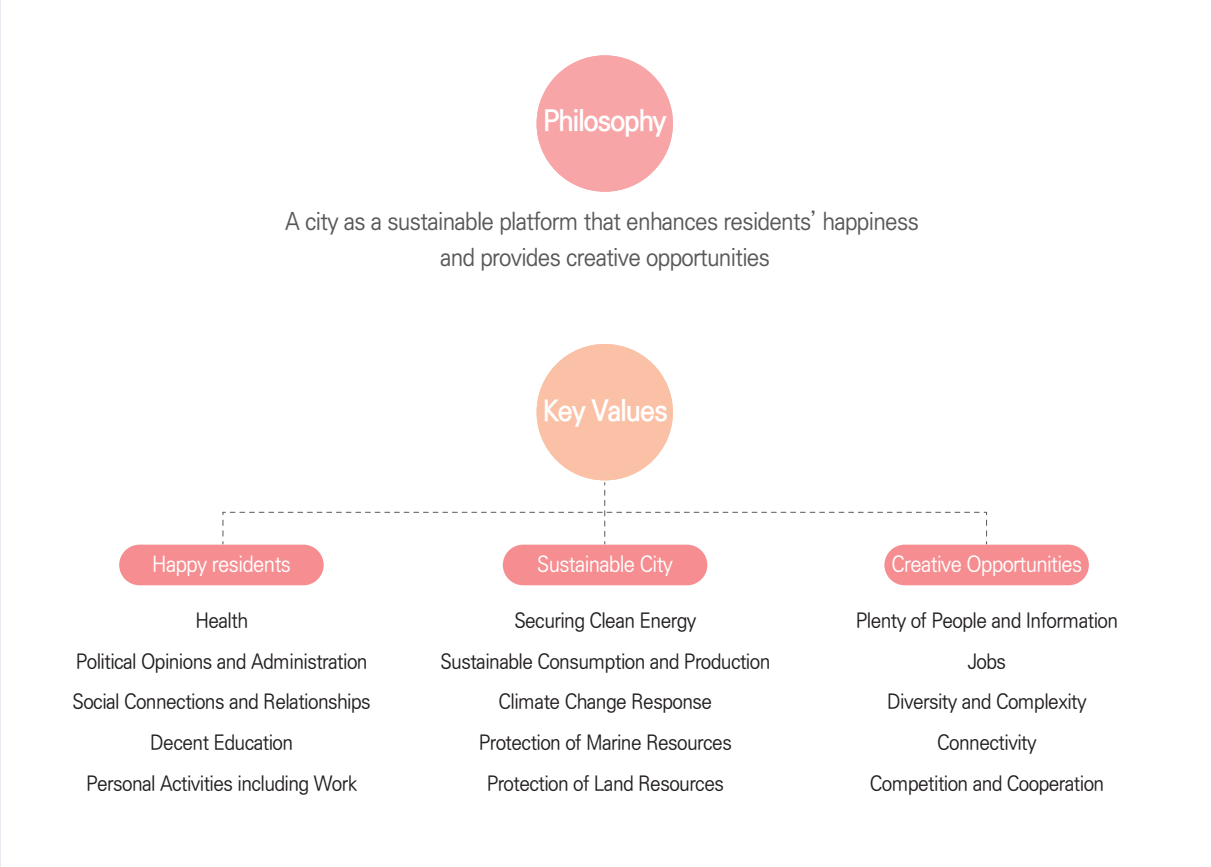
Urban Space Planning

The Sejong National Pilot Smart City will be located in the 5-1 living area to the east of Sejong's administrative city. Designed to accommodate a population of 20,000 people and 9,000 households, the city covers an area of 2,741,000 square meters. It will benefit from excellent transportation links, including its proximity to Cheongju Osong KTX Station, major highways, and Cheongju Airport. Additionally, being situated at the confluence of the Geumgang River, the city enjoys a beautiful natural environment. The Sejong National Pilot Smart City is built around four key concepts: a shared city, a walkable city, a city with job-housing proximity, and a city of experimentation. These principles aim to foster a highly connected, sustainable, and innovative urban environment.



Values of the Sejong National Pilot Smart City

Source: Jeong J.S., and Masterplan Team. 2019. p.23



Philosophy and Key Values

Source: Jeong J.S., and Masterplan Team. 2019. p.44

City of Sharing

The Sejong National Pilot Smart City plans to construct a circular lane exclusively for autonomous driving. Inside this lane, there will be a restricted vehicle access zone where privately owned vehicles are not allowed. Shared vehicles will be available in this area. This approach, which restricts privately owned vehicles and promotes shared vehicle usage, aims to reduce traffic congestion and establish an efficient transportation system.

A City You Want to Walk in

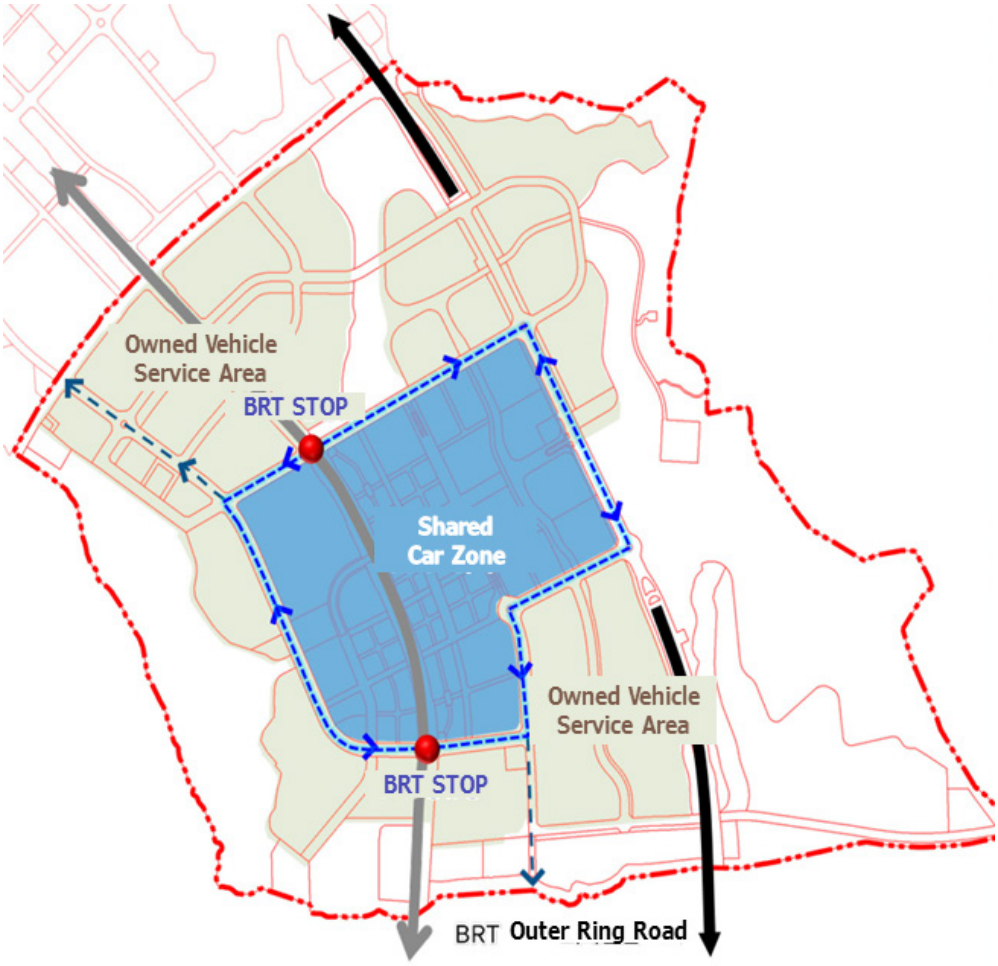
The Sejong National Pilot Smart City plans to create a walkable cultural shopping street within a 400m walking radius centered on the BRT main road. The goal is to provide pedestrians with various experiences and a pleasant walking environment. The city plans to achieve this by developing an open arcade-type cultural shopping street. This initiative is part of the broader effort to make The Sejong National Pilot Smart City a more appealing and livable place.

A City Close to Home

The national pilot smart city focuses on developing areas with mixed land uses that include business and residential spaces. The city aims to create major corporate and office zones and encourage the concentration of businesses to integrate work and living spaces. This will help residents reduce commuting time and expenses, leading to a more balanced lifestyle. These plans are intended to ensure a strong connection between work and life within the city.

Innovative Experiment

The Sejong National Pilot Smart City is designed to be a hub for innovation, offering spaces where various experimental projects can take place. It is fostering an environment conducive to research and discovery, including the creation of a complex communication center to facilitate collaboration and idea generation. In addition, the city plans to establish regional welfare centers and medical facilities, ensuring that citizens have access to essential welfare and healthcare services.



Shared Car Zone

Source: Sejong Special Self-Governing City. 2023b. p.14

The seven major services

The Sejong National Pilot Smart City offers seven key services aimed at building a cutting-edge smart city. These services encompass mobility, healthcare, education and jobs, governance, energy and environment, culture and shopping, and life and safety.

Mobility

The Sejong National Pilot Smart City aims to reduce car usage by one-third compared to other cities of similar size. Residents will park their private vehicles outside the pilot district and rely on shared cars within the area. All destinations will be within 50 meters of a parking lot. The city will also create a shared transportation system, including self-driving public transport, which will reduce dependency on personal vehicles, create a safer and more efficient transportation system, and improve urban living quality while contributing to environmental sustainability.

Healthcare

The city's goal is to build a comprehensive healthcare network to ensure the well-being of its residents. A smart home system will monitor health indicators and automatically regulate home environments, such as temperature, humidity, and ventilation. This data-driven approach will enable personalized healthcare

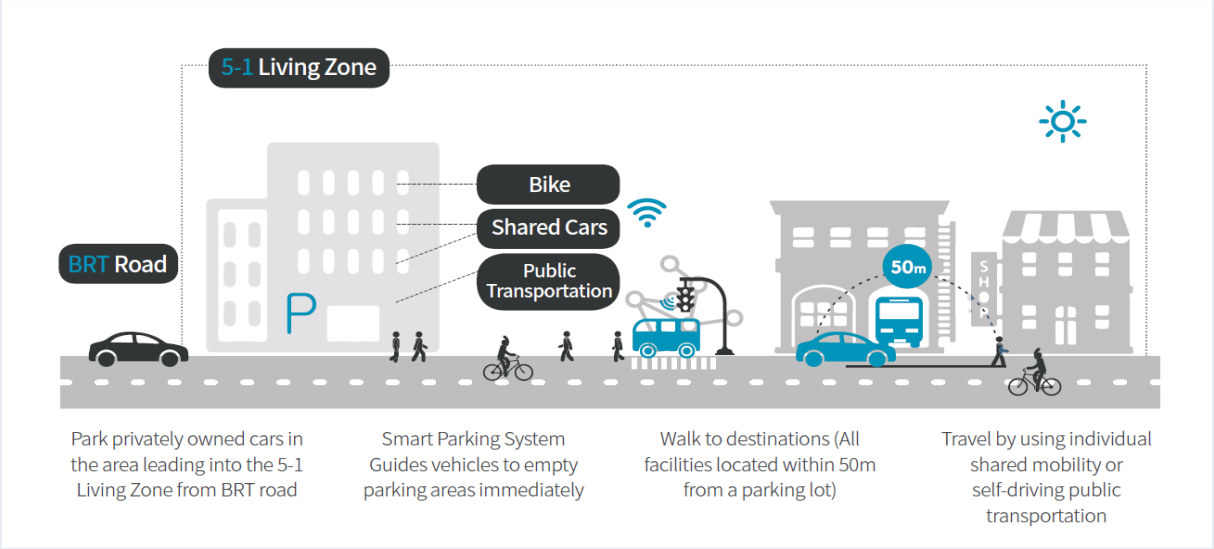
A mixed-use development plan to achieve proximity between workplace and residences

Source: Jeong J.S., and Masterplan Team. 2019. p.95

services. Additionally, care robots will assist elderly and vulnerable populations, and emergency drones will be deployed in urgent situations to provide immediate response and support.

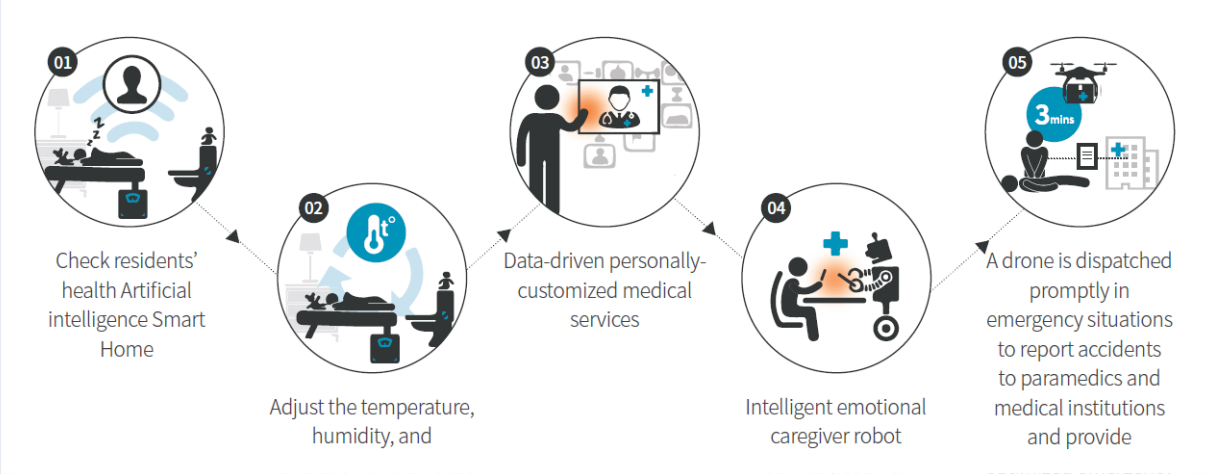
Education and Jobs

The Sejong National Pilot Smart City promotes critical and creative thinking in youth through the implementation of the International Baccalaureate (IB) education system, hands-on learning with maker equipment, and AI-driven tools for personalized instruction. For adults, lifelong education programs will focus on entrepreneurship and skills development to support employment and adaptability in a rapidly changing job market. The city also aims to create a thriving business ecosystem that encourages innovation and job creation, positioning Sejong as a hub for economic growth and opportunity.



Mobility

Source: Jeong J.S., and Masterplan Team. 2019. p.45



Healthcare

Source: Jeong J.S., and Masterplan Team. 2019. p.45

Governance

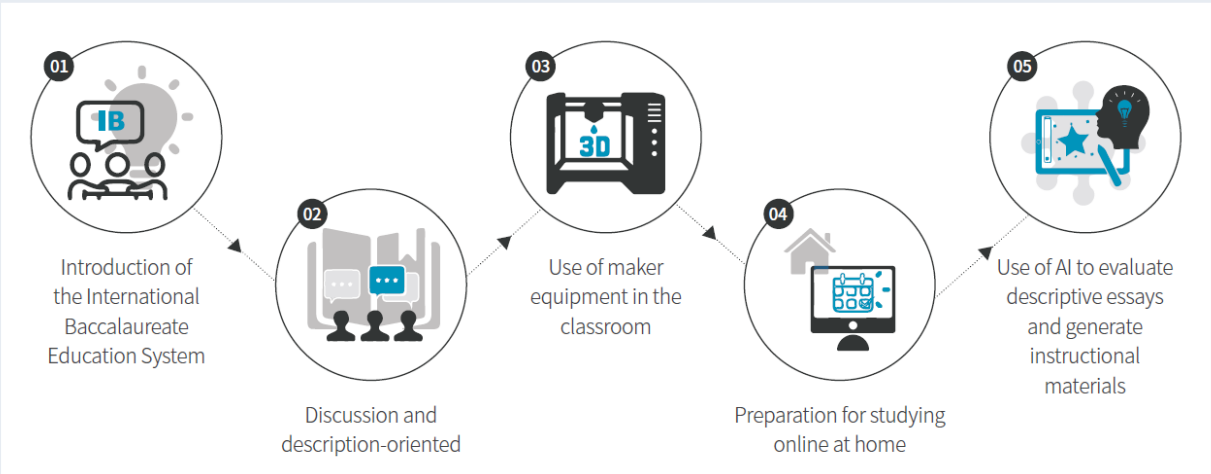
The governance of Sejong National Pilot Smart City emphasizes citizen participation and efficient administrative processes. Using smart technology, the city will enable direct engagement between citizens and various stakeholders through platforms like the Living Lab. Citizens can voice concerns, submit opinions, and participate in decision-making, fostering a transparent, responsive, and sustainable governance system focused on open innovation and community collaboration.

Energy and Environment

Sejong's energy strategy focuses on reducing fossil fuel use and minimizing carbon emissions through renewable sources such as solar, bioenergy, and hydrogen. The city will also generate energy from waste, including food waste, to lower carbon footprints. Smart grid technology will be employed to integrate distributed energy resources and energy storage systems, ensuring efficient energy use. Green buildings with advanced insulation, natural ventilation, and solar power, alongside electric vehicle infrastructure, will reduce urban energy consumption and promote environmental sustainability.

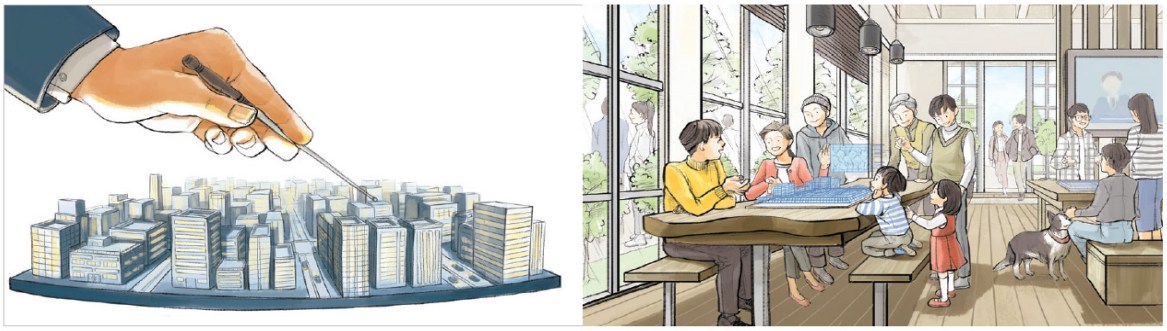
Culture and Shopping

Sejong National Pilot Smart City will provide a dynamic



Education

Source: Jeong J.S., and Masterplan Team. 2019. p.46



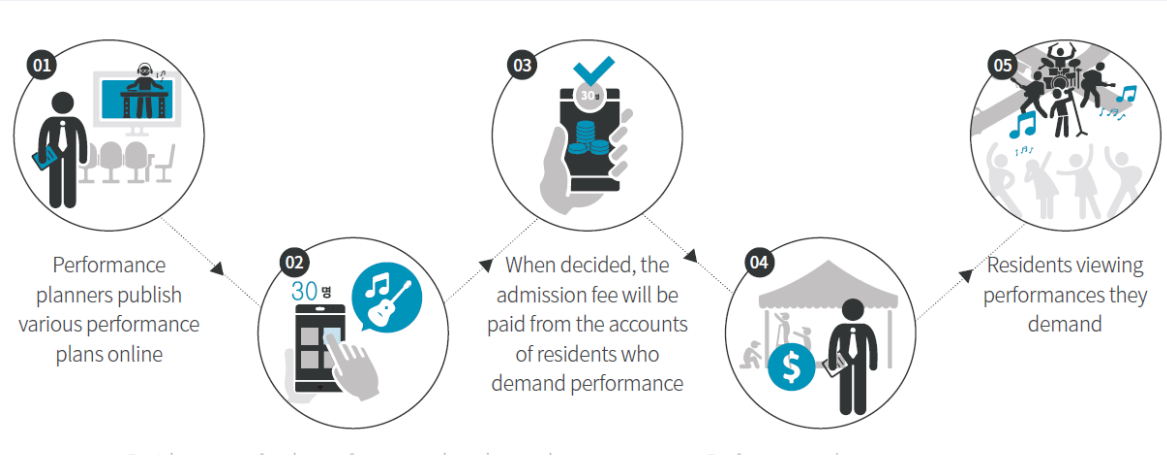
Governance

Source: Jeong J.S., and Masterplan Team. 2019. p.142

cultural and shopping experience, engaging citizens through smart services. Performances will be pre-connected to audiences, allowing citizens to vote for their preferred events ensuring reliable hosting of performances. Smart shopping services will offer store information, visitation, payment, and delivery throughout the city, creating a seamless experience for shoppers.

Life and safety

The city will be monitored through an integrated system of CCTV, streetlights, mobility, and drones, ensuring no blind spots. AI will analyze data to detect potential hazards and prevent incidents. Road hazard information, such as fog, rain, and snow, will be transmitted to self-driving vehicles, ensuring safer transportation. The city will also implement smart farming services to address urban food challenges, promoting sustainable agriculture and food security.



