

Smart City: Key Technology Areas

(Menu board)



Table of Contents

1. Security

- 1-1 Underground Monitoring Service for Pavement Depression Prevention
- 1-2 Early Warning Service System for Weather Risk Management in Climate-smart Agriculture
- 1-3 Real-time Field Support with IoT Smart Helmets in Emergency Events
- 1-4 Facility Safety Management with IoT Sensors
- 1-5 Drone-based Smart Maritime Safety Management Service

2. Healthcare

- 2-1 IoT-based Patient Care as part of Mass Casualty Management in Emergency Events
- 2-2 Silver Care Service for Seniors Living Alone
- 2-3 Air Quality Monitoring Service
- 2-4 Remote Medical Diagnosis System

3. Mobility

- 3-1 Traffic Enforcement in Tunnels Using Intelligent CCTV
- 3-2 Smart Parking Service in Public Parking
- 3-3 Monitoring and Warning Service of Drowsy and Careless Bus Drivers
- 3-4 Illegal Parking Notification Service
- 3-5 Smart Eco Bike Sharing Service
- 3-6 Cutting-edge Navigational Aid Service for Safe Sailing
- 3-7 Operating System for Passenger Information System (SEOUL TOPIS)
- 3-8 Integrated Public Transport Fare System

4. Energy

- 4-1 Development of an Optimized Model for Zero-Energy House and its Demonstration Complex Construction
- 4-2 IoT-based Smart Street Lights
- 4-3 IoT-based Energy Bill Tracking Management Service (ENERTALK)

5. Water

- 5-1 Smart Water City Project for Clean Water Supply Management
- 5-2 Smart Water City Project for Clean Water Supply Management: Smart Water Meter Solution
- 5-3 Real-time Water Quality Monitoring System
- 5-4 Intelligent Water Purification Plant Management System
- 5-5 Establishment of Intelligent Public Wastewater Treatment Plant
- 5-6 Real-time Water Damage Prevention Monitoring System for Pipe Damage and Leakage

6. Waste

- 6-1 Bulk Waste Disposal Service Based on AI Object Recognition
- 6-2 IoT-based Carton Recycling and Incentive Payment Service
- 6-3 Smart Trash Bin Service

7. e-Government

- 7-1 Cadastral Surveying using Drones
- 7-2 AI-based Chat Service for Delivery of Basic Legal Knowledge
- 7-3 IoT-based Cultural Heritage Management Service
- 7-4 Digital Tax Filing Service
- 7-5 KnowRe, an AI Math Learning Platform
- 7-6 Open Geographic Information System (National Spatial Data Infrastructure Portal)
- 7-7 Online Administrative System for Construction (Digital Permit for Land Use and Construction)
- 7-8 Online Permit Application Self-Check Service

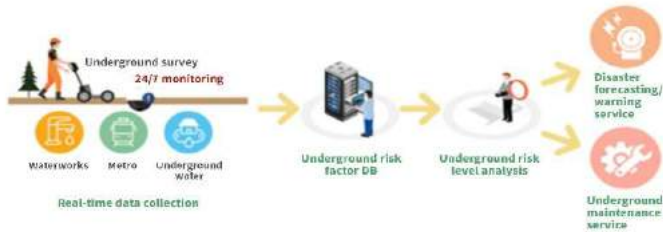
8. Public Engagement/Community

- 8-1 Blockchain-based Local Currency Service
- 8-2 Blockchain Evaluation for Local Community Project Selection Process
- 8-3 Smart Civil Complaint Management System
- 8-4 Wemap, a Community-based Online Platform for Public Engagement
- 8-5 Digital Service for Citizens

1-1 Underground Monitoring Service for Pavement Depression Prevention

About the Service

- Safety management service utilizes IoT sensors installed in underground objects to analyze and provide in real-time the risk level detected to prevent disasters and accidents such as road collapses and sink holes.



Service Implementation Cases

- In 2017, Seongdong-gu Office in Seoul conducted a pilot project of monitoring in real-time objects buried underground, underground structures of urban railway and nearby ground within the 500m diameter of Wangsimni Station, and forecasting underground water and geological conditions to assess risks and provide safety index
- Conducted by ETRI in partnership with Seongdong-gu Office, the pilot project successfully launched safety management system developed by ETRI's UGS (Underground Safety) Research Group.

Key Technology Areas

- Sensors detect leaks in water supply pipes, monitor underground water and geological features, survey sewer pipes with CCTV, and assess collapse risk of surrounding areas.

| Installation of pipe leakage monitoring device | CCTV survey and risk analysis of sewer pipes | Underground water & geological environment monitoring |
|--|---|--|
| <p>Pipe & valve</p> <p>Arsenite fitted on manhole cover</p> | <p>Sewer pipes monitored with CCTV.</p> | <p>Multi-sensor installed for monitoring of underground water and geographical conditions.</p> |
| <p>- Leakage detection sensor installed on gate valve located under the manhole.</p> <p>- 24/7 monitoring with installation date & pipe type data, diameter survey and analysis.</p> | <p>- Machine learning-based automatic pipe damage analysis with CCTV for evaluation of subsidence risk.</p> | <p>- Subsidence Risk Index developed for evaluation and visualization of vulnerability.</p> |

Underground space safety management system of Seongdong-gu, Seoul



* Source: KLID(2018). 2018 Smart-Nation Service Catalog

1-2 Early Warning Service System for Weather Risk Management in Climate-smart Agriculture

About the Service

- Farmstead-specific early warning service system for weather risk management was implemented in 2017 to provide custom risk management recommendations for individual farms by their level and risk assessments of specific crops.



Key Technology Areas

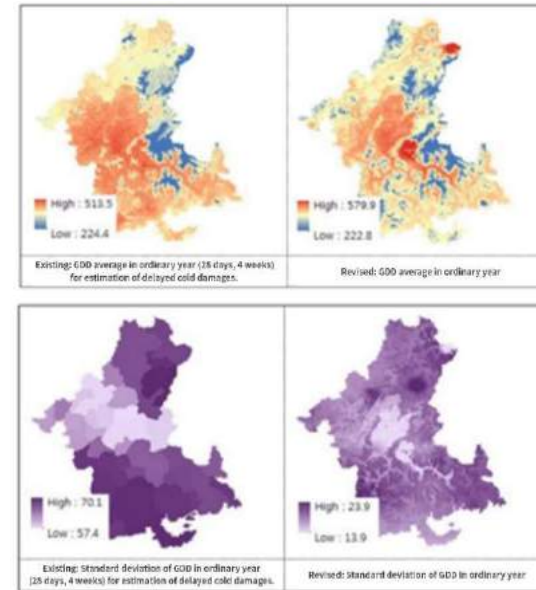
- Collection of site-specific agricultural information (farm land information: crop, variety, growth stage, location, etc.)
- GIS-based agro-meteorological early warning system
- Construction of database containing crop specific risk assessments prioritizing growth stages, mechanism of disaster occurrences, risk assessment criteria, and etc.



* Source: KLID(2018). 2018 Smart-Nation Service Catalog

Service Implementation Cases

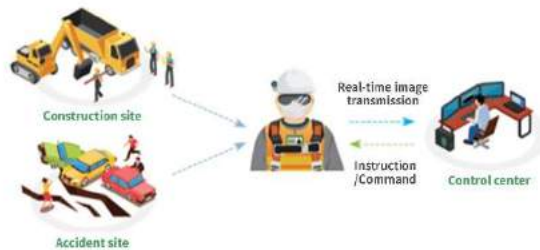
- “weather risk index” was built by collecting data from farmers owning farmland over 1 ha in ten cities and districts around Seomjin river basin who have volunteered to subscribe to the early warning service.
- Based on the Ministry of Agriculture, Food and Rural Affairs database, staple crop farmers were identified. Then, using the information on their land property lines, farmland border map database was created.



1-3 Real-time Field Support with IoT Smart Helmets in Emergency Events

About the Service

- IoT helmet worn by each field worker sends real-time accident site image and audio data to the control center for rapid on-site response.



Key Technology Areas

- IoT helmet:** LTE-based wearable device. Supports real-time control of helmet camera images from computers, smartphones and tablets. Supports helmet-to-helmet and helmet-to-control center audio communication.
- Real-time image transmission:** Data collected from IoT smart helmet feeds back to centralized software attached on the backside of the helmet, which allows real-time data access from the control center.
- Web-based control system:** Supports location tracking of IoT helmets (field workers), data and battery usage status, and individual and group voice calls

Service Implementation Cases

- Since June 2017, Seoul Metro has placed IoT smart helmets in major hotspots and has adopted the helmets in city emergency trainings, construction projects and inspections.
- Gangwon-do: Introduced IoT smart helmets to monitor wildfire and help curb high impact by ensuring immediate response and efficient management during emergencies from local government's forestry department.

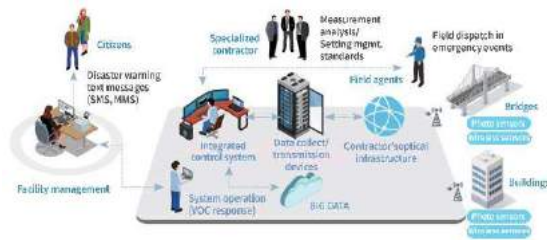


* Source: KLID(2018). 2018 Smart-Nation Service Catalog

1-4 Facility Safety Management with IoT Sensors

About the Service

- IoT sensors allow real-time monitoring of the safety status (i.e. cracks and deformation) of public facilities and supports comprehensive public facilities safety management.



Service Implementation Cases

- From Aug. to Nov. 2017 (four months), Daegu City in five of its aged facilities launched a pilot operation of facility safety management service using IoT.
 - The pilot project was launched in 2017 by Daegu City's Safety Management Team in partnership with KT and Kyungpook National University.

Key Technology Areas

- Optical and wireless sensors are installed in public facilities (i.e. bridges, parking lots), linked with “aging facilities safety management system” for operation of a control system that conducts continuous monitoring.

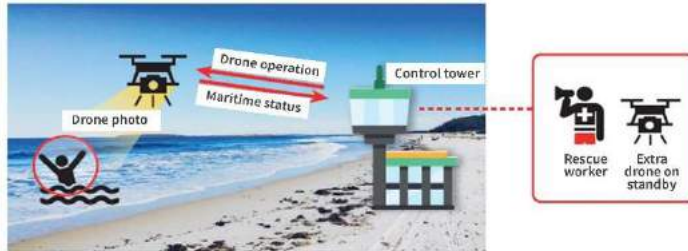


* Source: KLID(2018). 2018 Smart-Nation Service Catalog

1-5 Drone-based Smart Maritime Safety Management Service

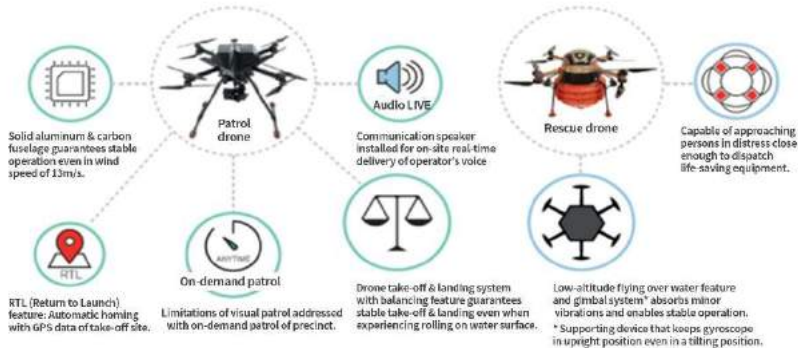
About the Service

- Uses drones to access hard-to-reach disaster afflicted areas to gain real-time monitoring insight and perform rescue operations.