Culture

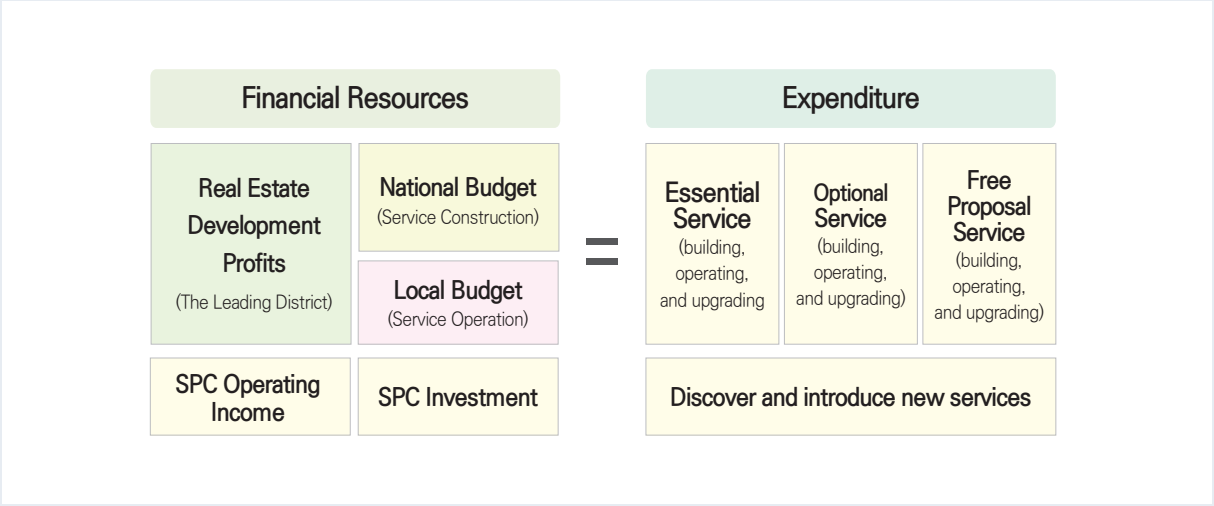
Source: Jeong J.S., and Masterplan Team. 2019. p.46

National Pilot Smart City Service Contents

Services	Service Contents
Smart City-based Service (6)	(AI Data Hub) Provides AI and big data-based analysis functions by establishing an integrated data storage for data-based city operation.
	Install smart poles containing IoT sensors such as smart lighting, public Wi-Fi, and CCTV to create a foundation for collecting city information and improve citizen safety and convenience of living.
	(Digital Twin) Build an innovative city that can proactively respond to problems by integrating 3D spatial information and establishing an open digital twin platform
	(Cybersecurity) Establishment of a smart city service base that is safe from information infringement by applying real-time monitoring of misuse and abuse of personal information and security measures for core facilities.
	(Citizen App) Integrated app provides one-touch access to daily life services and online citizen participation services such as E-Voting
	(Integrated city operation) Smart service operation status control facility operation
Smart Mobility (7 types)	(Personal Mobility) Providing personal mobility sharing service to increase first & last mile mobility of public transportation and citizen convenience
	(Car Sharing) Providing car sharing service for citizens living in restricted vehicle areas.
	(Autonomous Driving Mobility) Providing self-driving car service that circulates in restricted areas for owned vehicles
	(Integrated Mobility) Providing a service that recommends the optimal route when citizens use public transportation and allows integrated payment and settlement of fares
	(Demand-responsive Mobility) Provides optimal dispatch and route according to citizen demand through AI-based user pattern analysis and eliminates blind spots in public transportation services
	(Smart Parking) Providing AI and big data-based parking control services such as shared cars in parking lots near restricted areas for owned vehicles.
	(Convergence Charging Infrastructure) Establishment of electric vehicle charging infrastructure
Life Innovation Service (8 types)	(Personalized Health Management) Operates a healthcare zone , provides AI-based health management analysis services, and links exercise and diet management programs using wearable devices.
	(Smart Integrated Delivery) On-demand delivery service using delivery robots so that consumers can safely receive delivered products at the desired time
	(Smart Farm) Establishment of a smart farm where citizens directly participate in cultivation and produce safe food ingredients.
	(Integrated Media) Providing digital content and customized information quickly and easily through various media in the city center
	(Untact and Service) Providing customized services through personalized analysis, applying tagless such as facial recognition * Service name changed
	(Smart Home/Town Management) Integrated operation of smart homes/towns in the leading district, provision of online community for residents, online reservation of public facilities, etc.
	(Complex Cultural Space) Establishment of a media art space in the leading district where smart media technology, art, art and music are provided to citizens in a complex manner.
	Providing future financial services such as kiosk banking, urban life data-based financial services, and fintech services

Leading District in the Sejong National Pilot Smart City

The leading district, part of the national pilot smart city, will be developed by a SPC and consists of a total area of 2.74 million square meters. The district plans to offer 21 innovative services, including an AI data hub and smart IoT, within an area of 340,154 square meters. The aim is to create a city with smart service infrastructure, and any profits from development will be reinvested in services. The district comprises two spaces: the Innovation Venture Startup Zone, which aims to encourage innovative companies, and the Smart Living Zone, designed as a residential complex.



SPC's financial and expenditure structure

Source: Ministry of Land, Infrastructure and Transport. 2020. p.12

Source: Provided by Sejong City

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Sejong Birth Process Archives https://www.sejong.go.kr/archive/index.jsp?link=0

Sejong National Pilot Smart City The First White Paper

https://drive.google.com/file/d/17OmHavAfxF_ZkyPmb9BlFHsQuug-Nw7S/view?usp=sharing

Sejong Photo Studio https://www.sejong.go.kr/sejongphoto.do

Sejong Smart City https://smartcity.sjtp.or.kr/smartCity/smartCity?mid=a10103000000

Sejong Smart City Open Big Data Platform https://www2.sejong.go.kr/bigdata/

Sejong Special Self-Governing City Environmental Education Center https://sjeec.or.kr/

Shucle https://www.shucle.com/

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6) https://play-lh.googleusercontent.com/nyAhUgWBYc_Vv8fotwDzVkDAAXeZ1-qmRwlMWosZQDm'9lHNw8k21goJcLEqm1dtyiqi=w526-h296-rw
7) https://play-lh.googleusercontent.com/qBB47RVAHgFXrX-p_GCzTFHHJZWN3Cy1Hey_tDyVB0UxoWNlVEQZn2XDMQF-ltiXTIDs=w526-h296-rw
8) https://www.sejong.go.kr/images/recycle/sub05/sub050301.jpg
9) https://sjeec.or.kr/uploads/2023/12/19/1702980289_c02e530261e8d26e86bb.jpg
10) https://images.squarespace-cdn.com/content/v1/658ba86efc1fb41193cd1906/1703651443092-2S5B441839SVFMODBBQ8/app_phone_mockup.png?format=2500w
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CHAPTER

5

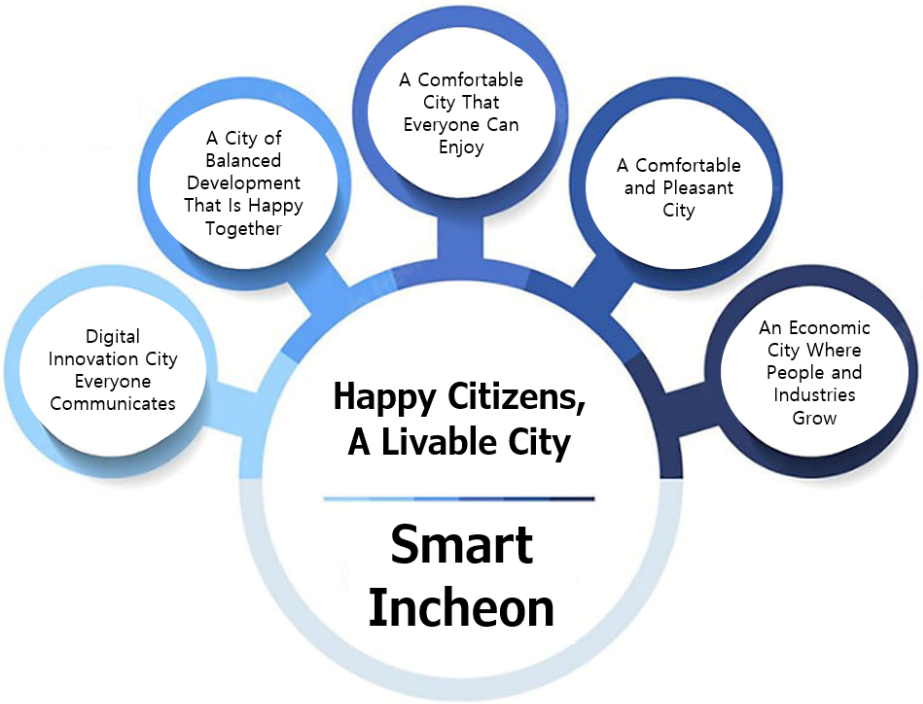
Incheon

01 Incheon, Gate of the Republic of Korea

Incheon, adjacent to Seoul, is Korea's third-largest city with a population of 3 million. Covering an area of 1,067 square kilometers, the city is home to both a historic city center and a modern urban landscape. The latter includes the Incheon Free Economic Zone (IFEZ), which consists of Songdo International City, Yeongjong International City, and Cheongna International City.

Designated as Korea's first free economic zone in 2003, IFEZ has grown significantly. In the 2010s, the global rise of smart cities positioned Songdo International City as a leading example of a smart city from Korea. Yeongjong International City, located on the island where Incheon Airport is situated, is developing into a major smart airport hub.

Incheon envisions itself as a livable and digitally innovative city where citizens can thrive. The city strives to be a place of happiness and inclusivity, offering a comfortable and safe environment for all. Incheon is actively promoting a range of smart city services aimed at creating an economic city where both people and industries can grow together. These initiatives include digital twin administration, XR metaverse, a citizen participation Living Lab, I-multimodal services, an integrated platform and data hub, Incheon Craft, and the expansion of smart village services.



Smart Incheon Vision and Strategies[1)]

02 Digital Twin Administration & Metaverse

Digital Twin Administration

Incheon is revolutionizing city administration through the use of digital twin technology. This technology creates a digital replica of the entire city, allowing for the replication of real environments and the simulation of various scenarios in three dimensions. By doing so, Incheon can anticipate and address issues arising from changes in the urban environment before they occur. This approach minimizes administrative errors and reduces social costs.

Additionally, Incheon is introducing several smart city services leveraging digital twin technology. For example, through an

Incheon Metropolitan City Solar Power Monitoring Pilot Service[2)]

Digital Twin-based Fire Truck dispatch[3)]

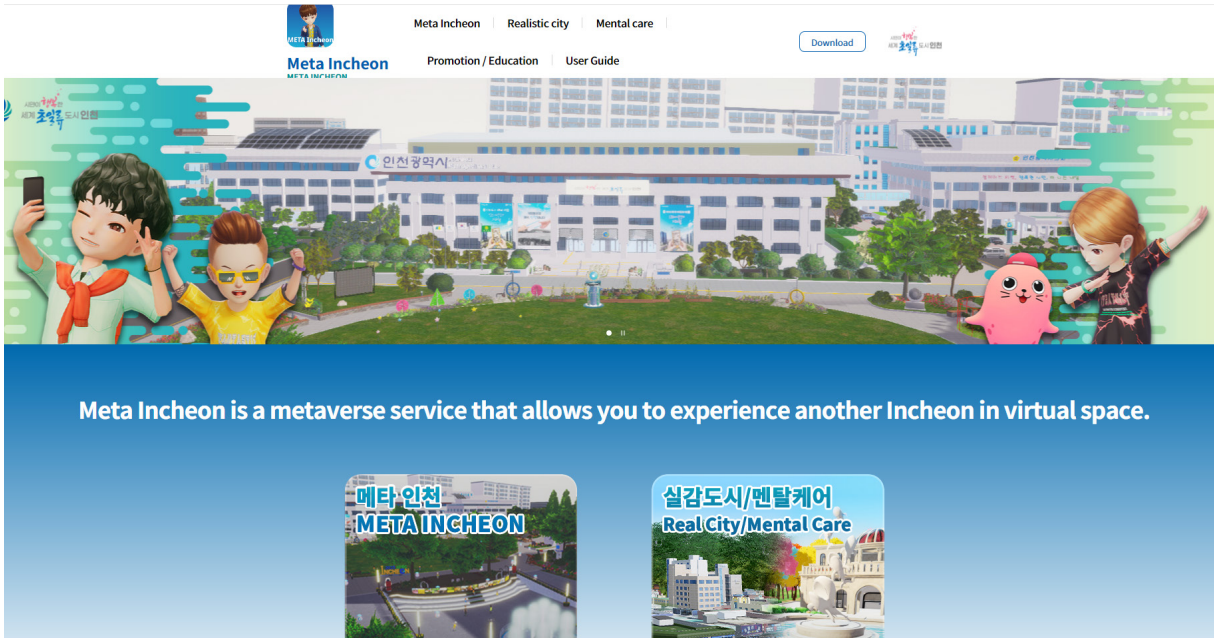
integrated fire response on-site command platform, the city provides on-site dispatch navigation and three-dimensional command capabilities during emergencies, enabling efficient and swift responses, such as in a fire.

Metaverse

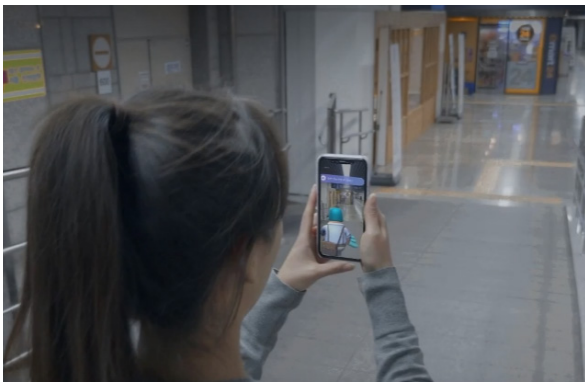
Incheon has developed its own metaverse, featuring a digital twin that mirrors the real world in scale. This virtual space offers a wide range of services, including tourism, shopping, and convenience, all within an extended reality (XR) platform that seamlessly blends online and offline experiences. Notable services include the Incheon Airport XR service, the Incheon Open Port docent service, and the Bupyeong Station XR navigation system.

Additionally, Incheon has created Incheon Craft using Minecraft, a popular metaverse game, to showcase the city's past, present, and future. Incheon Craft reproduces key aspects of the city's history, such as the prehistoric Ganghwado dolmens, the port opening era in the 1900s, Incheon Airport, the Incheon Bridge, Incheon City Hall, and Songdo. The platform features an online LAN travel feature, enabling users to explore and experience the cultural and historical significance of Incheon in a game-like environment.

Moreover, Meta Incheon has created a virtual world that closely mirrors reality, offering services like open municipal administration, administrative functions, and a virtual city council experience. In this digital environment, users can also virtually visit and experience Wolmido, recreated as a digital twin.



Meta Incheon[4]



Incheon Craft[5]

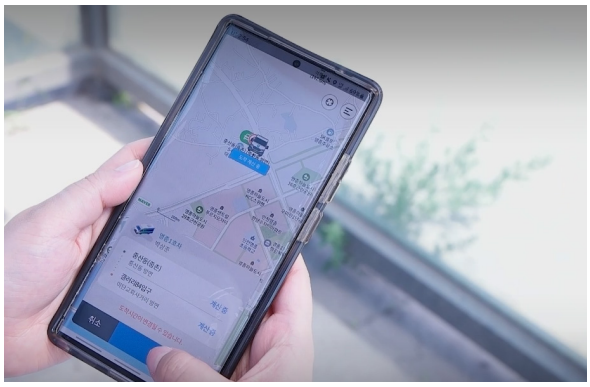
03 Smart Transportation and Safety

Smart City Integrated Platform

The integrated platform is a city operating system that gathers, organizes, and utilizes CCTV footage and extensive city data to promptly address traffic issues, prevent crime and disasters, and enhance efficient city operations. To achieve this, Incheon has set up 253 kilometers of cables and transmission equipment to establish a 10Gbps high-speed administrative information and communication network. This network integrates various information systems related to crime prevention, traffic management, and disaster response that were previously managed separately by different agencies and departments within Incheon, enabling real-time monitoring and coordination across the entire city. Furthermore, the establishment of the integrated platform allows for the effective coordination of public safety services and helps address safety disparities between the old and new city centers.

Demand-Responsive Bus

Incheon, in partnership with the Hyundai Motor Company consortium, has introduced an artificial intelligence-based Demand Responsive Transport (DRT) system, becoming the first local government in Korea to do so as part of the Smart City Challenge project led by the Ministry of Land, Infrastructure and Transport. Incheon has promoted this service, which involves using a mobile app to request demand response buses that are dispatched



I-MOD[6]

through an AI algorithm, replacing the traditional phone call and human dispatch method. The service was initially introduced in Yeongjong International City near Incheon International Airport and has since expanded to Songdo and Geomdan New Town. By June 2022, the cumulative number of passengers using the service had reached 390,000, with a total of 50,000 members. These innovative transportation services are significantly enhancing convenience for citizens and contributing to the development of an efficient public transportation system.

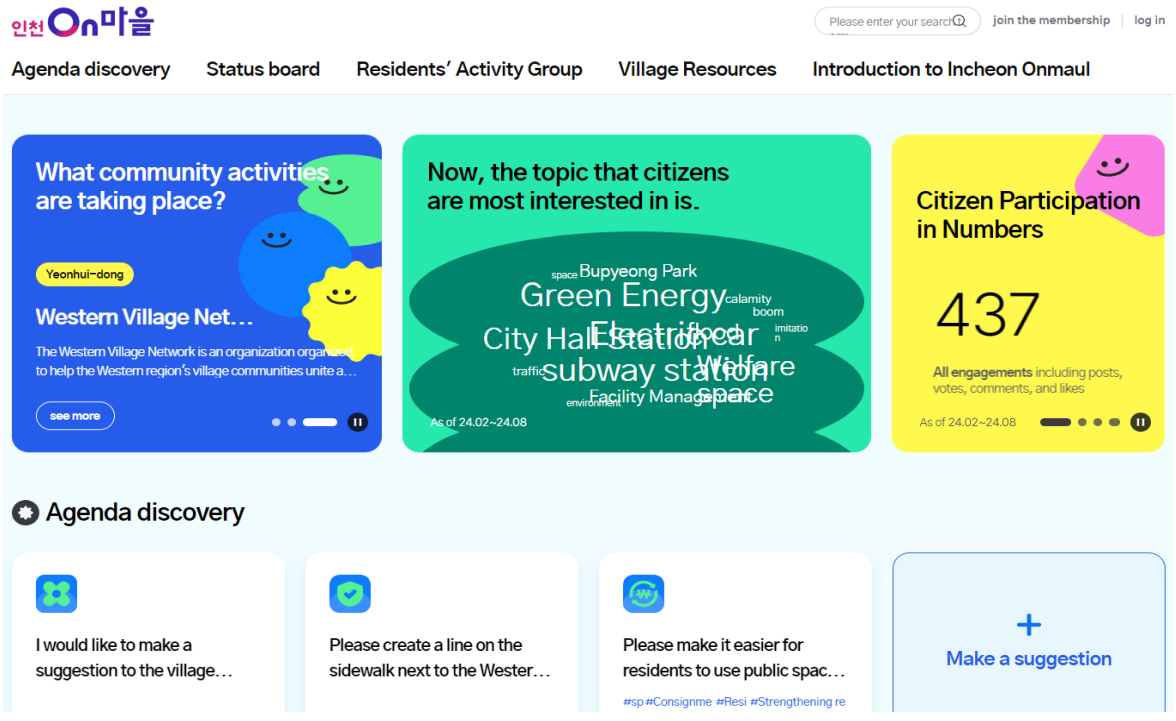
Citizens Participating in City Administration

In Incheon, a Living Lab is being run to identify urban issues from the viewpoint of the citizens and solve them with creative ideas, aligning with the city administration's principle of citizens participating. The Living Lab contest in Incheon aims to establish a local community foundation and operate a citizen-led Living Lab to address urban problems and find solutions using advanced technology.

Incheon has created a platform, named Onmaeul to address urban issues through active citizen participation. The Onmaeul platform offers several key features to engage residents:

- It provides a space where residents can easily plan and participate in local development activities.
- The platform serves as an online hub where various citizen participation groups, including residents, self-governing associations, Living Labs, and village communities, can collaborate.
- Residents are given an avenue to directly propose solutions and resolve local issues.
- The platform allows residents to identify and make use of local assets based on their community knowledge.

Additionally, the city manages 141 resident councils and communities through a digital management system. This system helps address the agendas and concerns raised by residents to resolve community issues. For example, one initiative involved painting murals with residents on aged village walls to enhance the local environment. Moreover, Incheon has established a resident-participatory resource circulation model to reduce the use of disposable delivery items and promote the discovery of local upcycled products made from recycled materials, encouraging sustainable practices within the community.



Inceon Onmaeul[7]

Incheon Free Economic Zone Industrial Complex Development Project

Creation of Incheon Free Economic Zone (IFEZ)

The Incheon Free Economic Zone (IFEZ) was established in 2003 as Korea's first free economic zone, aimed at actively attracting foreign investment by improving the business environment and living conditions for foreign-invested companies. The goal of IFEZ is to maximize the autonomy of economic activities and offer investment incentives to companies through the easing of various regulations. This special economic zone is located in western Incheon and is comprised of three major districts: Yeongjong International City (home to Incheon International Airport), Songdo International City (a global hub for IT, BT and cutting-edge knowledge and service industries), and Cheongna International City (a center for international finance and distribution).