Key Technology Areas

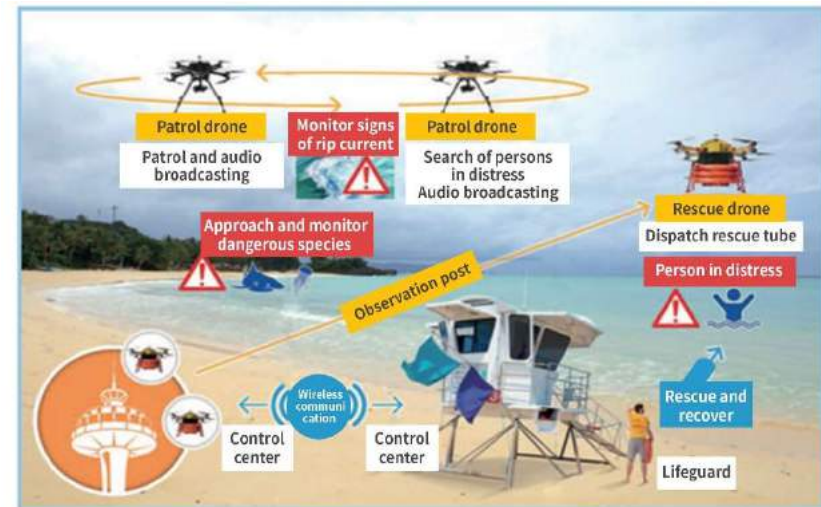
- Uses two types of drones: (1) beach monitoring drone; patrol drone (2) emergency situation rescue drone



* Source: KLID(2018). 2018 Smart-Nation Service Catalog

Service Implementation Cases

- Gangneung city introduced a drone-based smart maritime safety management service in Gyeongpodae Beach, a tourist destination with annual visitors surpassing ten million.
- Led by Gangneung city, the project was implemented and operated by a private contractor specializing in drone service.



2-1 IoT-based Patient Care as part of Mass Casualty Management in Emergency Events

About the Service

- Patient care service provides quick identification of patients' injury status to perform first aid and expedite medical transport during emergency events such as earthquake or fire.

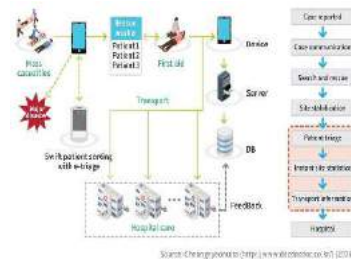


Service Implementation Cases

- Chungnam Fire Department developed e-Triage system in 2016 and began a pilot project in August 2017 applying IoT-based patient care service in emergency medical responses.
- Project scope: Dongnam (Cheonan), Seosan and Hongseong Fire Stations
- Participating hospitals: Dankook Univ. Hospital, Soonchunhyang Univ. Hospital, Cheonan Chungmu Hospital, Seosan and Hongseong Medical Centers

Key Technology Areas

- **e-Triage tag:** A paramedic uses an electronic tag embedded with a NFC module to enter data in the smartphone app → Tagged injury severity level (red, yellow, green, white) displayed on LED
- **Real-time monitoring:** Immediate monitoring of casualties in emergency events via patient data transmission on the server.



출처: 충남 소방본부, 2018

* Source: KLID(2018). 2018 Smart-Nation Service Catalog

2-2 Silver Care Service for Seniors Living Alone

About the Service

- “Medical biometrics detection sensors” installed or placed in homes enable 24/7 monitoring and allow social workers to continuously check on the seniors as well as their absence from home for the purpose of health management and prevention of lonely deaths (*kodokushi*).



Key Technology Areas

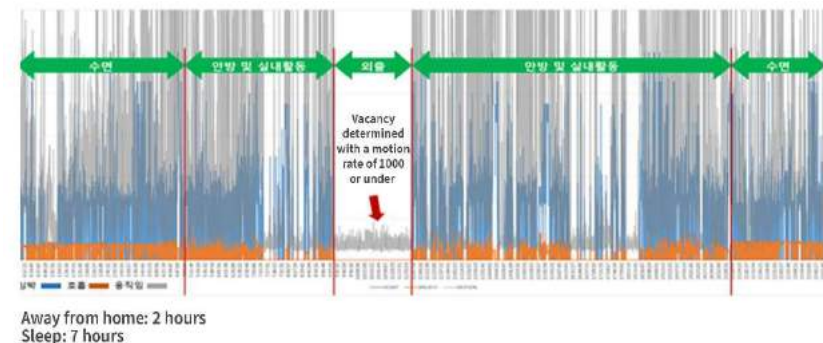
- Contactless biosensors enable monitoring without the seniors having to wear a device.
- Remote monitoring app allows for early detection of and planned response to risks and anomalies through 24/7 real-time monitoring of vital signs.



* Source: Dream Visions Co.,m Ltd.

Service Implementation Cases

- In 2018, Seoul introduced a care service for seniors living alone.



Away from home: 2 hours
Sleep: 7 hours

2-3 Air Quality Monitoring Service

About the Service

- Service provided to improve public park environment through collection of accurate data on weather, air quality, “fine dust,” and etc.



Key Technology Areas

- E-BAM fine dust measuring sensor:** Sensor-based monitoring device used to measure air quality. Weather and air quality sensors installed in target regions enable real-time air quality data collection and transmission.
- IoT complex gateway LTE modem:** Device that transmits collected data to the platform. In areas where wired Ethernet cannot be installed, LTE communication network is used to send air quality data to the Smart City Platform.

Service Implementation Cases

- In 2016, Goyang City launched an air quality monitoring service in a station inside Hosu Park, Ilsan.
- Goyang City and LG U+ jointly conducted the project, and is now operated by a specialized contractor.



* Source: KLID(2018). 2018 Smart-Nation Service Catalog

2-4 Remote Medical Diagnosis System

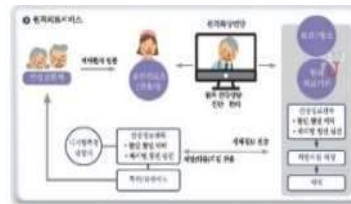
About the Service

- Medical system is evolving in line with the changing modern society.
- **The service provides remote medical treatment and diagnosis** for patients with limited access to hospitals.



Key Technology Areas

- Digital measuring devices collect and send patient's health record and medical biometrics to the central system.
- Physicians can make diagnosis and prescribe medicine based on medical records and collected medical biometrics.
- Diagnosis records and medication administration guidelines are stored to assist accurate medical diagnosis.



Service Implementation Cases

- In Aug. 2018, Pusan Nat'l Univ. Hospital signed MoU with Indonesian Hospital Association (IHA) for the export of its remote medical system.
- IHA plans to introduce the remote medical system to increase accessibility to medical service for Indonesian patients who live in remote areas or islands.



* Source : <http://www.medifonews.com/news/article.html?no=122558>
<http://www.bokuennews.com/news/article.html?no=164624>

3-1 Traffic Enforcement in Tunnels Using Intelligent CCTV

About the Service

- Service that uses traffic enforcement intelligent CCTV for accident prevention inside the tunnels.



Service Implementation Cases

- Pilot service was launched in 2016 in Changwon 1 Tunnel in Namhae Expressway, and was expanded to Sangju Tunnel in Jungbunaeryuk Expressway in 2017.
- First tunnel traffic enforcement system installed in Korea. Drivers are reported to the police after two violations.

Multi-vehicle collision accident in Changwon 1 Tunnel

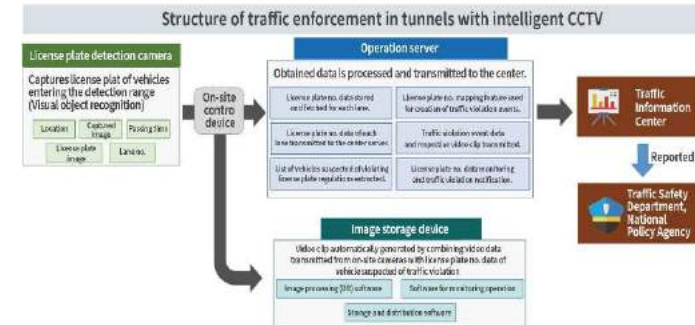


Source: Korea Expressway Corporation press release (Dec. 15, 2016)

- Project conducted by the Korea Express Corporation.
- From Dec. 1, 2017, traffic violations are reported to the police and the driver is issued a ticket of 30,000 won or 30 penalty points.

Key Technology Areas

- License plate recognition camera: Reads the license plate of vehicles entering the detection range and transmits the video data in real-time to the operation system.
- Intelligent image analysis: Image data acquired through CCTV is used for real-time analysis. Detects risks and issues warning through target detection, tracking, identification, behavior analysis and search.
- Integrated CCTV control system: Camera, digital storage, image analysis and recognition technology used in combination allows intelligent and proactive integrated control.



* Source: KLID(2018). 2018 Smart-Nation Service Catalog

3-2 Smart Parking Service in Public Parking

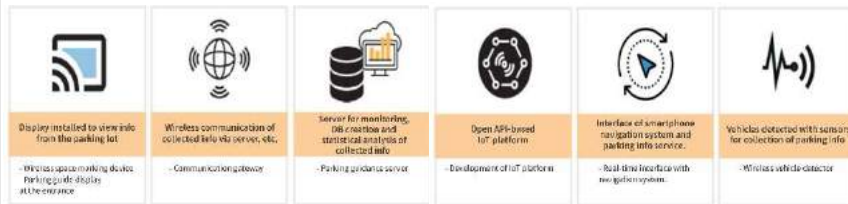
About the Service

- Service that uses IoT technology to provide customized information such as parking lot location, fare and available space to drivers.



Key Technology Areas

- IoT, sensor, network, server, display, and platform establishment are crucial in smart parking service operation.
- IoT-based smart parking allows real-time monitoring of parking space available, enabling drivers to access the data via the app, online, or navigation system.



Service Implementation Cases

- In 2016, in order to address parking issues in downtown, Incheon started providing real-time parking information of the city's 40 public parking garages using smart parking system, and also became the first Korean city to provide such information via navigation system.
- The service was implemented under a project subsidized by the Ministry of Land, Infrastructure and Transport (MOLIT), and Incheon's Transport Division and Planning Team operates and manages the system and servers.



* Source: KLID(2018). 2018 Smart-Nation Service Catalog

3-3 Monitoring and Warning Service of Drowsy and Careless Bus Drivers

About the Service

- Service that prevents traffic accidents by monitoring bus drivers' conditions and driving in real-time, sending warning messages, and managing the fatigue level of drivers.



Key Technology Areas

- Driver data collection/analysis technology: Preemptive or early detection of driver's drowsiness using driver's facial images and vital signs.
- Software module for comprehensive assessment of risky situations: By integrating drivers' images, vital signs, and driving situation awareness, assess risk factors in advance to issue timely visual, aural, or haptic warnings.
- Wearable wristband for drivers: Device is used to measure drivers' pulses and other vital signs, and to alert the driver in risky situations.
- Integrated driver monitoring system: System that identifies dangerous roads through analysis of driving behaviors and supports drivers' risk prevention activities.