Former Deputy Prime Minister Kim Man-je explained the rationale for choosing Incheon as Korea's first free economic zone. He emphasized Incheon's geographic advantage of being near Incheon Port and Incheon Airport, making it well-positioned to become an international city. Incheon's location offers strategic access to 43 cities with populations of over 1 million, within a three-and-a-half-hour flight from its airport, connecting it to key regions such as Japan, China, and Siberia.

IFEZ's development began with the initial plan for public water reclamation in the Songdo area in 1979. Following this, the zone was officially designated as a free economic zone in 2003, based on plans that included the development of Songdo new town, the construction of the new airport on Yeongjong Island, the reclamation of the Cheongna area, and the creation of a business hub for Northeast Asia. Songdo's development started with public water reclamation in 1994, with the land sold to cover development costs.

The completion of the Incheon Bridge in 2009 marked the beginning of visible development in IFEZ, particularly in Songdo International City. During this period, there was a surge in development and foreign investment, especially in housing and

IFEZ Vision and Strategies[8)]

About IFEZ

Source: Incheon Free Economic Zone Authority 2023. pp.10-11

Cheongna International City Development Overview

- Location: Cheongna-dong, Seo-gu, Incheon
- Area: 17.80 km²(6 times the area of Yeouido)
- Focus: International affairs(finance), high-tech industry, and distribution
- Budget: KRW 6.596 trillion
- Period: 2003. ~ 2024.
- Planned Population: 98,060(36,184 households)
- Current Population: 114,255(foreigners: 1,154)
- Major Projects:
  Business (financial) complex, theme-park-type golf course, flower market, high-tech industrial complex, robot theme park, and distribution industry

Songdo International City Development Overview

- Location: Songdo-dong, Yeonsu-gu, Incheon
- Area: 53.36 km²(18 times the area of Yeouido)
- Focus: International business, IT, and BT
- Budget: KRW 21.544 trillion
- Period: 2003. ~ 2030.
- Planned Population: 265,611(104,112 households)
- Current Population: 201,698(foreigners: 4,831)
- Major Projects:
  International Business Complex, Knowledge Information Industrial Complex, Bio Cluster, Songdo International Complex, High-Tech Industry Cluster, Songdo Landmark City, and Incheon New Port

high-tech industries. In 2009, revenue from land sales in IFEZ increased more than 2.5 times compared to the previous year, stabilizing IFEZ's financial structure and enabling continuous residential land supply. From 2009 to 2018, 68.7% of IFEZ's total revenue came from land sales, allowing it to move forward with development projects without relying on financial support from Incheon or the central government.

IFEZ is widely regarded as the most successful example of a free economic zone project in Korea. As of 2020, it accounted for 70% of all foreign direct investment in Korea's free economic zones, totaling approximately 18.3 billion USD and hosting 146 active foreign investment companies.

Under the theme of becoming a Global Business Hub City, IFEZ is pursuing four key strategies:

1. Global Business Hub: Strengthening the city's role as a center for global business.
2. Future New Growth Industrial City: Fostering innovation in high-tech industries.
3. Service Industry Hub: Positioning the city as a leader in service industries.
4. Attractive City for Living: Creating a city where people want to live, offering the best residential conditions and competitiveness.

These strategies are closely linked to IFEZ's smart city implementation, with a vision to transform Incheon into a Global Future City and a Smart Innovation Hub. This vision seeks to create an environment where residents can live conveniently and safely through advanced urban infrastructure and services powered by cutting-edge technology, reinforcing IFEZ's role as a leader in smart city development.

Global Bio Hub

IFEZ has established itself as one of the world's leading bio hubs, bringing together domestic bio companies, global corporations, and cutting-edge research facilities to create a world-class bio cluster. It is driving the global bio market by fostering synergy across a comprehensive value chain that includes pharmaceutical production, bio-R&D, and medical and healthcare services.

Mecca for High-Tech Industries

IFEZ is becoming a critical hub for high-tech industries, including semiconductors, aviation, automotive, and robotics. The aviation MRO (Maintenance, Repair, and Overhaul) industry is booming in Yeongjong, while the automobile and robotics sectors are flourishing in Cheongna. Additionally, a semiconductor cluster is forming in Yeongjong and Songdo, further positioning IFEZ as a leader in global high-tech innovation.

Smart City & Startup City

Incheon is embracing smart city technologies, integrating the 4th Industrial Revolution advancements into its urban infrastructure. The city manages the Songdo, Yeongjong, and Cheongna districts through its self-developed smart city platform. Incheon is also nurturing a vibrant startup ecosystem, with Incheon Startup Park playing a central role, helping transform the city into a leading hub for innovation and entrepreneurship.

Global Education City

IFEZ is emerging as a global education hub, hosting prestigious overseas universities, research institutes, and esteemed domestic academic institutions within the Incheon Global Campus (IGC). The city's focus on the bio and high-tech sectors has helped foster strong collaborations between academia and industry, further driving educational and research excellence both locally and internationally.

Global Tourism & Entertainment Hub

IFEZ is a premier global destination for tourism and entertainment, offering a rich blend of culture, arts, festivals, shopping, and leisure activities. Yeongjong features a world-class resort complex, while Cheongna is home to the iconic Cheongna City Tower and an innovative shopping mall centered around a lake park. In Songdo, Art Center Incheon hosts a variety of performances and festivals, making the city a vibrant cultural hub.

Eco City & Waterfront City

IFEZ is an eco-friendly ecological city that harmoniously integrates humans and nature. Green areas are interspersed throughout the city, alongside modern high-rise buildings. These parks and green spaces not only provide clean oxygen to the city's residents but also serve as healing spaces, akin to the way the Amazon rainforest supplies oxygen to the Earth.

Global Business City

IFEZ is recognized globally as a business city with world-class infrastructure tailored for high-tech companies and global organizations. As a testbed for new industries, it is leading the way in transitioning towards smart, convergent industrial structures, playing a key role in shaping the future of the 4th Industrial Revolution.

IFEZ's Digital Transformation

IFEZ Smart City Operation Center

IFEZ is comprised of Songdo New Town, Yeongjong Island, and Cheongna International City, with the Incheon International Airport located in Yeongjong. These three areas are efficiently managed through the Smart City Integrated Operation Center, which consolidates and operates all aspects of the smart city across the regions. Songdo, in particular, has leveraged the already established Cheongna Smart City Operation Center to develop a more advanced and interconnected urban management system, showcasing the integration of three regions—20 kilometers apart—into a cohesive smart city.

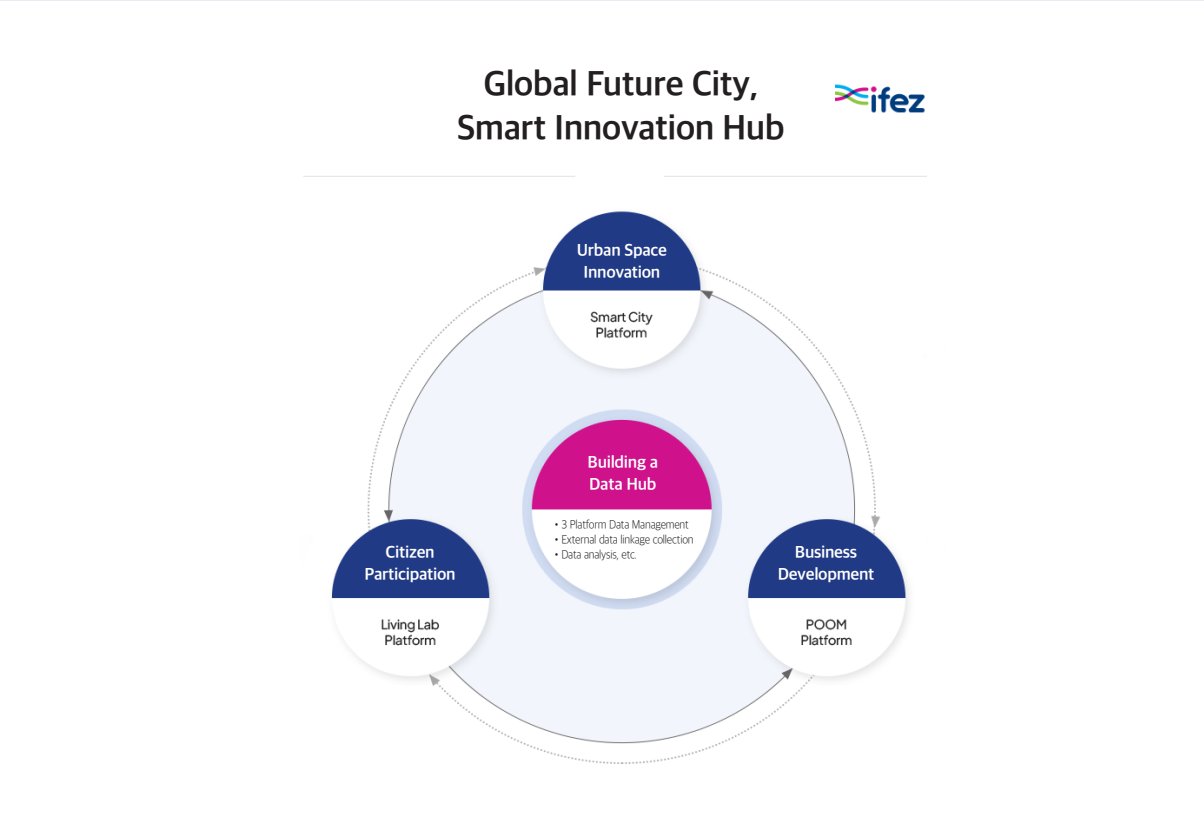
This integration is made possible by the Smart City Integrated Platform, developed by IFEZ, which efficiently manages and standardizes city data across these areas. Since its establishment in 2017, the Smart City Operation Center, located in G Tower in Songdo International City, has overseen the management of Songdo, Yeongjong, and Cheongna, using advanced control systems. These systems monitor every aspect of the city through an array of CCTV cameras and sensors, providing real-time data collection and integrated management through cloud technology.

Moreover, the center is linked to key organizations such as the Incheon Transportation Center, Incheon Fire Department, and Incheon Police Agency, enabling the seamless exchange of data across public services. This collaboration allows IFEZ to offer a wide range of smart city services, including:

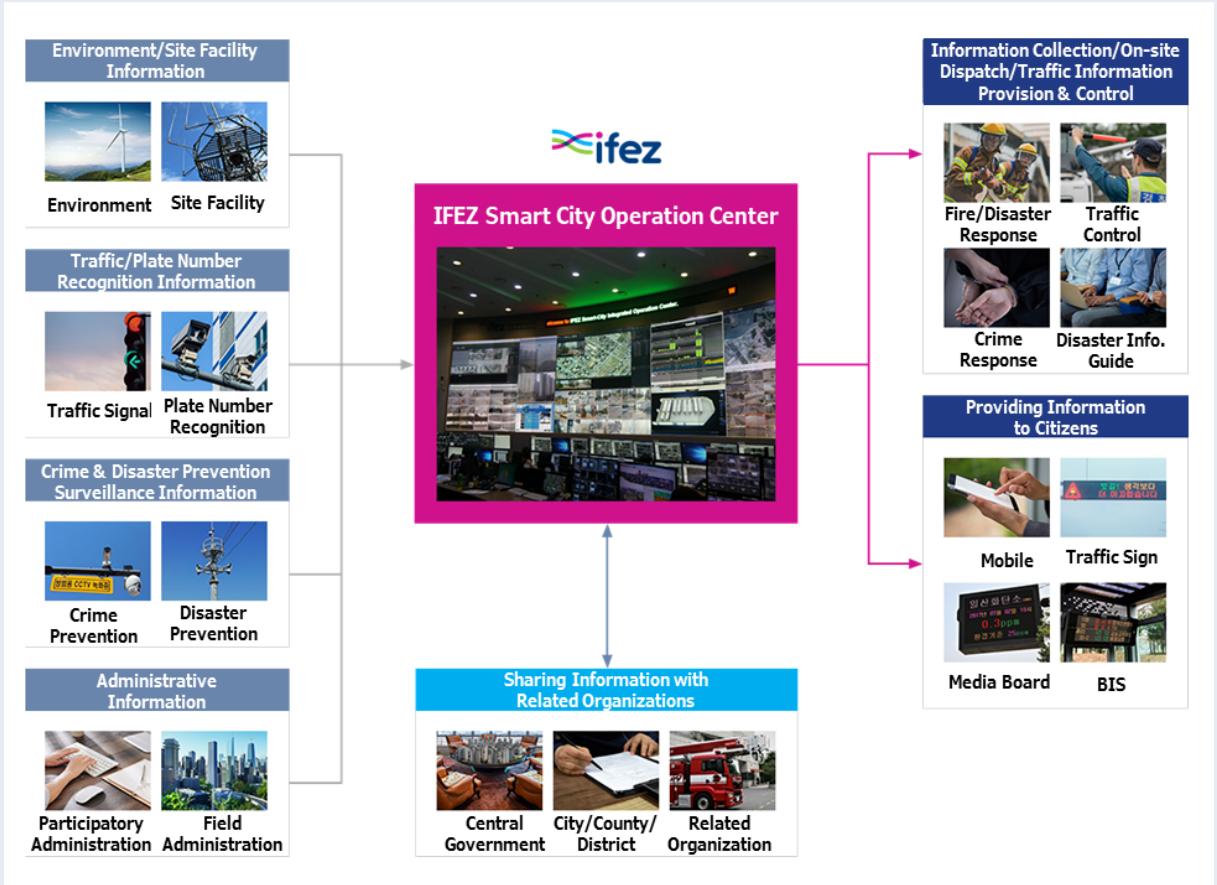
- Smart disaster prevention
- Smart crime prevention
- Smart transportation
- Smart facility management
- Smart portals

IFEZ Smart City Platform & Data Hub

IFEZ Data Hub consists of a smart city platform for city operations and a platform for corporate support. This hub aims to manage and analyze various data collected from the Living Lab platform with citizens. IFEZ promotes new industries, discovers public data with high industrial value, and de-identifies, and releases data, including structured and unstructured data. The goal is to link useful open data by combining public and private data. The data hub will be opened to discover integrated services using public data and to identify and support startups. IFEZ is establishing a continuous quality management system and promoting the operation of a company-wide organization and a private expert council for data processing.



IFEZ Smart City Vision and Objectives[9)]



IFEZ Smart City Operation Center [10]

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CHAPTER

6

Jeju

01 Climate-Neutral Island, Jeju

Jeju, located at the southernmost tip of Korea, is an island with a unique volcanic origin, having formed over 110 times during the Cenozoic Era. Hallasan Mountain, standing at 1,950 meters, is the highest peak in South Korea, and the island itself is primarily composed of basalt. Covering an area of 1,847 square kilometers with a population of approximately 670,000, Jeju is akin to a large city in size but stands out for its subtropical climate, making it a prime destination in Korea's domestic tourism industry. With a combination of breathtaking natural landscapes and distinctive cultural heritage, Jeju has earned its status as one of Korea's most popular resorts, attracting tourists from both home and abroad.

Jeju holds a special status under the Special Act on the Establishment of Jeju and the Development of Free International City, which allows for a visa-free stay of up to 30 days. Designated as Korea's first Free International City in 2002, it operates with a high degree of autonomy, enabling Jeju to make independent policy decisions and manage regional affairs efficiently. This unique status makes Jeju a pilot area for openness, liberalization, and the free movement of people, goods, and capital, positioning it as a critical hub in Korea's strategy for increasing national competitiveness. With these advantages, Jeju is steadily developing into a leading city in Northeast Asia for the 21st century.

In line with its forward-looking vision, Jeju is advancing its smart city initiative with the slogan "A space that connects intelligence-sharing-the future with citizens." This initiative prioritizes the values of sustainability, innovation, and inclusivity. The smart city development focuses on six key areas: environment/energy, transportation/safety, economy/industry, creative culture/tourism, health/welfare, and social integration.

Some of the specific goals and projects include:

- RE100 Town Pilot Service: Aiming for 100% renewable energy usage.
- Energy P2P Transactions: Enabling peer-to-peer energy exchanges.

Vision	A Space that Connects Intelligence, Sharing, and the Future with Citizens Digital Innovation Smart City, Sustainable Jeju					
Core Value	Sustainability		Innovation		Inclusive	
Objectives	Environment Energy	Transportation Safety	Economy Industry	Creative Culture Tour	Health Welfare	Social Integration
	Resource Circulation Eco-City Energy Self-Sufficient City	Leading Smart Mobility Smart Safety Jeju	Traditional Industry Innovation Leading the Future Industry	Creative City Global Tourist City	Personalized Healthcare Community Welfare	Citizen-led Balanced Development

Jeju Smart City Vision and Strategies

Source: Jeju Special Self-Governing Province. 2023. p.211

- Smart Hub: Creating a central digital platform for integrated smart services.
- Smart City Service Integrated Management Platform: Streamlining smart city operations.
- Smart Tourism Metaverse Service: Utilizing virtual reality to enhance tourist experiences.
- Demand-Responsive Smart Care: Implementing intelligent healthcare services.
- Jeju Smart City Lab: A space to test and develop smart city technologies.

Through these efforts, Jeju positions itself as a leader in specialized industries such as smart green cities, drone/UAM (Urban Air Mobility) hub cities, and digital twins. By integrating these cutting-edge technologies and approaches, Jeju is steadily advancing toward becoming a sustainable, global smart city.

Carbon Free Island, Jeju

Jeju is poised to become a carbon-free, environmentally sustainable city, mainly due to its favorable conditions for solar and wind power generation. The province's initiatives in new and renewable energy have been ongoing for several years, laying the foundation for a future powered by clean energy. Jeju's commitment to this vision is encapsulated in the Carbon Free Island Jeju by 2030 plan, introduced in 2012, which aims to achieve a carbon-free status by 2030.

The plan is structured in three stages:

1. Stage 1 (Gapado Island as a Pilot Model): Jeju began by establishing Gapado Island as a carbon-free island, serving as a model for renewable energy implementation.
2. Stage 2 (50% Renewable Energy by 2020): By 2020, the goal was to reach 50% renewable energy usage, expand smart grid technology, and increase the adoption of electric vehicles (EVs).
3. Stage 3 (Full Transition by 2030): Jeju aims to transition all electricity to renewable sources by 2030 and replace 75% of its transportation with electric vehicles to minimize greenhouse gas emissions and achieve energy independence.

To address the issue of energy surplus—where renewable energy production exceeds demand—Jeju is promoting electric vehicles (EVs) to increase demand and introducing Energy Storage Systems (ESS) to store excess energy. Additionally, the City Energy Management System (CEMS) is being developed to balance energy supply and demand through energy community towns. This system will also enable electricity trading and support emissions trading. Furthermore, Jeju is working on GRID+, a platform for small-scale renewable energy trading, to facilitate renewable energy distribution and market participation.

Wind Farm

Mobile ESS

Source: Jeju Special Self-Governing Province. 2023a. p.18

Electric vehicle chargin station

Source: Provided by KRIHS

Renewable Energy Sharing GRID+ Platform Scenario

Source: Jeju Special Self-Governing Province. 2023b. p.28

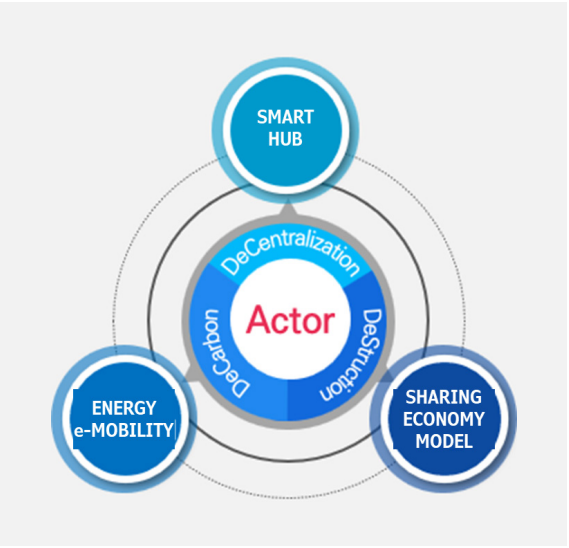
02 Smart Hub, a Space of Innovation

As the use of electric vehicles (EVs) grows globally, the demand for gasoline vehicles and gas stations is declining. In Korea, the number of gas stations dropped from 11,760 in 2018 to 11,144 in 2022, and the trend is expected to continue. Closing these gas stations incurs costs for land cleanup, leading to abandoned gas stations becoming urban nuisances.

In response, Jeju has partnered with GS Caltex, which is an oil company, to repurpose closed gas stations into mobility hubs as part of the e-3DA project. These hubs will not only provide electric vehicle charging stations but also offer personal mobility (PM) rentals, transforming gas stations into lifestyle-friendly spaces.