* Source: KLID(2018). 2018 Smart-Nation Service Catalog

Service Implementation Cases

- The Korea Transportation Safety Authority and the Automotive Technology Institute, along with four other companies, developed a drowsy driving warning system prototype and conducted pilot tests and operation.
 - Conducted initial pilot test* with five intercity buses in Apr. and May 2017, and launched a product after making corrections and improvements. (*Tested 86.5km route with 15 drivers for three weeks)
 - Launched pilot operation in Mar. and Apr. 2018 on 15 Seoul Metropolitan buses, intercity buses, and D-Expressway buses.



3-4 Illegal Parking Notification Service

About the Service

- Prevent vehicle collisions by tightening traffic law enforcement with IoT sensor installations in zones with frequent traffic safety issues due to illegal parking and obstructed view.



Key Technology Areas

- Vehicle recognition:** Contactless sensors installed roadside detect vehicle occupancy.
- Vehicle formation control:** Multi-channel control based on independent wireless network
- Scalability:** Interoperable with one M2M smart platform



* Source: KLID(2018). 2018 Smart-Nation Service Catalog

Service Implementation Cases

- In 2016, Goyang City introduced an illegal parking notification service in 15 stations to prevent traffic accidents caused by illegal parking.
- Guro-gu in Seoul is operating a similar service called intelligent bike route management system serviced to prevent illegal parking on bike lanes.



3-5 Smart Eco Bike Sharing Service

About the Service

- IoT module fitted on existing shared bikes uses GPS and gyro sensor to collect location data to facilitate public bike sharing system, including tracking stolen bikes. The IoT module also provides For riders, their route and fitness activity tracking service is provided.

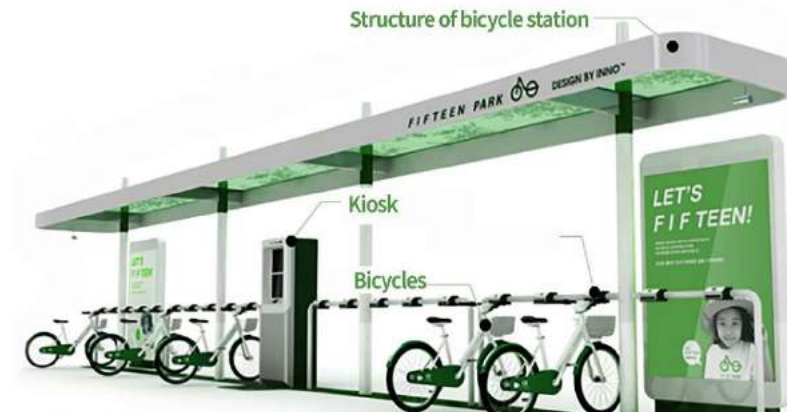


Key Technology Areas

- Implementation of IoT based smart eco bike service system using public bike location data (Bike start and end stations, risk warning)
- IoT GPS location tracking module enables data collection on bike trip histories.
- In the case that the end station does not have any empty docks, the riders are guided to another nearby station to return the bike.

Service Implementation Cases

- Various public bike sharing services (Seoul's Ttareungi, Goyang's Fifteen, Daejeon's Tashu, Changwon's Nubija, etc.) are made available by local governments in Korea.



3-6 Cutting-edge Navigational Aid Service for Safe Sailing

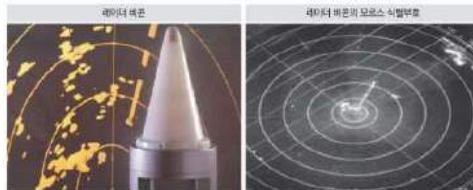
About the Service

- Radar beacon-based cutting-edge navigational aid service ensures that ships receive stable location information even in severe weather and restricted visibility conditions.



Key Technology Areas

- **Radar Beacon (Racon):** Navigational aid (radio beacon) that uses nondirectional transmitter/receiver to display certain Morse codes (M, --) on radar screen.
 - Detects incoming and outgoing radar signals of ships, analyzes frequency, converts pulse and frequency data in real-time and provides stable location information.



Service Implementation Cases

- Pohang Regional Office of Oceans and Fisheries (Beacon Division) in Sep. 2017 introduced a navigational aid (radar beacon) service in Ulleungdo Island.
 - Radar beacon installed and operated on the rooftop of Passenger Terminal of Dodonghang Port

View of Ulleungdo Island (Dodonghang Port)



* Source: KLID(2018). 2018 Smart-Nation Service Catalog

3-7 Operating System for Passenger Information System (SEOUL TOPIS)

About the Service

- GPS tracking devices and wireless communication devices installed on buses enable monitoring of vehicle movement in real-time. The transit information, such as bus location, status, arrival intervals, estimate arrival time, is delivered to commuters and bus operations.



Service Implementation Cases

- Seoul is operating TOPIS (Transport Operation and Information Service) Center to provide bus location information to commuters via wireless communication.
- Highly satisfactory service provided with highly accurate bus arrival time, location, and interval information.



Key Technology Areas

- Collected data is sent to Bus Information System (BIS), which is then used to estimate departure and arrival time.
- Usability is enhanced by providing information on various platforms.



* Source: KLID(2018). 2018 Smart-Nation Service Catalog

3-8 Integrated Public Transport Fare System

About the Service

- Integrated distance-based fare system with transfers up to five times without extra fees promote the convenience of the public transportation system without financial burdens.

| Fare charging mechanism | Before | Current |
|--|----------------------------|---|
|   5 km (Bus) + 4 km (Bus) | 900 + 900 = 1800 won | 900 won (Basic fare applied within 10km) |
|   5 km (Bus) + 7 km (Subway) | 900 + 900 = 1800 won | Basic fare + 100 won (Additional fare applied to 10-15km range) 1,000 won |
|    6 km (Bus) + 8 km (Subway) + 4 km (Bus) | 900 + 900 + 900 = 2700 won | Basic fare + 200 won (Additional fare applied to 10-20km range) 1,100 won |

Key Technology Areas

- As smart card comes into contact with a terminal (card reader), start and end data of each trip, including any transfers made, are stored and the card reader immediately receives the location and time information through GPS.



* Source: <https://seoulsolution.kr/ko/content/%EB%8C%80%EC%A4%91%EA%B5%90%ED%86%B5-%ED%86%B5%ED%95%A9%EC%9A%94%EA%B8%88%EC%A0%9C>

Service Implementation Cases

- T-money smart card system has since expanded, and is currently compatible in 60 cities throughout the country.
- The ease in which to recharge the smart card and its seamless compatibility across different regions has greatly increased the number of public transportation users.



4-1 Development of an Optimized Model for Zero-Energy House and its Demonstration Complex Construction

About the Service

- Zero-energy house can procure essential energy such as heating, cooling, hot water, lighting and ventilation without the use of fossil fuel by minimizing energy consumption and relying on renewable energy sources. Energy consumption can be minimized through high-performance insulation, airtight materials, and heat recovery ventilation, and renewable energy sources include use of solar panels and thermal heat pumps.

Key Technology Areas

- Thermal bridge breakers: By installing thermal bridge breakers in wall corners, balconies and windows that cause loss of building energy through thermal conductivity of elements, it prevents heat loss and forming of condensation.
- High-performance windows: Triple low-E glass and Tilt&Turn system windows minimize heat loss and enable natural ventilation even in severe weather conditions while guaranteeing safety.
- Enhanced airtightness: Airtight materials and airtight construction techniques applied to prevent deterioration of heating and cooling efficiency in sections prone to dampness such as building joints and around pipes.

Service Implementation Cases

- Funded by MOLIT and guided by the Korea Agency for Infrastructure Technology Advancement, Seoul, Nowon-gu and the Zero Energy Research Group of Myongji Univ. collaborated for four years to complete Nowon EZ House, Korea's first zero-energy housing complex, in Nov. 2017.
 - Obtained Germany's Passive House certification



4-2 IoT-based Smart Street Lights

About the Service

- IoT-based street lights that dynamically detect road conditions such as time-based variation of brightness in surrounding areas, movements of vehicles and pedestrians, and traffic volume to automatically or remotely control illumination and operation.



- Brightness of perimeter
- Motion of vehicle
- Traffic volume and speed
- Human motion and pedestrian traffic (pedestrian road lights)
- Light or sensor failure info



- Brightness of perimeter
- Human motion
- Pedestrian traffic
- Festivals and events of each season
- Light or sensor failure info



- Brightness of perimeter
- Motion of humans, bicycles, etc.
- Pedestrian traffic
- Human motion and pedestrian traffic (pedestrian road lights)
- Light or sensor failure info

Key Technology Areas

- Uses smart sensors and wireless communication technologies to set-up and operate “lighting zones.”
- Basic dimming rates and number of lighting zone control relays configured differently based on the analyzed traffic big data.
- Operation status, energy consumption and saving status of each streetlight are collected using smart sensors and monitored in the control system.



* Source: Epel Co., Ltd.

Service Implementation Cases

- Seoul introduced smart street lights in Janganbeotggok-ro in 2016, and the smart park project was implemented in Seoul Botanic Park in 2018, thereby achieving energy savings of 50%.
- Sejong City in 2018 conducted a pilot project for installation of smart streetlights in 1-5 Zone, where energy savings of 40% was achieved.



4-3 IoT-based Energy Bill Tracking Management Service (ENERTALK)

About the Service

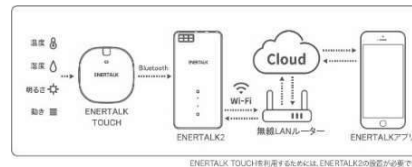
- Service is provided with an IoT device and an app that allow users to check electricity consumption level in real-time. The device can be installed in the distribution board of any home, and users can check electricity consumption status anytime, anywhere using a smartphone.



자료 : 인코어드테크놀로지스

Key Technology Areas

- Device installed in a distribution board tracks electricity consumption every second.
- Daily energy consumption patterns analyzed by time.
- Real-time push notification sent to users who have set an energy consumption plan.



* Source: Encored, Inc.

Service Implementation Cases

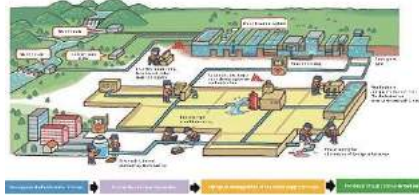
- Most ENERTALK users expressed that the service has helped them become more aware of their energy consumption levels, which encouraged them to make conscious efforts to save energy. The service also improved energy bill tracking by allowing the users to conveniently set-up monthly energy usage plan with real-time push notification reminders.



5-1 Smart Water City Project for Clean Water Supply Management

About the Service

- By combining ICT in the entire water treatment process, from reservoir to tap, to enable efficient production, distribution and delivery, the smart water management model is able to assure continuous tracking of water level and quality in the tap water supply. It also provides user-friendly service of providing information on delivered tap water.



Key Technology Areas

- Real-time data collected throughout the entire process of water treatment is monitored for analysis of distribution network to establish a structured water supply management system. This supports water leakage management, flow rate, pressure, quality control, and decision-making assistance in water supply operation.
- Water treatment process is continuously monitored and managed for clean water quality control through the installation of rechlorination system that injects chlorine at regular intervals throughout a distribution system, and automatic drain system that automatically discharges water upon detection of failing water quality. In addition, pipes prone to quality deterioration, such as low-flow and long retention pipes, are cleaned.
- A smartphone app was developed to allow the public to monitor real-time water quality status.

Service Implementation Cases

- In 2014, Paju conducted a pilot Smart Water project for three years.
- Tap water drinking rate increased from 1% to 36.6%.
- Leak detection system helped improve water flow rate from 75% to 88% and save 500 million won annually.