There are four types of smart hubs:

1. Gas Station Conversion: Existing gas stations are transformed into centers for renewable energy use.
2. Life-Friendly Hubs: Located in commercial districts like marts, cafes, and convenience stores, these hubs support electric PM rentals for locals and tourists.
3. Energy Community Towns: These hubs serve as community-centered spaces for renewable energy production and trading.
4. Convergence Smart Plus Hub: These hubs act as integrated control centers for energy and mobility sharing, facilitating energy optimization and smart transportation.



DeCarbon
provides a 'carbon-free' mobility environment with renewable energy.

DeCentralization
fosters local communities and 'decentralized hubs'.

DeStruction
Shifting from an ownership economy to a 'sharing economy' model for energy e- mobility.

e-3DA

Source: Jeju Special Self-Governing Province. 2020. p.6

03 Smart Mobility and Digital Platforms

Smart Mobility

Smart mobility is central to Jeju's smart city initiative, which aims to improve transportation for residents and tourists. The focus is on last-mile mobility solutions, including electric vehicles, electric motorcycles, bicycles, and kickboards.

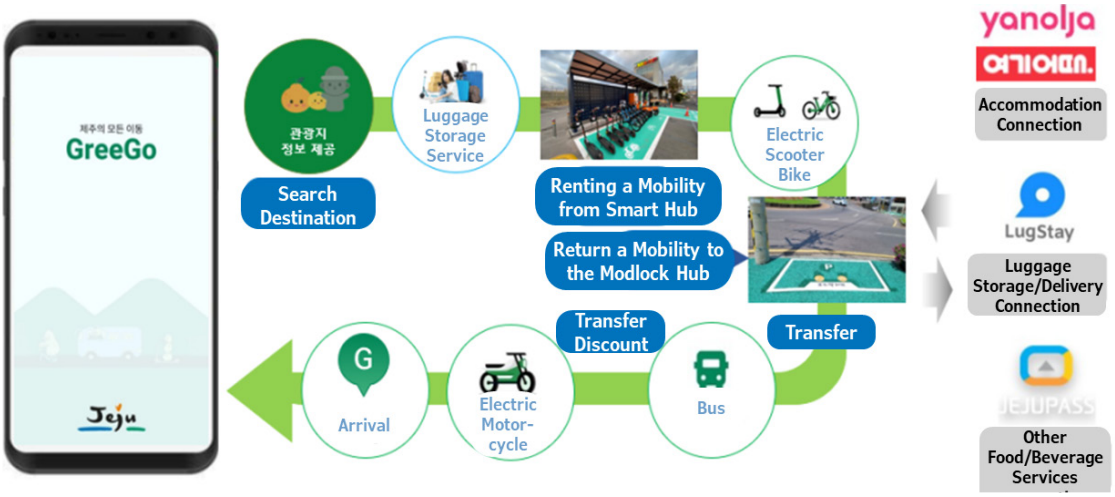
Jeju also implements smart hubs and integrated parking systems while exploring urban air mobility (UAM) services to reduce traffic congestion and parking problems. However, the rise of personal mobility (PM) also creates new urban challenges, such as illegal parking and safety concerns. To address these issues, Jeju is implementing the PM Use Safety Plan, which includes crackdowns on illegal parking, designated parking areas, and public awareness campaigns to ensure a safe and convenient environment.

GreeGo: Promoting Smart Mobility and Supporting Small Businesses

The GreeGo service is an all-in-one mobile app that connects residents and tourists to various mobility options, including electric bicycles, kickboards, and minibikes. Users earn GreeGo points, which can be redeemed for public transportation discounts, encouraging eco-friendly travel.

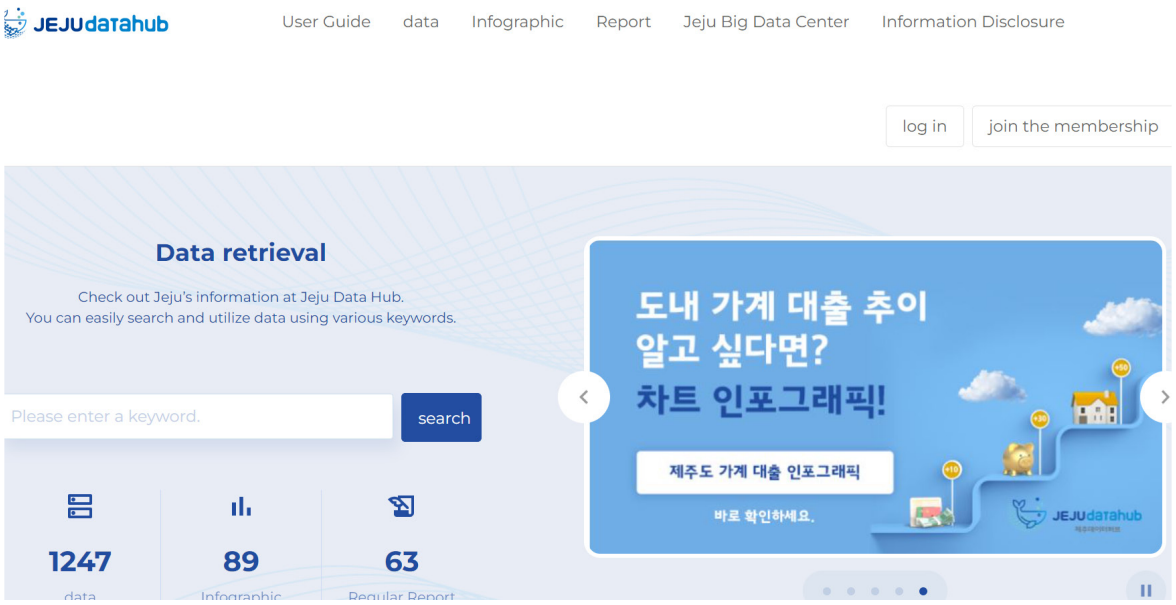
The app also provides real-time bus information and tourist information, such as locations for luggage storage and nearby attractions, enhancing user convenience.

GreeGo also benefits small businesses by fostering partnerships that promote local growth. Businesses providing locations for personal mobility rentals or other services can benefit from shared usage fees, while tourist attractions can be revitalized through increased foot traffic driven by GreeGo users.

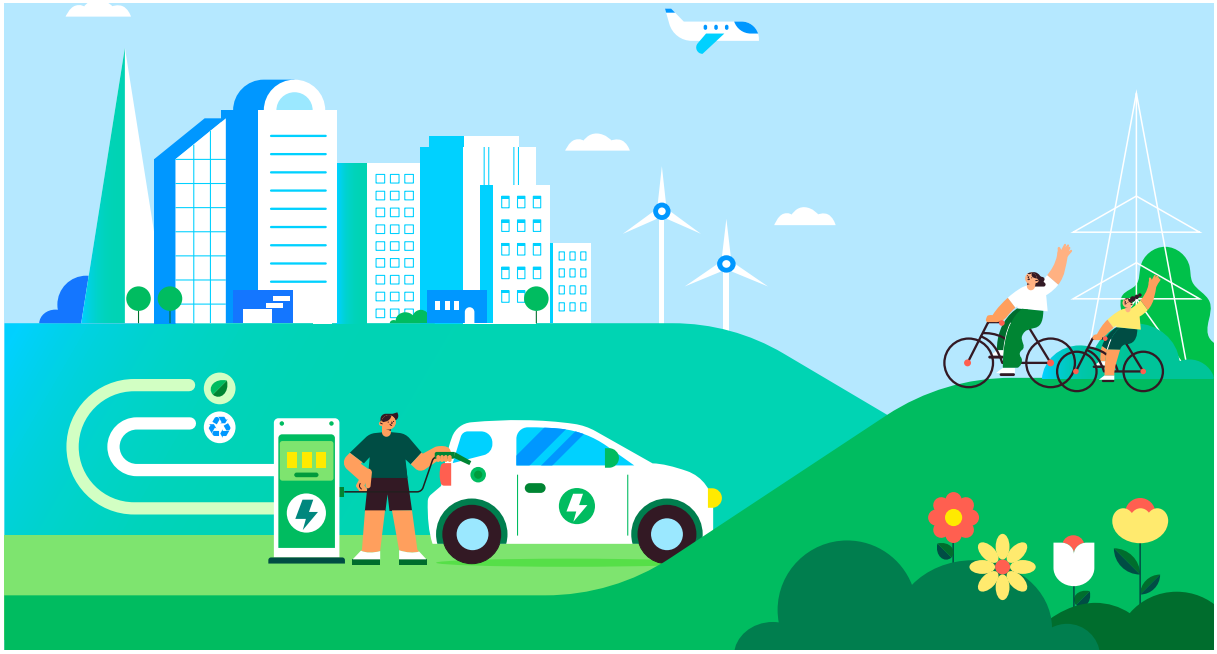


GreeGO shared mobility service scenario for citizens

Source: Jeju Special Self-Governing Province. 2023a.p.25



Jeju Data Hub[1)]



Data Platform for City Management

Jeju is leveraging data governance to solve urban problems, using data collected through the Smart City Data Hub. This platform gathers and analyzes data on a wide range of urban issues, including traffic safety, air quality, and electric vehicle charging infrastructure.

Key projects include:

- Identifying areas prone to accidents due to PM.
- Implementing variable vehicle speeds in protection zones.
- Pinpointing locations in need of electric vehicle charging stations.

This data-driven approach will help Jeju propose effective urban management strategies and improve the city's overall sustainability and efficiency.

04 An Inclusive Smart City

Governance for Smart City Project Promotion

Jeju is creating a forward-thinking smart city through collaborative efforts, particularly under the e-3DA project. This initiative involves close cooperation among a wide range of stakeholders, including local communities, relevant organizations, private companies, citizens, and research institutes. By engaging with the Residents Association, the province has ensured that residents contribute directly as service users, helping to evaluate the effectiveness of smart city services. The provincial government plays a key role in coordinating the comprehensive planning and implementation of these initiatives.

Key partners in this effort include:

- Jeju Energy Corporation, Jeju Techno Park, and Jeju Development Corporation contribute to the development of smart city infrastructure.
- Private entities such as the Jeju Smart Grid Enterprise Association, Jeju Rental Car Cooperative, Gas Station Association, and Bus Transport Operators Association help connect and expand services.
- Academic institutions like Metis Information Co., Ltd., KT, Jeju National University, and KAIST form an industry-academia consortium, driving research and offering expert consultation to ensure innovative solutions.

This partnership ensures that Jeju's smart city evolves with a strong foundation, promoting sustainable growth and improving the quality of life for all residents.

Efforts to Realize an Inclusive Smart City

Jeju's commitment to an inclusive smart city is reflected in its focus on innovation, digital participation, and the empowerment of local communities. The city is actively fostering collaborative events to generate innovative ideas and solutions, running initiatives like the Living Lab, which involves an experienced group to gather feedback from residents. In addition, Jeju is executing a value-added program that leverages digital technologies led by residents to identify and address community issues. Since its launch in 2019, this program has attracted 15,659 participants and received 266 proposals, demonstrating the strong involvement of citizens in shaping the future of their city.

Digital Participation Platforms

To promote inclusive governance, Jeju is developing digital participation platforms that allow residents to actively contribute to city planning and service development. These platforms ensure that all voices are heard, and citizens can directly influence policies and services, reinforcing the city's commitment to transparency and equity in its smart city development.

Jeju Smart Senior Citizen Center

Source: Provided by Jeju Special Self-Governing Province

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CHAPTER

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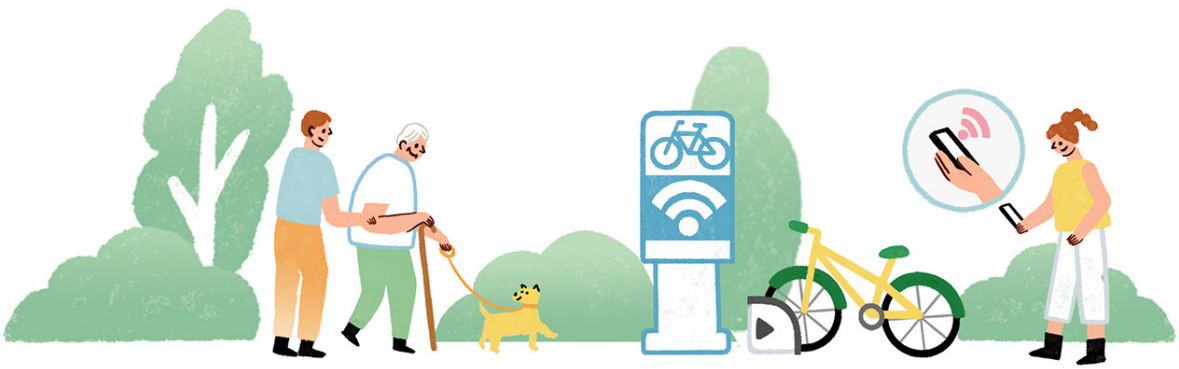


Gimhae

01 Gimhae, a Historical and Cultural City

Gimhae is a large city with a population of 560,000 located in Gyeongsangnam-do, South Korea. It is a historically and culturally significant city with a history dating back 2,000 years. It was the center of the Gaya Confederation and the capital of Geumgwan Gaya, which existed from the mid-1st century to the end of the 4th century. The city is also known for the love story of King Suro and Queen Heo, said to be the first international marriage on the Korean Peninsula. The Daeseong-dong Ancient Tombs, the burial sites of the ruling class of the Gaya Dynasty, were registered as a UNESCO World Heritage Site in September 2023. As a result, the city is widely recognized for its international historical and cultural significance.

In recent years, Gimhae has emerged as a key logistics and industrial city in the southeastern region, boasting a natural tripod system that includes an airport, railway, and port. Leveraging its geographical advantages, it is increasingly seen as an optimal location for logistics platforms in Northeast Asia.

Gimhae envisions itself as a city that supports innovation, smart sharing, and sustainable growth. Its slogan, "Gimhae, a smart city where citizens are relaxed and companies grow innovatively," highlights its focus on creating an economic-based city that drives innovative growth while also being a convenient, citizen-centered place to live. Gimhae has outlined strategies to achieve these goals, with an emphasis on becoming an intelligent, efficient, and data-driven city.

In 2024, Gimhae introduced the vision of a hyper-connected city that integrates people and space, with "connection" as its core theme. The city is implementing five detailed promotion strategies across 17 areas: Industry, safety, education, welfare, transportation, and data connections.

Although Gimhae is known for its rich Gaya history and culture, it has faced challenges in developing cultural attractions, leading to short tourist stays, traffic congestion, and inadequate parking in tourist areas. To address these issues, Gimhae developed the Gogo Gaya Smart Tourism Service, which was selected as a cultural tourism project under the Smart Town Challenge, led by the Ministry of Land, Infrastructure, and Transport, in 2018.

Gimhae has implemented various smart city solutions, including a smart tourism platform, smart parking facilities, and immersive smart tourism experiences. These initiatives have helped increase tourists' length of stay, alleviate traffic and parking problems, and contribute to the revitalization of the local economy and improved quality of life for residents. As a result, Gimhae is steadily transforming into a smart historical and cultural hub.

Source: Provided by Gimhae City

02 Gimhae's Services for Smart Tourism

Smart Tourism Solutions

Gimhae offers the Bogo Gaya (recommending things to see) service, an experiential tourism experience that incorporates advanced technologies such as 3D media facades, VR/AR, and holograms to showcase historical and cultural stories. This service features media facades, holographic water screens, VR lidar, AR magic mirrors, and smart shadows. Its goal is to attract more tourists and extend their stay by offering diverse, immersive tourism content.

Information about these services is available in seven languages, including English, on the Gimhae Smart Tourism website. The city of Gimhae is dedicated to providing visitors with a richer tourism experience while promoting local history and culture through a variety of services.

The Algo Gaya service is part of the broader Gogo Gaya smart tourism initiative, which offers various festivals and events to both citizens and tourists to help boost the region. Additionally, there is the Meokgo Gaya (recommending places to eat) service, which provides information about Gimhae's popular foods and restaurants at tourist attractions, as well as the Jago Gaya (recommending places to stay) service, which offers accommodation information.

Gimhae, Light Rail Museum Station Media Facade

Source: Provided by Gimhae City

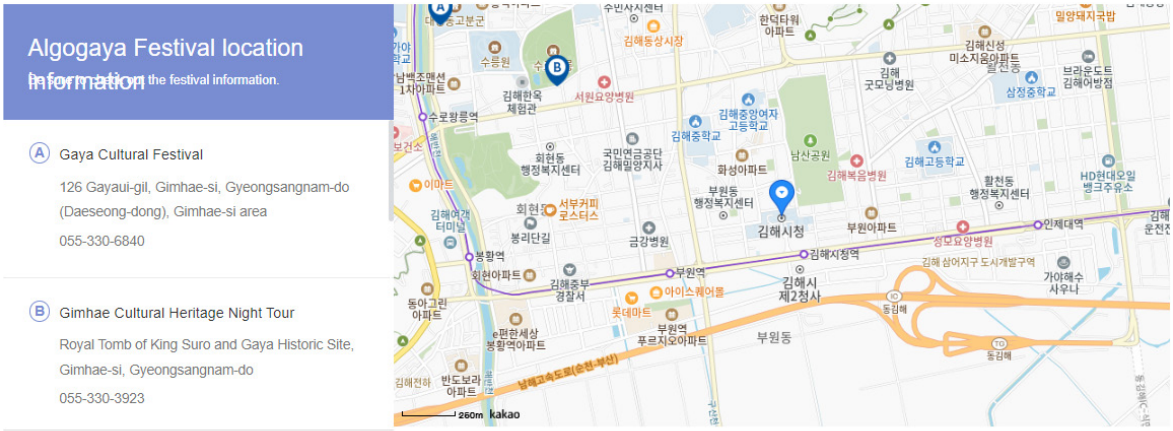
Daeseongdong Daeseong-dong Ancient Tombs Museum VR Rider

Smart Tourism Platform and Tourism Pattern Analysis

Various data can be collected through the smart tourism platform. Public Wi-Fi availability plays a crucial role in shaping tourism policies by providing essential data. Additionally, data gathered from impact-sensing Internet of Things (IoT) sensors installed on public electric bicycles serves as vital information for maintaining road surfaces, including resurfacing roads when needed. In case of a bicycle safety accident or impact, an observer at the Gimhae Smart City Integrated Operation Center can quickly review CCTV footage to respond in real-time.

The smart tourism platform also enables the development of private business models by providing access to key data through an Open API. This includes information on public Wi-Fi locations, public

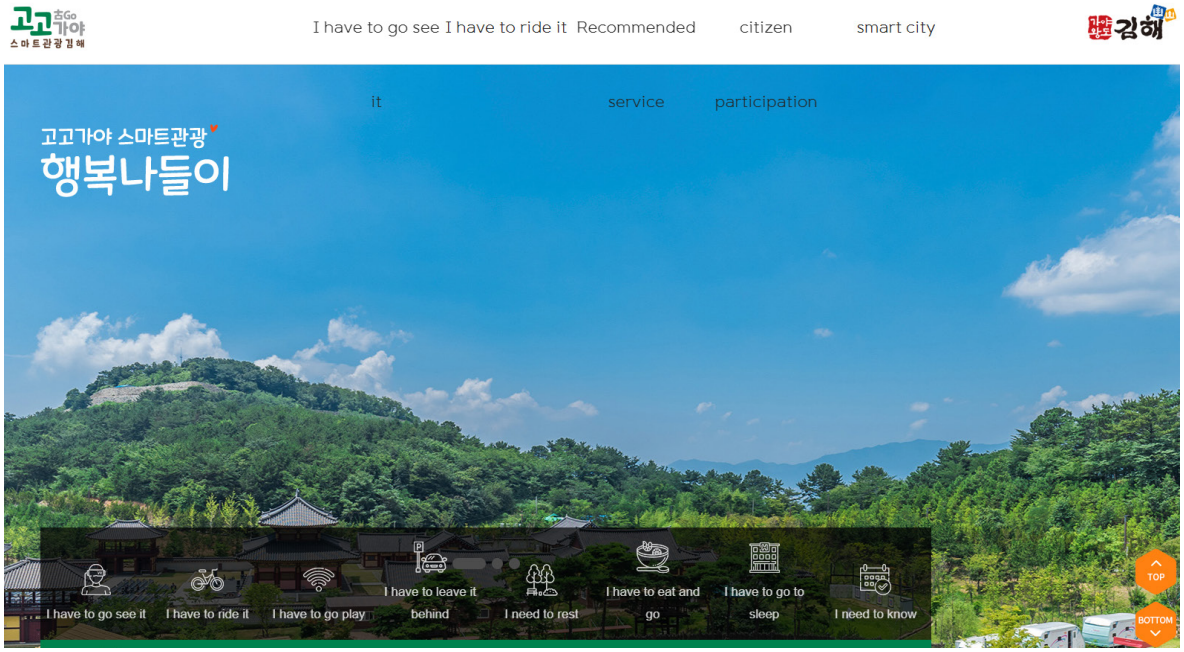
Pyramid hologram



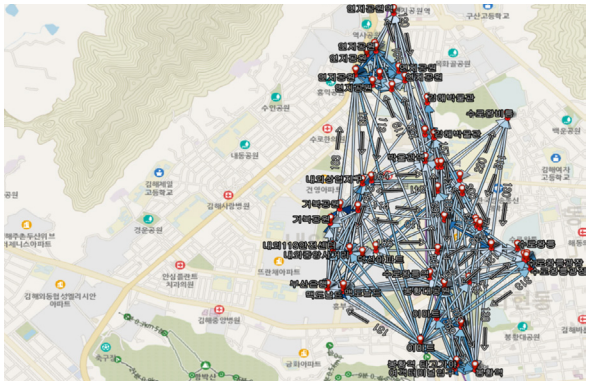
Algo Gaya[1)]

Daeseong-dong Ancient Tombs

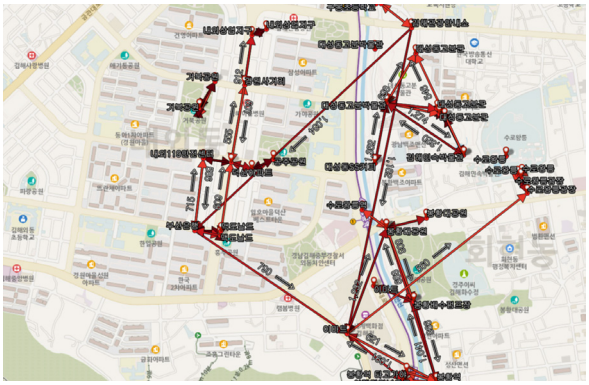
bicycle rental and return stations, smart parking availability, and air quality measurements. Gimhae plans to integrate more smart city services into the platform in the future, further enhancing the city's tourism experience.



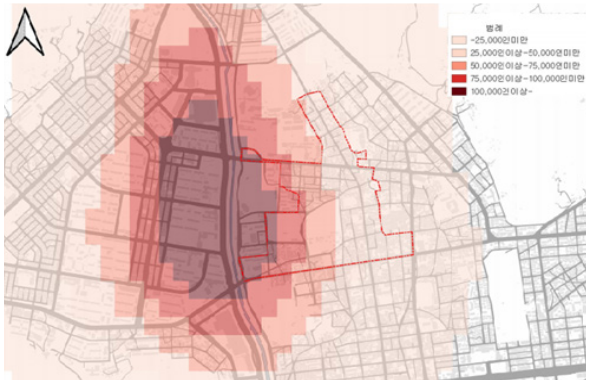
Gimhae Smart Tourism Portal Gogo Gaya[2)]



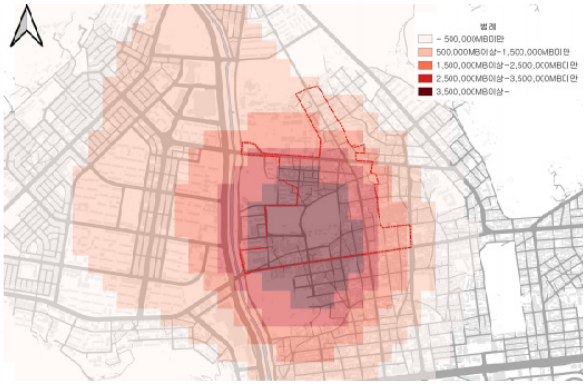
Visualization of the entire movement path of public Wi-Fi floating population



Analysis of the movement path of the floating population by the most users of public Wi-Fi



Analysis of the number of public Wi-Fi users



Analyzing Public Wi-Fi Data Usage

Source: Provided by Gimhae City

03 Gimhae's Response to the Climate Crisis Eco-friendly Transportations

Eco-friendly Transportation

The Tago Gaya service is a public electric bicycle service provided by Gimhae, which is designed to promote sustainable travel while increasing transportation convenience for both tourists and residents. It supports the city's carbon neutrality goals by allowing tourists to explore major tourist destinations by e-bikes and reducing reliance on private cars by encouraging locals to opt for eco-friendly transportation.

Tourists can easily visit Gimhae's landmarks, such as the Daeseong-dong Ancient Tombs, a UNESCO World Heritage Site, as well as other convenience facilities and public transportation hubs. To use the service, simply scan the QR code attached to the bike using a mobile app to begin your ride. The basic fare is 500 KRW for the first 30 minutes, with an additional charge of 200 KRW for every extra 10 minutes. By offering a convenient and affordable mode of green transportation, the Tago Gaya service aims to alleviate urban traffic congestion while promoting sustainable urban development.

Tago Gaya bicycles

Responding to Fine Dust

Gimhae's Shigo Gaya (recommending resting areas) service is a solution aimed at mitigating the growing issue of fine dust, which has become a pressing environmental concern. This service introduces smart shelters with clean air domes, providing citizens with a safe and comfortable place to rest. These air domes are equipped with advanced filtering systems that ensure clean air, even on days when fine dust levels are high. The initiative focuses on protecting the public, particularly vulnerable groups such as children and the elderly, by providing a safe environment during outdoor activities.

Through this project, Gimhae is actively addressing the fine dust problem, creating healthier public spaces, and promoting the well-being of its citizens.

Gimhae City Gogo Gaya Smart Tourism Promotional Video[3)]

Gimhae Smart Shelter

Source: Provided by Gimhae City

AI Circular Resource Recovery Robot

The recovery robot, powered by artificial intelligence, helps enhance Gimhae's recycling efforts by classifying and collecting recyclables. This initiative encourages citizen participation in sustainable practices and supports the city's environmental goals.

Gimhae introduced the first two AI-powered circular resource recovery robots as part of the Smart Town Challenge project. Following their success, the city's 8th mayor supported the expansion of this initiative. By 2026, Gimhae plans to install 30 recovery robots across 26 locations, with each unit costing around 20 million KRW. The project aims to improve recycling efficiency, reduce waste, and support environmental conservation.

AI Circular Resource Recovery Robot

Source: Provided by Gimhae City

Smart Green City, Jinyeong-eup, Gimhae

Gimhae introduced the first two AI-powered circular resource recovery robots as part of the Smart Town Challenge project. Following their success, the city's 8th mayor supported the expansion of this initiative. By 2026, Gimhae plans to install 30 recovery robots across 26 locations, with each unit costing around 20 million KRW. The project aims to improve recycling efficiency, reduce waste, and support environmental conservation.

Smart Green City, Jinyeong-eup, Gimhae

In the Jinyeong-eup area of Gimhae, the Ministry of Environment launched a smart green city project to tackle environmental challenges. Located next to an industrial zone and a newly developed residential area, Jinyeong-eup has experienced high levels of fine dust, making it one of the most environmentally vulnerable regions in Gyeongsangnam-do. The area also faces issues such as water pollution, unpleasant odors, and heatwave risks. To address these problems and build a climate-resilient city, three key projects were initiated to enhance environmental conditions and strengthen infrastructure in preparation for future climate challenges.

Reservoir Smart Ecological Restoration Project

Gimhae has experienced a rapid rise in impermeable surfaces due to urbanization, leading to water pollution and odor problems in the reservoir located between apartment complexes. To tackle these challenges, Gimhae launched the Low Impact Development (LID) project to enhance water circulation around the reservoir. The city also introduced wetlands, ecological restoration efforts, and smart water management systems to transform the reservoir into a more sustainable and enjoyable space for citizens.

Before the implementation of the reservoir project

After the implementation of the reservoir project

Source: Provided by Gimhae City

Green Line Network Project

The portion of the abandoned railway that passes through the city center of Jinyeong-eup was neglected because of illegal farming activities and pollutants such as fertilizer flowing into the river, making it highly susceptible to heat waves in Gyeongnam. To address this, vegetation ditches were constructed along the railway, air-purifying trees were planted, and trails were created as part of a waterway and climate recovery project. These efforts aimed to transform the abandoned railway into an ecological space and reconnect the city center.

Smart environmental patrol project

Due to the proximity to industrial areas, there has been a rise in the number of complaints from residents about bad odors, and the concentration of fine dust in Gyeongnam has reached its peak. In response, smart measuring equipment has been installed to monitor odor and fine dust levels in real-time and to provide citizens with updates. Additionally, residents have utilized drones and mobile measuring vehicles. The implementation of a participatory environmental patrol system has contributed to the enhancement of the living environment for citizens.

Abandoned railway before the project

Abandoned railway after the project

Source: Provided by Gimhae City

Smart Patrol – Odor and Fine Dust Meter

Source: Provided by Gimhae City

04 Digital Inclusive Smart City Projects

Smart Senior Center

The Smart Senior Center Project in Gimhae is an innovative initiative designed to enhance the welfare environment for the elderly. It has been implemented across 36 regional senior centers, supported by 800 million KRW in national funding.

The project leverages AI technology to offer a range of services for seniors. It provides health management and leisure programs through AI-powered devices, monitors real-time health conditions, and delivers personalized health advice. Additionally, live-streamed lectures from professional instructors enable the elderly to participate in various educational and leisure activities via TV directly in the senior centers near their homes.

The smart senior centers in Gimhae are significantly enhancing the quality of life for seniors, supporting a vibrant and healthy old age. This project is playing a crucial role in establishing Gimhae as a senior-friendly city.

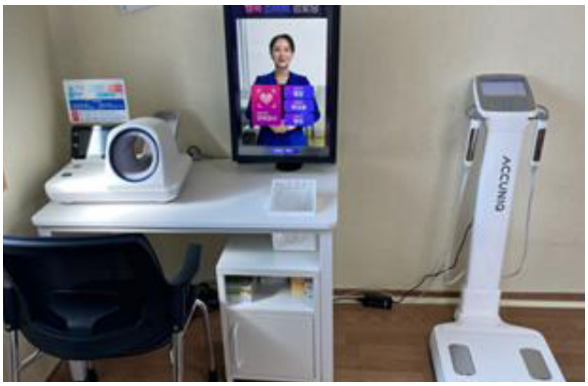
These smart senior centers are significantly improving the quality of life for seniors, fostering a vibrant and healthy aging process. This project plays a key role in positioning Gimhae as a senior-friendly city.

Dance class

Centenarian Health Online Lecture

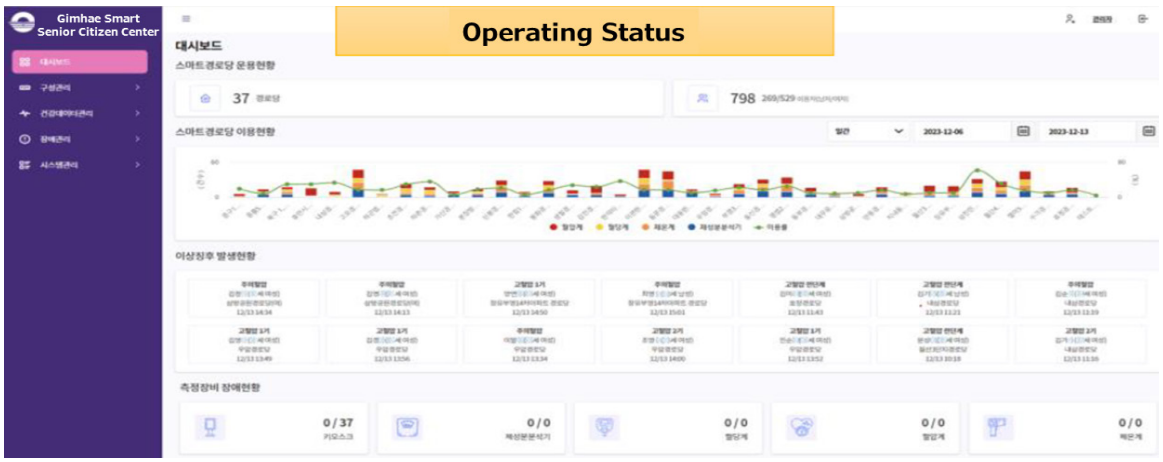
Source: Gimhae City, 2024, p.27

Senior TV



Healthcare Zone

Source: Gimhae City, 2024,p.15



Operating System

Source: Gimhae City, 2024, p.22

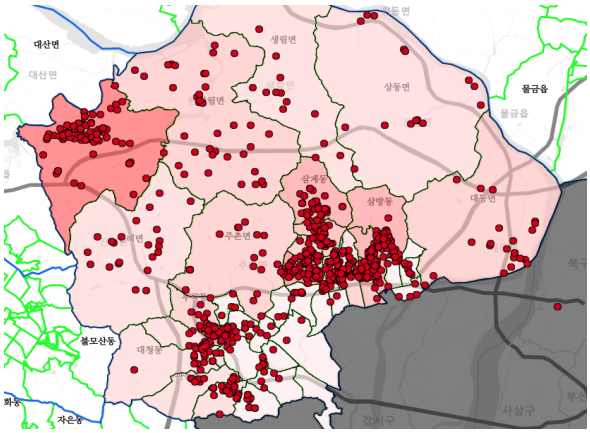
24-hour Heart Guard (AED) in Convenience Stores

Gimhae is undertaking a project to improve the accessibility and visibility of automated external defibrillators (AEDs) for the safety of its citizens. As part of the 2023 Ministry of the Interior and Safety's Public Medical Vulnerable Area Standard Analysis Model Establishment and Expansion Project, the initiative responds proactively to emergencies by strategically deploying AEDs at high-risk locations across the city, informed by fire emergency data analysis. Currently, there are 410 AEDs installed in Gimhae, though some are located in apartment complexes and non-mandatory facilities, limiting their accessibility.

In response, AEDs have been redeployed to areas with high rates of cardiac arrest incidents and those with lower accessibility. Notably, AEDs have been installed in 24-hour convenience stores, ensuring that citizens can access them in emergencies, anytime. To further enhance preparedness, first aid training is being provided to store owners and nearby residents. Additionally, the Gyeongsangnam-do Smart Spatial Information Platform is used to optimize AED placement and improve user education across the region.

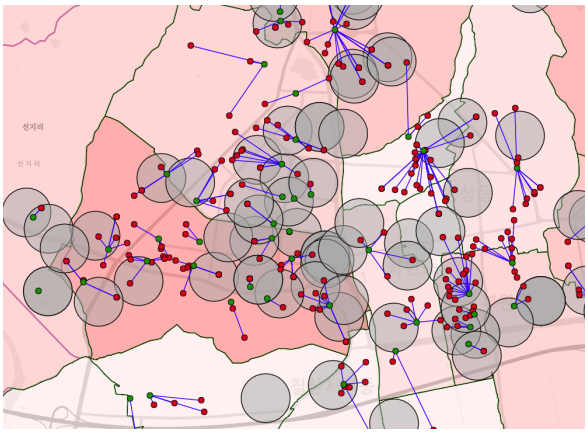
In 2024, Gimhae plans to expand this initiative, promoting the installation of AEDs in convenience stores using the city's official mascot, Todergi, to raise awareness. This initiative will highlight the importance of AEDs, demonstrate how to use them, and ensure that the service is widely recognized and accessible to all citizens.

Through these efforts, Gimhae is advancing digital inclusion and developing as a smart city that is well-suited to its aging population. These projects play a crucial role in enhancing public safety and supporting the city's sustainable development as a smart, citizen-friendly community.



Analysis of the location of cardiac arrest patients in Gimhae City

Source: Provided by Gimhae City



Cardiac arrest location fusion AED blind spot analysis

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Gimhae Smart Tourism(Gogo Gaya) https://smartcity.gimhae.go.kr/smart_tour/main.do

1) https://smartcity.gimhae.go.kr/smart_tour/argogaya/festivalList.do?menuId=866&menuId=866
2) https://smartcity.gimhae.go.kr/smart_tour/main.do
3) https://youtu.be/Z4flot1JQtM

CHAPTER

8

Suwon

01 Suwon Hwaseong, Korea's First Innovative City

Suwon is located in the southern part of the metropolitan area, which includes Seoul, and covers an area of 121 square kilometers. With a population of around 1.2 million, it is Korea's most populous city among basic local governments. Suwon is considered more of a self-sufficient city than just a bedroom community in the metropolitan area. Additionally, it is home to Samsung Digital City, which serves as the headquarters of the Samsung Group.

Suwon has a smart city plan that aims to become a smart, inclusive city of history, technology, and people. The plan is guided by the core values of people-centered, sustainable, innovative growth, mutual development, and citizen experience. This plan was established in 2021 with the main goals being to realize a green smart city that is easy to live in, build an innovative smart city that connects and converges, and create an open smart city that people want to visit and experience.

Suwon is considered Korea's first new city from a historical perspective. It was established by King Jeongjo of the Joseon Dynasty in 1794 as a symbol of innovation and creation. The Hwaseong Temporary Palace, constructed during this time, was recognized as a World Cultural Heritage site by UNESCO in 1997. Despite the destruction of most of its buildings during the Japanese colonial period and the Korean War, the palace's design drawings allowed for successful restoration, leading to its UNESCO registration. A three-stage restoration project has been ongoing since 1999 and is currently over 80% complete.

The Hwaseong Temporary Palace in Suwon was constructed in 1794, using state-of-the-art technology of the time. King

Suwon Smart City Vision and Strategies

Source: Suwon Special City, 2021b

Suwon Hwaseong[1)]

Jeongjo founded Korea's first innovative city in Suwon Hwaseong with the concept of caring for the people. Suwon is fostering an innovative city that is citizen-centered and inclusive.

Urban Problems in the Hwaseong Area

Currently, Haenggung-dong is the original downtown area of Suwon and is home to Hwaseong Haenggung Palace. As the city continues to grow, it encounters challenges such as urban decline, aging demographics, economic and commercial stagnation, and rising safety concerns. Suwon is working to tackle these issues in an inclusive manner by implementing smart city solutions that integrate information and communication technology with its citizens.

Category	Urban Issues	Detail
Spatial Structure	The exterior of the city diffusion phenomenon	The significance of the old city center is diminishing as urbanization accelerates and urban areas expand. Cities are grappling with issues like growing space needs driven by population growth, declining residential conditions due to overcrowding, and traffic congestion causing the urban elements to spread out.
Living Env.	Original downtown area, Poor residential environment	Poor living conditions in Suwon Hwaseong and existing urban areas have caused communication issues among residents due to the focus on apartment complexes.
Transport Cost	Traffic congestion and lack of connectivity between modes	Habitual vehicle congestion occurs in the Suwon Station and Paldalmun areas, which are major transportation transfer points in the downtown area. The congestion and inconvenience are caused by the lack of route planning for transfers, bus platform maintenance, and transfer area upkeep.
Green Env.	Original downtown deliberation, lack of comfort	There is a lack of pedestrian comfort due to a vehicle-oriented road system and aging street facilities, a lack of urban green space and open space, and urban deterioration due to a lack of connection between residential areas, green spaces, and waterfronts.
Tourism Resources	Insufficient management of historical and cultural resources	Insufficient revitalization of historical and cultural tourism exists aside from the Suwon Hwaseong Fortress, a World Cultural Heritage site, located within the city center. Additionally, Suwon lacks unique tourism and accommodation options.

02 Smart Tourism and Digital Transformation of Hwaseong Palace

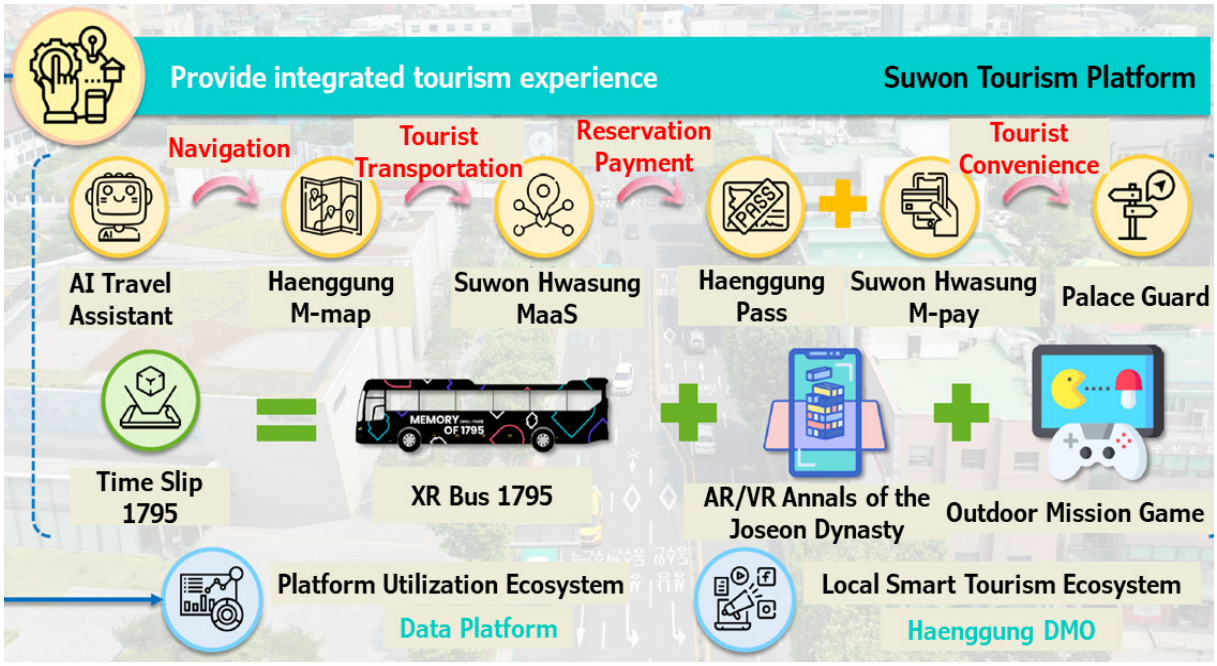
In 2016, Suwon designated the entire area of Haenggung-dong, Paldal-gu, as a special tourism zone and launched projects for local tourism development, urban regeneration, construction of Namsu-dong Hanok Village and King Jeongjo theme performance hall, and cultural city creation. Furthermore, the Ministry of Culture, Sports, and Tourism selected Suwon for the smart tourism city project in 2021. It has established 10 major services with a budget of 4.5 billion KRW in national funds and 4.5 billion KRW in city funds.