Overview of Paju Smart Water City Pilot Project

Phase 1: Gyoha and Jeokseong, Paju (37,000 residents. From Apr. 2014 to Jun. 2015)
Phase 2: Phase 1 regions + Wollong (223,000 residents. From Jun. 2015 to Dec. 2016)

- Waterworks system for systematic water level and quality management
- Provision of tap water quality information
Residents can check the real-time tap water status on street displays and with smartphones.
Smartphone app with various features for checking water quality and tap water charge, requesting specialist's visit, and filing complaints.
- A to Z care service
Specialist called Water Codi visits home and checks water quality at faucets.
Water Doctor evaluates water pipes and helps pipe cleaning.
- Tap water insurance
- Drinking fountains installed to promote drinking of tap water.

5-2 Smart Water City Project for Clean Water Supply Management: Smart Water Meter Solution

About the Service

- A digital meter is installed in homes to track water usage in real-time with IoT technology.



Key Technology Areas

- A digital meter is installed in homes, and data is collected using global standard wireless IoT communication protocol.
- Collected big data is efficiently managed with smart metering control system.



Service Implementation Cases

- Daegu introduced a smart metering system in 2017 to reduce the cost of conventional meter reading and to address customer feedback.
- The project was led by Daegu Techno Park, and the service was implemented by a private contractor specializing in smart metering systems.

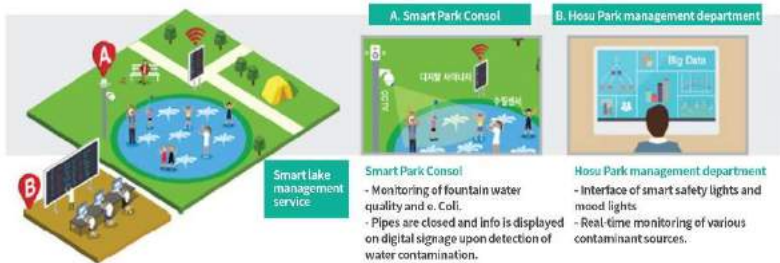


* Source: KLID(2017). 2017 Smart-Nation Service Catalog

5-3 Real-time Water Quality Monitoring System

About the Service

- As part of water quality monitoring system, public fountain water quality is tested real-time and the results are displayed publicly on digital signages.



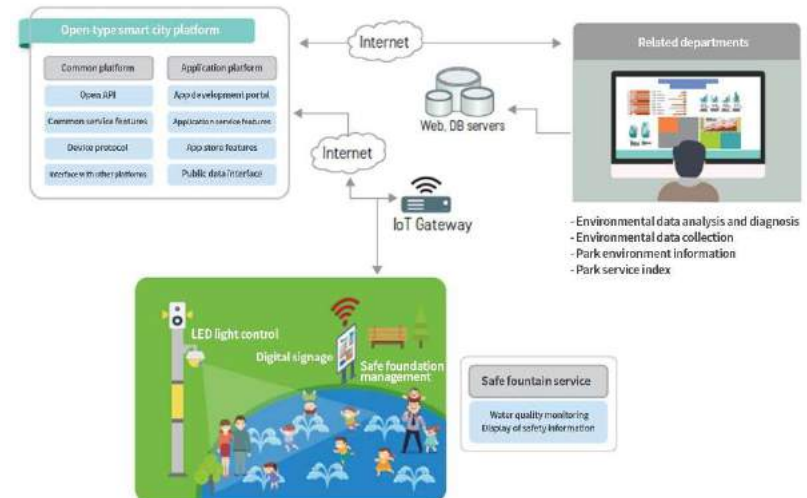
Key Technology Areas

- Key areas include water quality monitoring system, E. coli bacterial water quality analysis and monitoring system, and digital signage displays that provide water contamination information to the public.



Service Implementation Cases

- In 2016, Goyang installed and started operating a real-time water quality display service in two stations in Hosu Park.
- The project was jointly conducted by the city of Goyang and LG U+, and a specialized contractor developed and is currently operating the service.

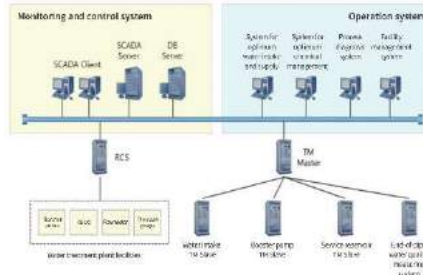


* Source: KLID(2017). 2017 Smart-Nation Service Catalog

5-4 Intelligent Water Purification Plant Management System

About the Service

- System built for optimum operation and management of waterworks facilities including water purification plants, surrounding water intakes, pump stations and water reservoirs.

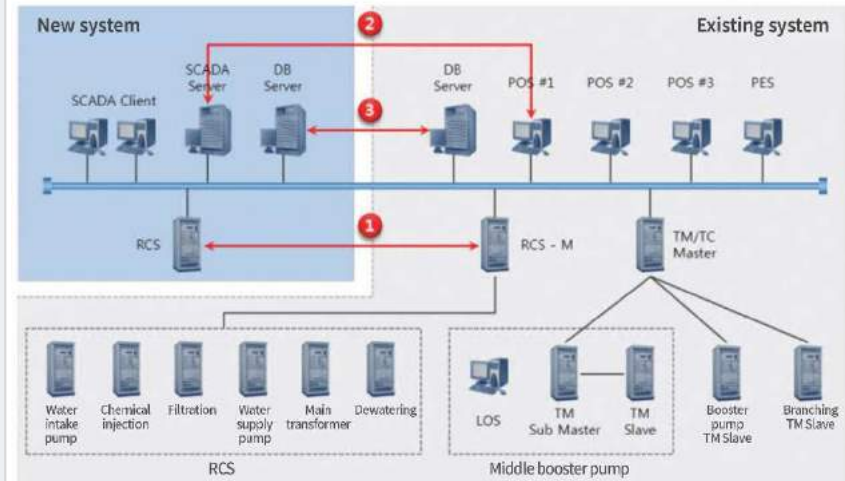


Key Technology Areas

- Control systems within the purification plant, remote telemetry and HMI (human machine interface) installed in the central operation center enable real-time monitoring and control of measured data (i.e. operation status and pressure of major facilities across the waterworks system, water flow and water quality).
- Neural network theory applied in each process of the status monitoring system run with main features including: HMI-based integrated real-time monitoring of waterworks, remote operation of major facilities (pumps and valves), alarm notification of outliers, system event logging and search, and real-time trend analysis and provision.