In particular, Suwon provides tourists with Suwon history in AR and XR formats instead of printed materials. It has also developed an app called Touch Suwon that allows tourists to conveniently access the main functions they need. Additionally, Suwon is operating Korea's first XR tour bus equipped with a transparent OLED display called XR Bus Route 1795. The XR Bus Line 1795 reproduces the story of the construction of the Suwon Hwaseong Fortress and the royal procession of King Jeongjo in the year of Eulmyo through transparent displays on the bus windows.

As a major achievement, as of December 2023, more than 200,000 people have downloaded the Touch Suwon app, and 12,000 people have used the XR bus.

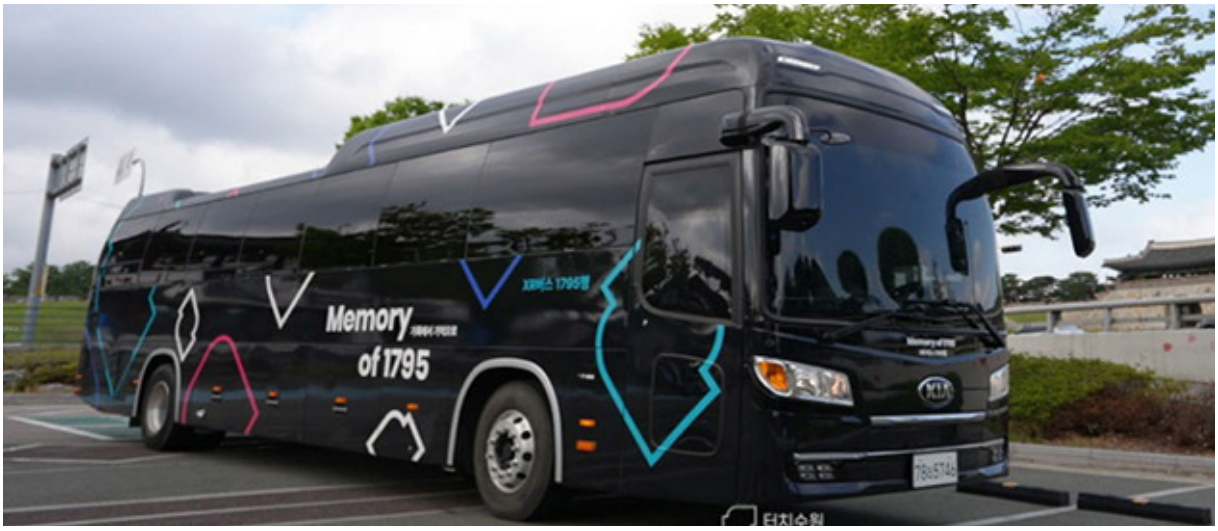
Suwon Smart Tourism City Top 10 Services

Project Name	Detail
Integrated Tourism Experience Platform	Suwon offers an all-in-one tourism experience that can be enjoyed using just a smartphone.
Time slip, 1795 Suwon Hwaseong Fortress	This includes immersive experiences such as XR Bus Line 1795, digital heritage, the AR/VR Joseon Annals outdoor mission game, and the secret of Hwaseong Temporary Palace.
AI Travel Assistant	After analyzing personal tendencies through a simple survey, the AI suggests a schedule and provides personalized guidance services.
Haenggung Village M-map	Route-finding services are offered through destination-based maps.
Suwon Hwaseong MaaS	It provides transportation information for moving within and outside the destination and allows the use of various means of transportation within the Suwon Hwaseong Special Tourist Zone.
Suwon Hwaseong M-pay	Suwon offers reservations and payments for services provided by major establishments such as restaurants and cafes within the Suwon Hwaseong Special Tourist Zone.
Haenggung Village Pass	Suwon produces and markets products that allow visitors to enjoy diverse experiences within the Suwon Hwaseong Special Tourist Zone.
Haenggung Keeper	Suwon provides support for mobile tourism services, including LAN tours, multilingual assistance, and the 1330 chatbot.
Data Platform	Suwon adds value by collecting and analyzing app usage and Wi-Fi access data.
Haenggung Village DMO	Suwon aims to build strong connections with local commercial districts and related organizations to promote and market Suwon City as a smart tourism destination.



Smart Tourism City Service 10 Major Services Flow Chart

Source: Suwon Special City, 2021a, p13



XR BUS 1795[2)]

03 Suwon's Efforts to Achieve Carbon Neutrality

Carbon neutrality is a critical focus for smart cities, and Suwon has been proactive in this area. In 2014, the city opened DoDream, the Suwon Climate Change Experience Education Center, which aims to educate the public on climate change adaptation and sustainable lifestyles. The building itself is eco-friendly, incorporating renewable energy sources such as solar power and geothermal heat alongside super insulation, enabling it to generate and conserve up to 85% of its energy.

Suwon's carbon-neutral green city project is a major initiative aimed at establishing systems to implement and expand carbon neutrality. A total of 40 billion KRW will be invested in the project, with 24 billion KRW from the national budget, 4.8 billion from the provincial budget, and 11.2 billion from the city budget. The project's goals include shifting from fossil fuels to eco-friendly energy sources such as water heat, sewage heat, and biogas. In addition, Suwon plans to expand green spaces and wetlands, restore damaged urban areas, and increase green infrastructure to serve as carbon sinks.

To further promote sustainability, Suwon will implement smart waste collection and screening systems and introduce multifunctional natural shade canopies, rooftop greening, and smart goods management systems to help adapt to climate change. The city also intends to integrate carbon-neutral initiatives into everyday life through enhanced policies and participatory social structures, such as living labs and resident agreements. Citizen participation will be vital for achieving carbon neutrality, with initiatives aimed at saving energy in homes and businesses, encouraging public transportation use, reducing waste, and improving recycling rates.

A key aspect of this initiative is the Citizen Action Carbon Neutral Platform, which will allow citizens to track greenhouse gas emissions and monitor the impact of carbon-neutral policies in real-time. This platform will also help raise awareness of the city's carbon footprint and guide residents on ways they can reduce emissions.

Suwon's strategy goes beyond monitoring and control. It includes managing carbon emissions from buildings, energy usage, and renewable energy generation by using public data such as meteorological, road network, population, and terrain information. This data-driven approach will allow the city to predict, manage, and respond to carbon emissions and climate change effectively. Additionally, Suwon plans to manage eco-friendly transportation, carbon sinks, climate adaptation facilities, and resource circulation systems, ensuring that vulnerable groups are supported in the transition to a carbon-neutral society.

In this ambitious transition, Suwon aims to create a digital platform that supports real-time monitoring, helping both the government and citizens to manage and control emissions while contributing to a sustainable and carbon-neutral future.

DoDream[3)]

Samsung Digital City, Global Smart City Innovation Ecosystem

In Maetan-dong Yeongtong-gu Suwon-si Gyeonggi-do, a sprawling corporate hub is often referred to as a "city within a city." This area is home to the headquarters of Samsung Group and Samsung Electronics, along with its vast research and development complex, office towers, and industrial facilities. Spanning 1.72 million square meters, Samsung Digital City comprises around 131 buildings, with a central office complex featuring four high-rise towers.

More than just a workplace, Samsung Digital City is designed to function like a self-contained community. In addition to the company's offices and research labs, the area offers a wide range of urban amenities, including lodging facilities, childcare centers, sports complexes, cultural venues, and convenience services. These facilities provide a high level of comfort and convenience for Samsung employees, making it a true "city" that supports both their professional and personal needs.

Transformed from a TV and Radio Production Complex into a High-tech R&D Mecca

Samsung Electronics was founded in 1969 with the establishment of a radio and TV production line in Suwon, starting with just 36 employees. Over the next 49 years, the company's workforce would grow more than 900-fold. In its

Samsung Digital City[4]

early days, Samsung Electronics was a newcomer to the export industry, opening a 122,000 square meter business site in Suwon. By 2018, Samsung Digital City had expanded to a vast 1.72 million square meters, equivalent to 250 soccer fields.

In 1968, Samsung Electronics conducted a survey in cities such as Busan, Suwon, Ulju, and Yangsan to choose a location for its first factory. Suwon was selected for its strategic advantage: Its proximity to Seoul and logistical ease. The company officially registered its establishment on January 13, 1969.

The 1980s marked a key shift as Samsung invested heavily in research and development (R&D). The company built its first R&D labs in 1980, with space for 390 people, and expanded them in 1988 to accommodate 1,500, signaling a move toward becoming a technology-driven enterprise.

By the 2000s, Samsung Digital City had transformed from a production site into Korea's largest R&D complex. In 2001, the company opened a 27-floor Information and Communication Research Center with a capacity of 6,000 people, supporting the global expansion of its mobile phone business. In 2005, a 37-floor Digital Research Center was completed, accommodating 9,000 people, focusing on advancements in TV and video display technologies. In 2013, the Mobile Research Center was added, with two buildings housing 10,000 people, further solidifying Samsung Digital City as a hub of innovation.

Most of the company's previous production lines have since been relocated, leaving the majority of the workforce dedicated to R&D. Today, manufacturing roles account for just about 1% of the total workforce at Samsung Digital City, which has grown significantly over the years. From fewer than 100 employees at its founding, the workforce reached approximately 11,000 by 2000, 21,000 by 2005, 28,000 by 2010, and 34,000 by the end of 2023.

Samsung Electronics also employs around 70,000 people across its other business sites and affiliates in Gyeonggi-do, including Suwon, Giheung, and Hwaseong. The company plays a vital role in the region's economy, contributing to employment, consumer spending, and tax revenue and serving as a responsible corporate citizen.

Joint Growth with Suwon for Over Half a Century

Samsung Digital City has played a pivotal role in the transformation of Suwon into a vibrant, modern urban center. The rapid growth of Samsung Electronics has driven the development of surrounding areas, including new apartment complexes, roads, and commercial districts. Today, approximately 24,000 of Samsung's 34,000 employees at Digital City live in Suwon and the wider Gyeonggi-do region. Additionally, 26,000 employees from the Giheung and Hwaseong business sites reside in Suwon, Yongin, and Hwaseong, contributing to the local economy and community.

Since its opening in 1981, Samsung Digital City has become a key destination for international visitors, particularly high-ranking officials and dignitaries. The Digital City Promotion Center has hosted over 1,000 state-level VIPs, including leaders such as the Presidents of India and Hungary, helping to position Suwon as a global business hub. The center plays a crucial role in promoting both Gyeonggi-do and Suwon on the world stage.

A notable addition to the site, the Samsung Innovation Museum, which opened in May 2013, has further solidified Samsung Digital City's reputation as a cultural and educational landmark. The museum attracts more than 100,000 visitors annually, including VVIPs, residents, and international tourists, further enhancing the city's status as a world-class destination.

A Space of Innovation and Creativity

Samsung Digital City, named as part of the Dream Workplace Creation Project in 2009, is home to 35,000 global talents from 56 countries, working in an environment that fosters innovation. The campus features 131 buildings, including offices, laboratories, and welfare facilities, and is the base for 69,000 R&D professionals at Samsung Electronics who are involved in developing new technologies and products.

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POLICE

Appendix

Smart City Solutions

01 Urban Integrated Operation Center and Smart City Integrated Platform

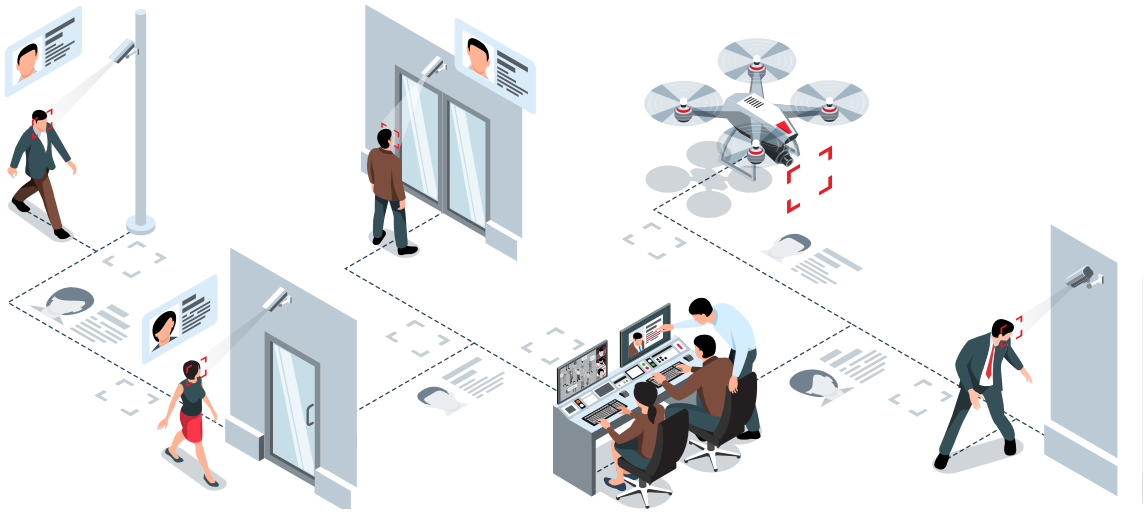
From the 2nd phase of the new city, the ubiquitous city is designed to centrally manage and monitor crime prevention CCTV and traffic CCTV centered on the Urban Integrated Operation Center. The Urban Integrated Operation Center is a facility that has numerous monitors placed on the wall so that monitoring personnel can control crime and traffic conditions in real-time.

The center has become a leading model of Korea's smart city initiatives, drawing global attention as a model for urban development. By combining various local government functions—such as transportation management and disaster prevention—under one system, it offers a physical integration of services. The integration is further enhanced by a smart city platform developed through extensive research and development (R&D), which links and consolidates services across the city, enabling more efficient operations.

Originally, the integrated platform in Korea was foreign-made, but as part of the Ubiquitous City R&D project, a domestically developed platform was introduced in 2015. Early on, local governments showed little interest in the new platform due to a gap between its features and the specific needs of cities. However, once linked services such as real-time 112 (police) and 119 (fire) responses were showcased in the media, public interest surged. By 2017, many local governments were actively adopting the smart city integrated platform, recognizing its potential for enhancing urban safety and management.

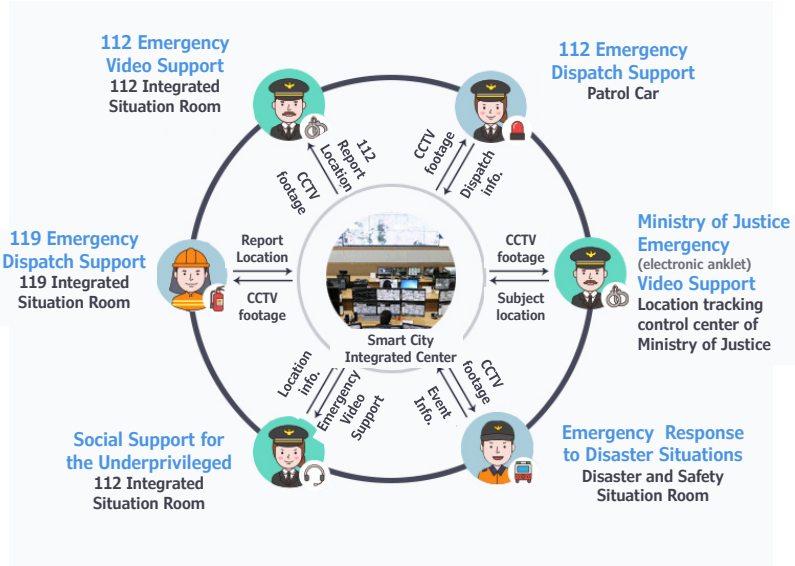
IFEZ Smart City Operation Center

Source: Provided by KRIHS



The Urban Integrated Operation Center has significantly improved public safety, enabling rapid response to emergencies and reducing issues like illegal dumping and parking. By using CCTV footage, authorities have been able to swiftly respond to incidents and gather evidence, leading to a higher crime arrest rate. Real-time video feeds are shared with emergency services, such as police and fire departments, facilitating quicker and more coordinated responses to emergencies.

In conclusion, the Urban Integrated Operation Center and Smart City Integrated Platform have proven to be vital in enhancing public safety and quality of life. Through the use of advanced CCTV systems and integrated services, these solutions have made significant contributions to the well-being of residents, positioning them as leading models in smart city development.



Five major linked services of the smart city integrated platform[1)]

02 TOPIS, Intelligent Traffic Control System

Since 1998, Seoul's traffic management system has undergone significant evolution, beginning with the launch of a real-time traffic information system for the Namsan area (central Seoul). This system provided updates for the three Namsan Tunnels, helping citizens choose the fastest route and marking the inception of Seoul's Intelligent Transportation System (ITS).

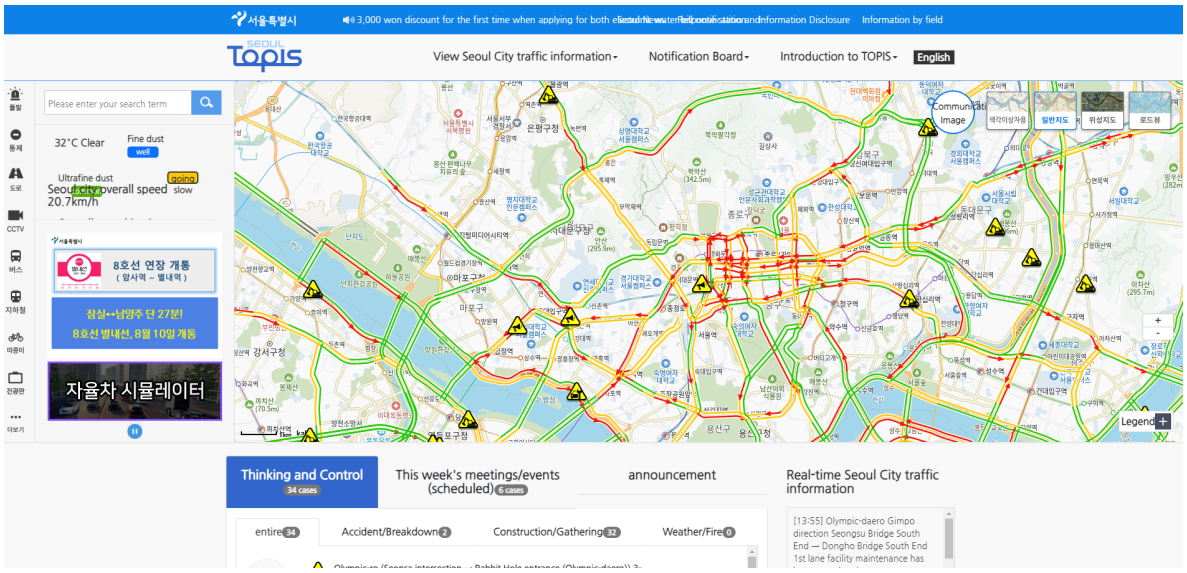
In 2002, Seoul introduced the Traffic Operation and Information Service (TOPIS), which expanded the real-time management of urban highways. By 2004, the city had introduced a real-time bus operation management system and a transportation card system, reshaping Seoul's public transportation landscape. TOPIS quickly became a cornerstone of the city's infrastructure, enabling efficient traffic and public transit operations.

The next major upgrade came in 2013 with the introduction of TOPIS 3.0, along with the inauguration of the Seoul Integrated Safety Center. This new center consolidated transportation, disaster prevention, and safety functions under one roof, relocating the control room to the third basement level of a newly constructed building. This design facilitated improved inter-agency cooperation during emergencies, enhancing both traffic management and disaster response.

TOPIS gathers and analyzes data from multiple sources, including transportation cards, bus GPS systems, and CCTV cameras, to provide real-time traffic updates to the public. Information is made available via websites, social media, and mobile apps, helping citizens navigate traffic conditions. The system also leverages big data analysis to predict potential traffic issues and optimize solutions, allowing for early identification of congestion and quick response to traffic incidents.

TOPIS has since become Seoul's flagship smart transportation technology, garnering international recognition. It has been adopted and exported to several countries, including Azerbaijan and Mongolia.

The integrated traffic management system has significantly improved traffic efficiency and convenience for Seoul's residents. By exchanging information with policy agencies, broadcasting stations, regional construction offices, and road management authorities, the system plays a critical role in preventing and addressing traffic issues quickly. TOPIS's big data analysis also aids in refining traffic and public transportation planning. By



TOPIS[2)]

Source: KRIHS 2024

analyzing data from transportation cards, buses, taxis, subways, and navigation systems, the platform can suggest optimal routes, adjust public transportation services, and provide real-time traffic coordination. This comprehensive system has made it possible to dynamically manage road traffic, adjust bus routes, and optimize subway service intervals, benefiting citizens with smoother and more efficient commutes.

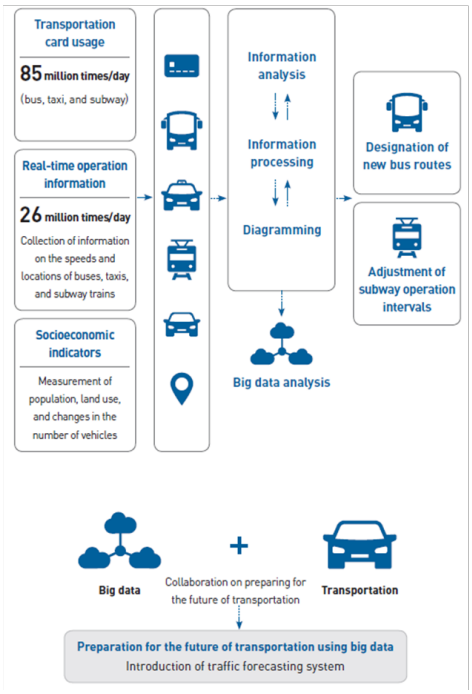
The main achievements of TOPIS are as follows:

First, TOPIS gathers and delivers real-time traffic information through multiple channels. Around 4,500 bus stop terminals across Seoul allow citizens to track bus arrivals in real-time. Second, it offers comprehensive transportation guidance, helping users find the optimal route by combining various modes of transport—cars, buses, subways, and bicycles—to enhance convenience and efficiency.

Third, Seoul supports the creation of private services through the opening of open APIs. TOPIS opened traffic information to the private sector, allowing the development of various traffic information services and the creation of added value. Private companies can use this data to develop new applications and services.

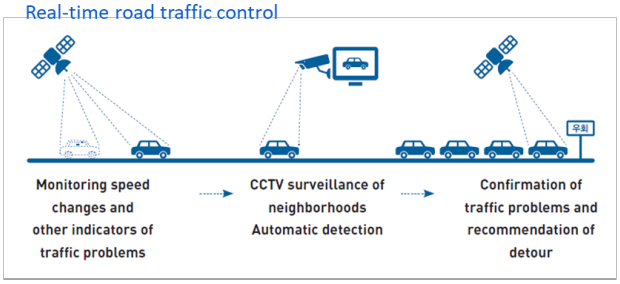
These achievements demonstrate that TOPIS significantly contributes to improving transportation efficiency in Seoul and providing more convenient transportation information to citizens.

Establishment of transportation policy based on big data analysis

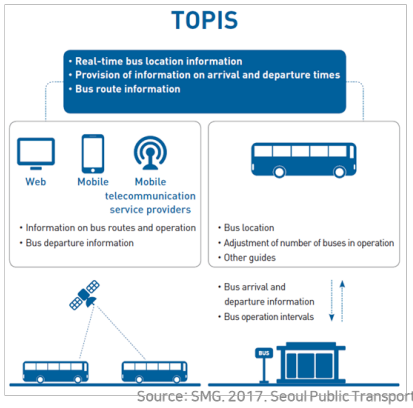


Source: Seoul Metropolitan Government. 2017. pp.36-37

Real-time road traffic control



Real-time bus operation management



Source: SMG. 2017. Seoul Public Transportation

03 Smart City Data Hub

The Smart City Data Hub was established to integrate and manage urban data, driving the development of a data-driven smart city. It serves as a platform to demonstrate service models that address urban challenges and promote sustainable growth. Developed as a key component of the smart city innovation R&D project—part of the 3rd Smart City Comprehensive Plan—the hub aims to foster open, collaborative city management and services. This initiative lays the foundation for advanced digital operations and positions the city at the forefront of the 4th industrial revolution.

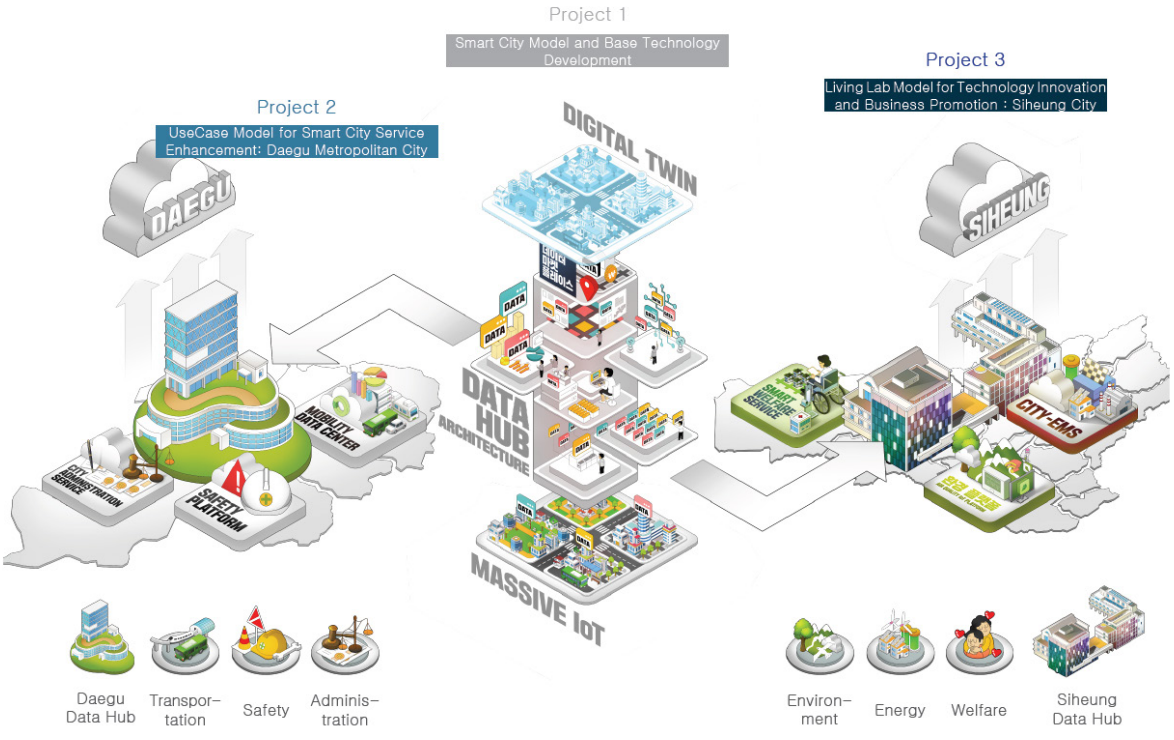
Key features of the Data Hub include:

Data integration and management: Collecting data from various sources, integrating and managing it, and monitoring the city's operational status in real-time;

Data analysis and prediction: Using big data analysis technology to predict various problems in the city and develop solutions;

Open data platform: Supporting the creation of innovative services and business models by making data accessible for use by private companies and research institutes.

The smart city innovation R&D project for developing a smart city data hub consists of three detailed project groups: the first is data hub development, the second is metropolitan big data, and the third is Living Lab-based data.



The Concept Mapping of the National Strategic Smart City Program

Source: DEAPCITY. 2023. p.4

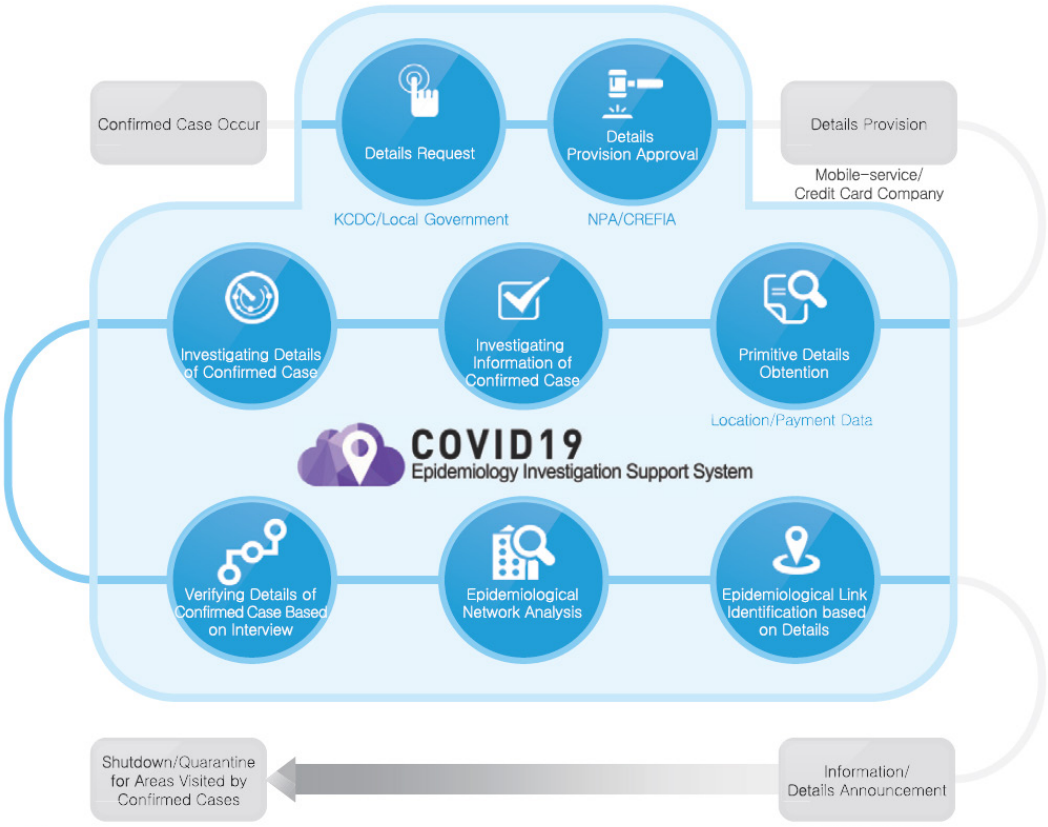
Smart City Data Hub Use Case: COVID-19 Analysis System

The COVID-19 Analysis System was developed in response to the rapid spread of COVID-19, which first emerged in Daegu in February 2020. Its primary goal was to swiftly trace the movement of infected patients, identify sources of infection, quarantine locations visited by the patient, and alert contacts for screening and self-quarantine. This system played a crucial role in minimizing the virus's spread.

By collecting and analyzing real-time data, such as patients' locations and their card usage, the system quickly mapped the movement of confirmed cases. The spatiotemporal analysis allowed for the rapid identification of transmission routes and hotspot areas, reducing the time required for epidemiological investigation from 24 hours to just 10 minutes.

The system achieved several key outcomes. First, it enabled fast identification of infection sources, preventing further spread. Second, it facilitated prompt disinfection of locations visited by confirmed patients, preventing secondary infections. Third, it alerted those who had been in contact with infected individuals, prompting immediate screening and self-quarantine measures.

In summary, the COVID-19 Analysis System, powered by the Smart City Data Hub, demonstrated the ability to respond swiftly and effectively to a pandemic using big data and real-time analysis. This system highlights the potential of smart city technologies in enhancing public health management and overall city resilience.



Source: MOLIT. 2020. p.6

04 Digital Twin

A digital twin is a virtual model of a physical object that allows for interaction, monitoring, and real-time data analysis of the actual environment. This technology provides more information than 2D geographic information systems, enabling a better understanding of real-world situations.

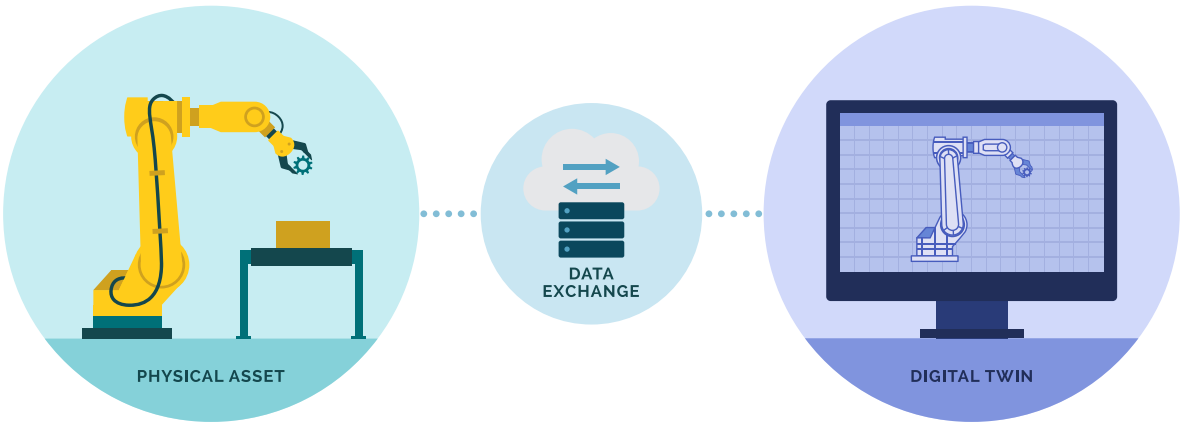
One early example of using digital twins in urban environments is Virtual Singapore, introduced in December 2014. Since then, numerous countries, including Korea, have been working on developing digital twins for their cities.

Seoul has had the Urban Planning Information System (S-UPIS) in place since 2006 to support urban planning efforts. In 2020, it was integrated into a platform called Virtual Seoul, which is a three-dimensional system. Virtual Seoul serves as a digital twin, modeling approximately 600,000 buildings and over 13,500 structures. The Virtual Seoul aims to provide a way to intuitively understand the future of Seoul and empathize with its citizens.

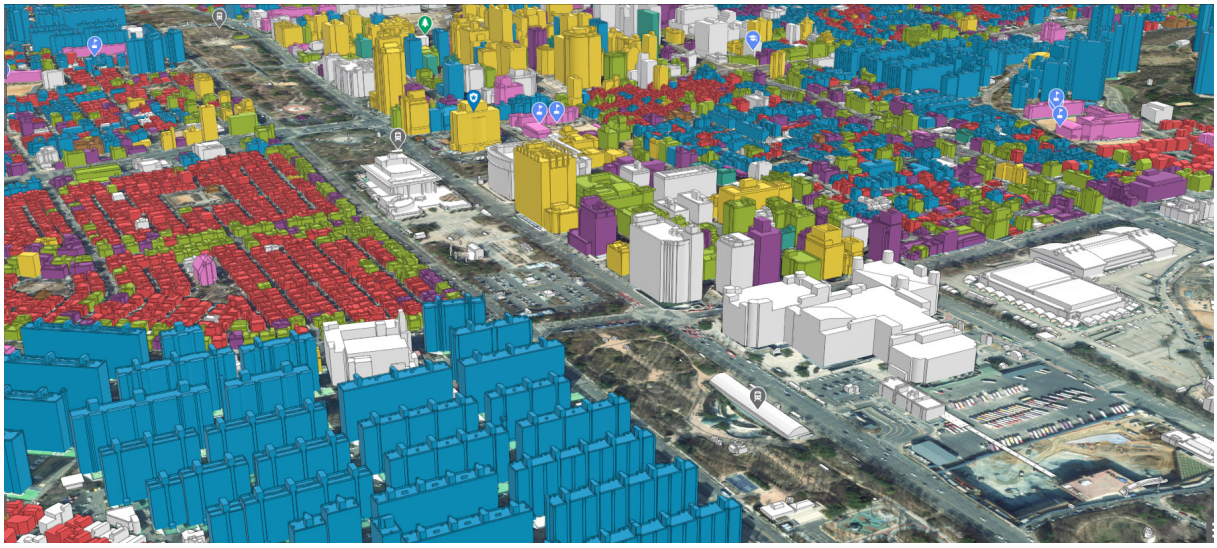
Incheon is actively working on developing a smart city using its digital twin. The city is creating a digital twin platform to digitalize major infrastructure, buildings, roads, and transportation systems for real-time management and analysis. This initiative aims to address traffic congestion, enhance disaster response, and improve environmental management.

NAVER, a private company, is utilizing a digital twin for various projects. NAVER's digital twin technology enables an accurate replication of a city with an error margin of less than 10 cm. They recently entered into a contract with Saudi Arabia to develop a digital twin platform for five major cities: Riyadh, Medina, Jeddah, Dammam, and Mecca. The purpose of the project is to enhance public services such as urban planning, weather simulation, and natural disaster prediction.

Digital twin technology solves complex urban problems, predicts the future, and enables efficient management. Examples such as Seoul, Incheon, and NAVER show how digital twins can play an important role in urban planning and management. These technologies are essential for sustainable urban development and are expected to lead to innovation in various public services.



Seoul Digital Twin S-Map[3)]



Incheon Digital Twin[4)]

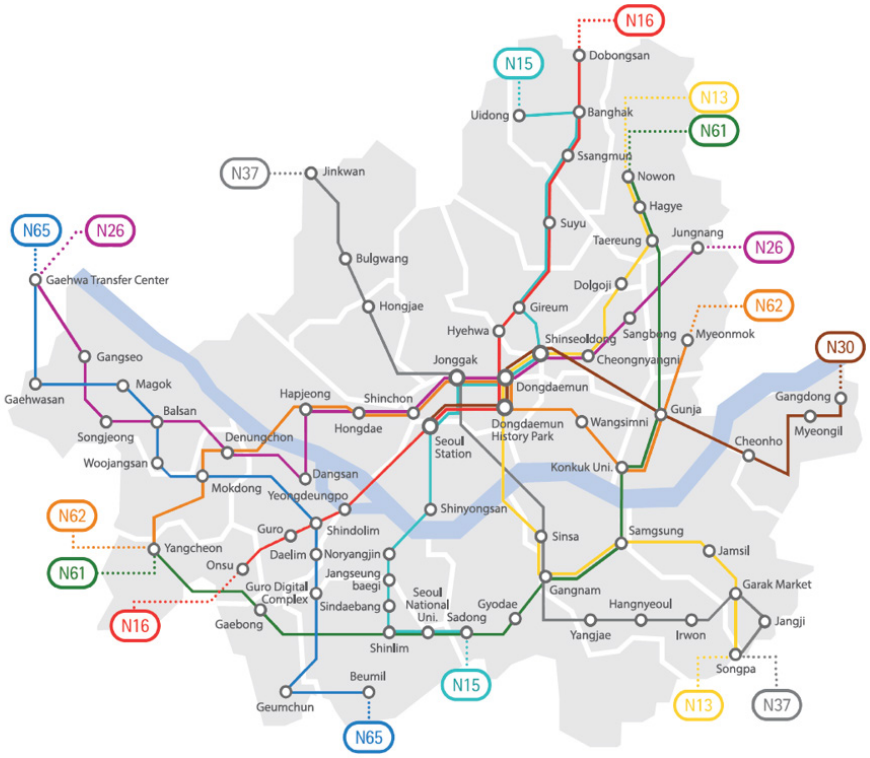
Naver Digital Twin[5)]

05 Big Data Traffic Analysis and Seoul Owl Bus

The introduction of owl buses in Seoul was driven by the need to address transportation gaps during late-night hours. To tackle this, the city leveraged big data analysis, examining over 3 billion call and taxi ride data points to identify common travel routes and times. This analysis enabled Seoul to create optimized bus routes that catered to high-demand areas during the late-night period.

The Owl Bus program has achieved significant success in three key areas. First, Seoul designed new routes based on actual citizen movement patterns, enhancing transportation efficiency during late-night hours. Second, the Owl Bus offers affordable fares, providing a cost-effective alternative for those who find taxi fares prohibitive, especially low-income individuals and office workers returning home late. Third, the program promotes safer travel during late-night hours, contributing to crime prevention and overall public safety.

The Owl Bus is a great example of how public-private collaboration, supported by big data analysis, can lead to effective urban policies. By accurately identifying late-night transportation needs, Seoul has been able to offer tailored solutions that better serve its citizens. This initiative not only addresses a critical transportation challenge but also serves as a model for other cities aiming to enhance their public transit systems through data-driven decision-making.



Owl Bus Routes

Source: Seoul Metropolitan Government. 2017. p.37

06 Smart Poles and Smart Crosswalks

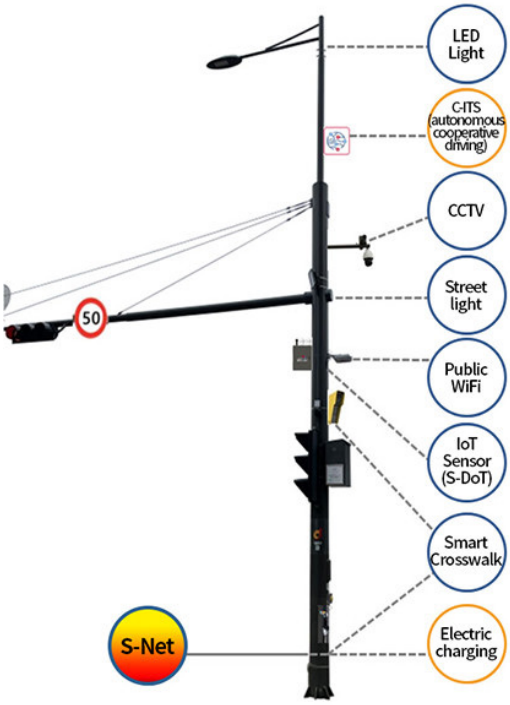
Smart Poles are integral to modern urban infrastructure, combining traditional road facilities—such as traffic lights, streetlights, CCTV, and security lighting—with advanced ICT technologies like Wi-Fi, IoT, intelligent CCTV, and smart crosswalks. These poles have become crucial for smart cities, offering safe and convenient urban services to citizens.

For example, along Songjeong Road in Seoul, a smart pole equipped with CCTV, security lighting, electric bicycle charging stations, and public Wi-Fi enhances both safety and convenience for the public. Similarly, smart poles along the Cheonggyecheon Stream integrate streetlights and CCTV to improve security in high-traffic areas.

Traditionally, various road facilities have been installed separately, cluttering the cityscape and creating obstacles for pedestrians. While there have been efforts to integrate certain road facilities, such as traffic lights, the broader integration of other smart technologies has often been overlooked. Initiatives like the "Walking City, Seoul" and the "Integrated Holdings Project" have aimed to address this by combining basic functions like streetlights and guidance signs with traffic lights, but broader integration remains limited.

Installing infrastructure in areas without traffic lights, such as alleys or back roads, posed challenges, particularly with smart devices like Wi-Fi, electric chargers, and self-driving car infrastructure, which lacked standardized installation guidelines. This haphazard placement raised safety concerns. To resolve these issues, it's essential to establish standardized procedures for the installation and management of integrated infrastructure, such as smart poles. This approach would streamline operations, enhance safety, and improve the city's visual appeal.

Seoul is actively promoting the widespread adoption of smart poles, offering guidelines for their installation. Other cities in Korea are following suit, deploying smart poles and incorporating smart crosswalks—one of the key features of these poles. Beyond traditional road functions, smart poles are now playing a vital role in solving urban challenges and improving the quality of life for citizens through the integration of cutting-edge technology.



Smart Pole[6)]

Smart Pole Field Photo[7)]

Seoul Smart Pole[8)]

Smart Pole Functions[9)]

Function	Seoul
LED Light	Provides future street lighting services. Saves energy by using LED lighting. Performs intelligent lighting brightness adjustment through illuminance recognition (illuminance sensor).
CCTV	Provides intelligent integrated CCTV functions. Provides social safety services such as traffic information collection and facility management. Provides life safety services such as crime prevention and parking enforcement.
C-ITS (autonomous cooperative driving)	Links with next-generation intelligent transportation system (C-ITS) help reduce traffic accidents and create a foundation for future transportation innovation. This provides an autonomous cooperative driving basis.
Public WiFi	Provides basic communication rights to citizens. Offers high-quality communication services by connecting to S-Net.
IoT Sensors	S-DoT (Smart Seoul Data of Things) complex IoT sensor. A total of 17 types of urban phenomena were identified, including fine dust, temperature, wind, and floating population. The data collected will be used to develop urban policies and discover services experienced by citizens through analysis.
Smart Crosswalk	Provides intelligent walking safety functions. It includes floor-type traffic lights, voice guidance for walking signals, and an IoT speeding prevention system. The system prevents jaywalking and traffic accidents, and provides a driver speed map.
Electric Charging	Provides charging infrastructure for mobility, offers wireless charging for electric vehicles and smartphones, and promotes the use of eco-friendly energy.
S-Net	Seoul has its own communication network, a self-communication network that connects the entire city of Seoul. It provides public Wi-Fi, intelligent CCTV, and an Internet of Things service network.
Future New Technology	Provides acceptance of future new technologies Facilitates acceptance of ever-evolving future technologies such as 5G and drones Includes additional features for the citizen-experience smart pole (S-Pole) Offers QR code-based city guide service Features floating population sensor, safety-linked IoT sensor, IoT common box, emergency bell, and more.

07 Smart Bus Stop

Bus stops in Korea have a system that provides bus arrival information. These features are often referred to as smart bus stops. Recently, more advanced types of smart bus stops equipped with various civic amenities have been spreading. These advanced stops, also called smart shelters, are changing the concept of existing bus stops. They have screen doors that open based on the bus's arrival and departure, as well as air purifiers installed on the ceiling. Additionally, they have a system to measure indoor and outdoor air quality and provide information on fine dust, allowing citizens to easily check the air quality. In the summer, smart shelters provide cool air conditioning, and in the winter, they have warm chairs so that people waiting for the bus can wait comfortably regardless of the weather.

These smart shelters are being distributed to various local governments, including Seoul and Busan, through the Smart Challenge project, which is increasing citizens' use of public transportation. They are receiving positive responses from citizens by greatly improving convenience and providing a better public transportation environment. Korea's smart bus stops go beyond simply providing information and are establishing themselves as a comprehensive transportation infrastructure that integrates various functions to enhance the health and convenience of citizens.

Smart Bus Stop

Smart Bust Stop Functions

Function	Detail
Real-Time Bus Arrival Information	An LED display and voice guidance system provide real-time bus arrival information, and features for the visually and hearing impaired are included.
Screen Door System	To help passengers embark and disembark safely, ensuring the safety of children, the elderly, and the disabled.
Air Purifier and Air Quality Information	Air purifiers have been installed inside the bus stop to maintain indoor air quality. A system is in place to check the waiting environment, measuring indoor and outdoor air quality and providing fine dust information.
A Pleasant Bus Waiting Environment	A comfortable waiting environment is provided with air conditioning in the summer and heaters and warm chairs in the winter, ensuring comfort even in extreme weather conditions.
Free WiFi	Providing free Wi-Fi and enhancing information accessibility for citizens to use the Internet while waiting for the bus.
CCTV Security System	Security and safety monitoring functions are provided through the CCTV system, facilitating crime prevention and swift response in case of an incident.

Smart Bus Stop[10)]

Smart Bus Stop[11)]

08 Public Transportation Integrated Operation System

Overview

In the 1980s, as incomes in Seoul rose, car ownership surged dramatically. By 2014, the number of private vehicles in the city reached approximately 3 million—an increase of 103 times from 1980—while the road network expanded by only 1.2 times. This sharp rise in private car ownership prompted the need for smart and effective public transportation policies to ensure a safe and efficient transportation system, managing an average of 32 million vehicle trips daily. As of 2015, public transportation accounted for about 65% of all trips in Seoul, with 39.3% using the subway and 26.5% taking the bus. In contrast, private cars made up just 23% of the city's transportation share, underscoring the critical role of public transit in Seoul's mobility landscape.

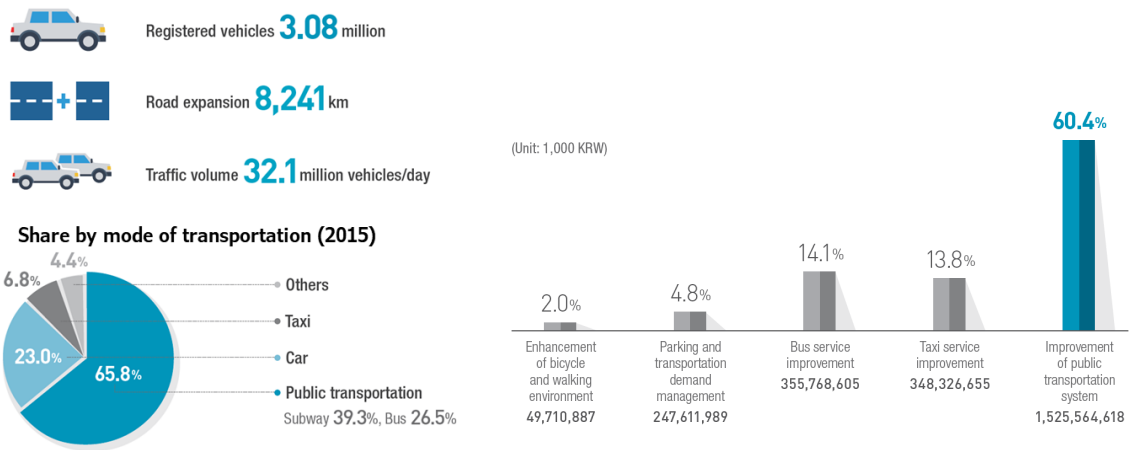
In 2017, Seoul's transportation budget amounted to around 2.53 trillion KRW (22.4 million USD), with 60.4% allocated to improving public transportation infrastructure and 14% dedicated to enhancing bus services. This investment highlights the city's ongoing commitment to maintaining a robust and convenient public transportation system.

Bus System Improvements

In 2004, Seoul reformed its public transportation-oriented bus system to reduce traffic congestion by decreasing the use of private cars. As a result of this reorganization, 7,413 buses operate in 353 bus lanes, serving an average of 4 million passengers per day. These improvements have effectively reduced the use of private cars.

Smart Transportation Cards and Public Transportation Integrated Fare Systems

Seoul was the first city in Korea to integrate public transportation payments using smart transportation cards. With a single card, citizens can access all forms of public transportation, including buses, subways, and taxis. Initially introduced in Seoul, this system



Seoul Transportation Sharing Status (2015)[12)]

has since expanded nationwide, allowing seamless travel across cities with just one card.

In the metropolitan area, this system allows passengers to transfer between buses and subways without paying multiple fares. For example, transfers between two buses used to require paying separate fares, but under the integrated fare system, a single fare covers transfers within a certain distance, with additional charges applied only for longer journeys. Discounts are also available for transfers between buses and subways, lowering transportation costs and enhancing convenience for passengers.

In recent years, big data analysis of transportation card usage has been leveraged to predict demand, optimize service efficiency, shape transportation policies, and provide traffic forecasting services. This data-driven approach continues to improve the overall public transportation experience in Seoul and beyond.

Improvements	Detail
Classification by Bus Route	Increased awareness was accomplished by introducing four distinct bus routes: circulation (yellow), trunk (blue), branch (green), and rapid (red) buses. This allows citizens to easily recognize bus routes.
Establishment of a Demand-responsive Bus System	A new bus route has been established in Seoul to better meet the needs of citizens. The area now has an "Owl Bus" that operates from 11 PM to 6 AM, and a "Squirrel Bus" that runs shorter distances during rush hours. These routes were planned based on the analysis of citizens' public transportation usage patterns using big data, as well as feedback from citizens. For example, the Owl Bus was created after analyzing late-night mobile phone usage and call taxi data.
Semi-public Bus System	A semi-public system was implemented to enhance bus operations' transparency and efficiency, leading to improved service quality and stable operations.
Introduction of Bus Center Lanes	Implementing a dedicated lane exclusively for buses addressed traffic congestion and improved bus punctuality. This allowed buses to bypass traffic congestion and operate more efficiently. Consequently, bus speeds increased from 15 km/h to 20.65 km/h, representing a significant improvement of around 37%.

09 Demand Responsive Buses

Many public transportation routes are facing financial challenges because of low profits compared to operating costs. This has led to a continuous increase in public transportation subsidies, imposing a heavier financial burden on local governments. In addition, infrequent service intervals on non-major routes have hindered freedom of movement, resulting in many unnecessary detours, even when there is no actual demand to reach the destination. To address these challenges, an optimized means of transportation that can efficiently utilize limited financial resources was necessary. In response, demand responsive buses were discovered through the Smart City Challenge project.

In 2020, Incheon City and Hyundai Motor Company introduced the demand-responsive bus for the first time in Korea as part of the Ministry of Land, Infrastructure and Transports Smart City Challenge project. A demand-responsive bus operates by flexibly adjusting routes and times according to passenger requests, reducing unnecessary detour routes and enabling efficient operation based on actual travel demand. This introduction of demand-responsive buses contributes to improved public transportation service quality and easing the financial burden on local governments. When a passenger requests a bus through a smartphone application, the bus is dispatched at the requested location and time, making public transportation more convenient and eliminating long service intervals.

This has been regarded as a successful example of using smart city technology to solve city traffic problems. Furthermore, the success of the demand response bus in Incheon has led to the service spreading nationwide, with Gyeonggi-do, Sejong, and Pohang also introducing the service.

Here are the procedures for utilizing the demand-responsive bus: When a user calls DRT through a smartphone app, the system provides estimated dispatch information. The user

Key features of the user app

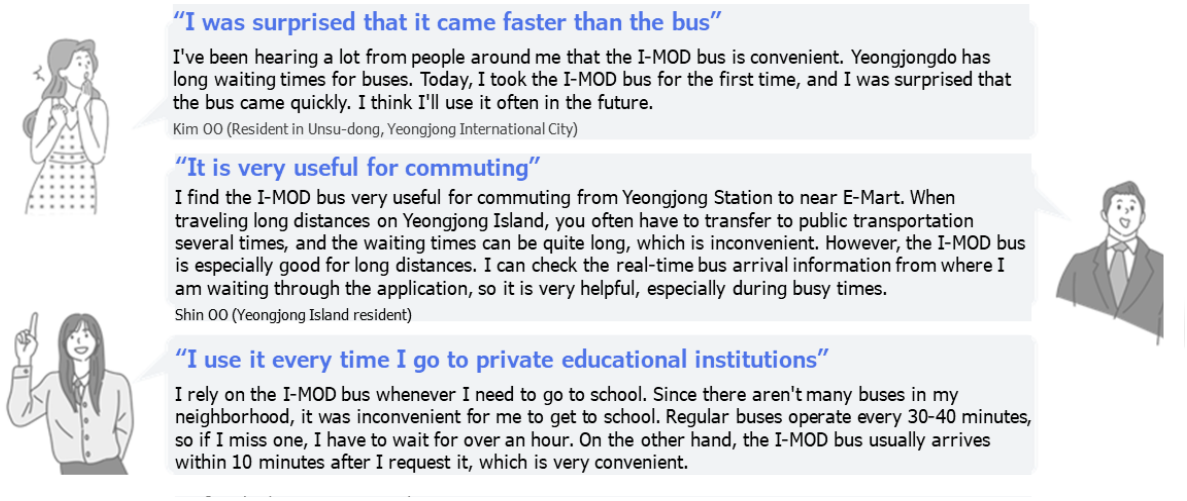
Source: Incheon Metropolitan City. 2022. p.16

then requests dispatch, and once confirmed, a QR code for the boarding pass is issued.

Citizens are highly satisfied with demand-responsive buses because they arrive faster than regular buses. This allows passengers to reach their destination without the hassle of changing buses during their commute. In Yeongjong Island, Incheon, the waiting time for regular buses, which used to be up to 75 minutes, was reduced to about 16 minutes with demand-responsive buses. In Geomdan and Gyeyang areas of Incheon, the waiting time was 8 minutes, much shorter than the target of 13 minutes, demonstrating the effectiveness of the service.

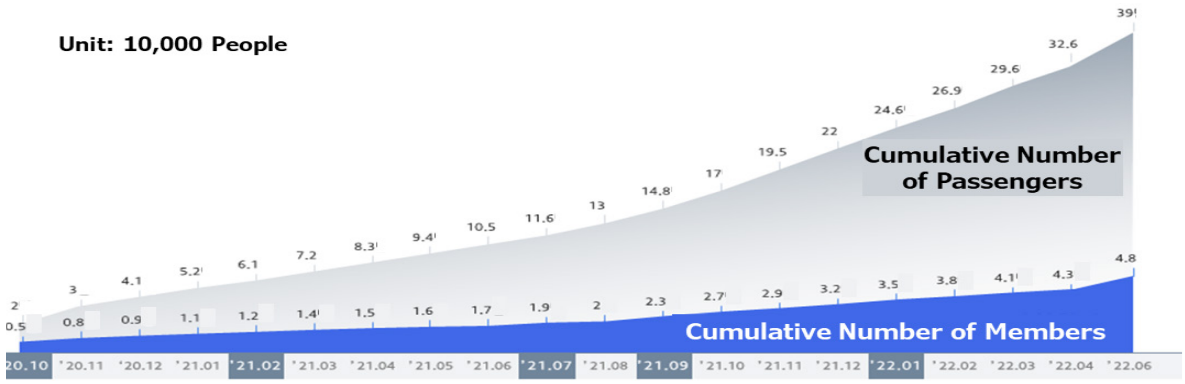
Demand-based vehicle operation

Source: Incheon Metropolitan City. 2022. p.13



I-MOD User Interview

Source: Incheon Metropolitan City 2023. p.49



Cumulative number of passengers and members

Source: Incheon Metropolitan City. 2022. p.38

10 Smart Waste Collection Management Integrated Solution

Seoul Recyclables Automatic Sorter Nephron

To reduce waste, it is best to improve awareness that waste is another resource and to recycle it. In this regard, Gangdong-gu, Seoul began introducing the recyclable collection box Nephron that applies AI and IoT technology in 2019 to increase the recycling rate. Nephron is a vending machine-style recycling robot that automatically sorts and compresses cans and PET bottles. When a user puts a can or PET bottle into Nephron, the device recognizes the recyclables and automatically sorts and compresses them.

Nephron provides economic rewards to the user. When you enter your mobile phone number on the device, circulation can accumulate points worth 10 KRW per transparent PET bottle and beverage can, up to 30 per day, and these points can be converted to cash and used. At the same time, they are accumulated separately as carbon neutral points of the Korea Environment Corporation, and circulation can receive up to 70,000 KRW per year. Nephron has received tremendous response from residents, who are actively participating, to the extent that over 100,000 cans and PET bottles were collected in the first year after installation.

By introducing Nephron, Seoul has presented a new model for resource recycling using smart technology. The recycling collection system that combines AI and IoT technologies has become an important tool for encouraging residents' participation and realizing efficient resource management and environmental protection. This approach is being evaluated as a successful case that can be benchmarked in other cities.

RFID Trash Bin

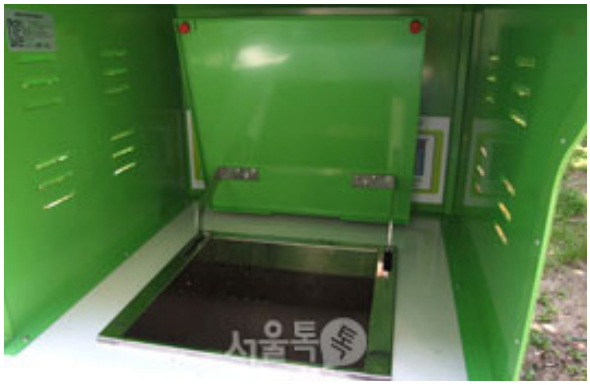
In 2010, relevant ministries jointly launched a comprehensive measure to reduce food waste, which was implemented in 2012 along with the Ministry of Environment guidelines for the volume-based food waste system. In 2013, RFID-based

Nephron[12)]

Source: Seoul in my hands. 2020.

RFID Dumpster

Show Apartment building/unit



The Cover is Open[13)]

Standard and Mini Cards

Source: Seoul in my hand. 2013

food metering devices were distributed to apartments in Geumcheon-gu, Yeongdeungpo-gu, and Seocho-gu in Seoul. This system changed the previous method of charging a lump sum fee per household regardless of the amount discarded to a system where fees are metered and charged based on the amount discarded. Each household received an RFID-only card to authenticate the disposal of food waste. The system measures the amount of food waste per household, and the charges are calculated by the management office and added to the management fee. The RFID-based food billing system is now spreading across the country and plays a crucial role in improving waste management efficiency, promoting resource recycling, and contributing to environmental protection.

Smart Waste Management System

domestically and internationally, including in cities such as Seoul, San Francisco, and Baltimore in the United States, as well as in Melbourne, Australia. Ecube Labs, a leading company in this field, is contributing to the reduction of a city's waste management costs by using sensors on trash cans to collect information about which bins need to be emptied. Based on this data, the company suggests optimal routes for trash collection vehicles, thereby improving collection efficiency.

Waste management involves managing the entire process of waste, from collection and transportation to processing, recycling, and final disposal. The main components are:

1. Collection: The first step is to collect waste from residential, commercial, and industrial areas. Garbage collection takes place according to a set schedule using different types of vehicles and equipment. There is also smart technology available that monitors the filling level of trash cans in real-time and plans the optimal collection route.

2. Transportation: Collected waste is then transported to a treatment facility. Efficient route planning and vehicle management are crucial in this stage. Collection vehicles use tracking technologies such as GPS to follow optimal routes, reducing fuel use and increasing efficiency.

3 Processing: Waste goes through sorting, recycling, incineration, or landfilling. Sorting separates recyclable materials, incineration reduces the waste volume and can generate energy, while landfilling safely buries untreated waste in a designated location.

3-1 Recycling: Creating new products from reusable resources is essential for reducing resource waste, energy consumption, and environmental pollution. Recyclable materials include paper, glass, metal, and plastic.

3-2 Final Disposal: Unrecycled or untreated waste is disposed of in a landfill. The aim is to minimize environmental pollution and use landfill capacity efficiently, adhering to strict regulations to prevent groundwater contamination and minimize odor and pest problems.

Modern waste management systems utilize advanced technologies to greatly improve efficiency. The waste bin is powered by solar energy and equipped with ultrasonic sensors to monitor waste levels in real-time. This data is sent to a cloud-based waste management platform, enabling it to optimize collection routes and lower operational expenses. An effective waste management system offers both environmental and economic benefits by reducing resource waste, preventing air and soil pollution, and conserving energy. This system also leads to cost savings in waste disposal and generates new economic value through recycling.

In summary, an effective waste management system is crucial for creating a sustainable urban environment. The integration of smart technology enhances the efficiency of this system, leading to environmental protection and resource conservation. As technological advancements continue, more innovative waste management methods are anticipated to be developed in the future.

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