Service Implementation Cases

- Yangpyeong Water Purification Plant in 2009 installed and started operating a monitor and control system, which covers rapid sand filtration and membrane filtration.



* Source: KLID(2017). 2017 Smart-Nation Service Catalog

5-5 Establishment of Intelligent Public Wastewater Treatment Plant

About the Service

- Intelligent system built by applying cutting-edge digital technologies, IoT, big data and AI in public wastewater treatment plants to support stable operation based on big data platform that monitors sewage and wastewater treatment.
- Improve energy efficiency, and renovate repair and maintenance system of public wastewater treatment plants.

Key Technology Areas

- IoT-based sensors installed in facilities track and send abnormalities (i.e. water contamination, temperature increase and energy consumption spike) and other data.
- The data is used for analysis of big data including water quality, facility operation data and energy consumption, and AI supports decision-making for optimum operation in terms of energy saving and operating rate.



▲ 운영실는, 운영실내에서 운영실 관리 시스템을 통해 실시간으로 시설물 작동 상태를 모니터링하고 있습니다.

| Year | 2019 | | 2020 |
|-------------|---|---|--|
| | Phase 1 | Phase 2 | Phase 3 |
| Phase | IoT infrastructure setup | Big data platform setup | Software and equipment of the smart data processing platform |
| Description | <ul style="list-style-type: none"> IoT-based automatic water quality monitoring system Sensor (flow, pH, DO, etc.) and temperature sensor IoT-based power and temperature sensor | <ul style="list-style-type: none"> Data collection platform (DCS) Water quality, power supply, temperature, etc. Analysis platform (AI) Water quality modeling Optimize response activities (energy saving) Machine learning forecasting AI algorithm Operation platform (SCADA, MES) Real-time monitoring of operation status (web/APP) | <ul style="list-style-type: none"> Advanced system for energy saving in facilities (sensors) based on water quality (DO, NH3) modeling analysis (AI) or optimization Optimum operation through AI of wastewater treatment plants Scale up to sewer treatment plants |

Service Implementation Cases

- The pilot project operated by the Korea Environment Corporation that covers Bonghwa Public Wastewater Treatment Plant (3,000 ton/day) located in the upstream of Andong and Imha Dam and Chunyang Public Wastewater Treatment Plant (800 ton/day) will have the relevant intelligent technologies completed by Dec. 2021.
- Energy saving rate of the facilities is expected to improve from 5% in 2019 to 10% in 2021, and the operating ratio is expected to improve from 5% in 2019 to 15% in 2021.
- Before application, the intelligent technologies will be tested and verified through a sewage and wastewater demonstration test conducted in the national water industry cluster scheduled to open in Daegu in July 2020.
- From 2021, the intelligent system will expand to all public wastewater treatment plants and sewage treatment plants in Korea.

* Source: Ministry of Environment website

5-6 Real-time Water Damage Prevention Monitoring System for Pipe Damage and Leakage

About the Service

- Rather than focus on ex-post recovery, the system assures prevention of water pipe leakage and real-time detection of leakage in pipe joints. Gas pipe damages caused by unreported excavation can also be prevented.



Key Technology Areas

- “Leak detection sensors” fitted on every water pipe joints inform the managers the exact location of leakage or loss of coating caused by other construction works in real-time.
- Smart Prevention Sheet: Upon detection of pipe damages during an excavation work, the heavy equipment operator is notified in real-time of the presence of pipes underneath to prevent further damage.



Service Implementation Cases

- Since 2012, MOLIT-commissioned Smart Water Grid Research Group conducted the initial technology development for five years. Beginning 2017, the Ministry of Environment's Eco-Smart Management System for Waterworks Project Group began developing the monitoring system using embedded systems.
- K-Water is implementing the system in the construction of Songsan Green City.

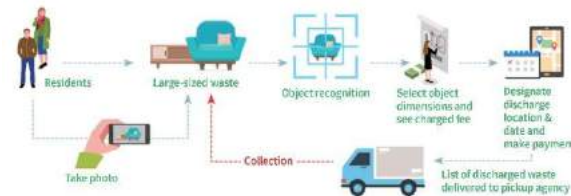


* Source: Cowithone co., Ltd.

6-1 Bulk Waste Disposal Service Based on AI Object Recognition

About the Service

- Uses AI object recognition technology to automatically identify the type, size and quantity of waste that the user has requested removal of, and the processed data determines cost owed by the user and facilitates paid waste collection service.



Service Implementation Cases

- Eunpyeong-gu Office of Seoul conducted a project to develop and introduce bulk waste removal service using AI object recognition, and launched pilot service in 2018.
- In 2018, system was upgraded to be integrated into KakaoTalk service, enabling users full access without the need to install a separate app.

Key Technology Areas

- AI object recognition technology with latest deep learning technologies including GAN and Active Learning automatically identifies the type and size of bulky waste and calculates the fee according to the standards.

| 대형폐기물 Large-sized waste | 대형폐기물 Large-sized waste | 대형폐기물 Large-sized waste | 대형폐기물 Large-sized waste |
|----------------------------|----------------------------|----------------------------|----------------------------|
| 가전제품 34.33% | 의자 0.00% | 물수거기 0.76% | 주방기구 (냉장고) 37.20% |
| 책상 30.61% | 침대 0.00% | 냉동 10.15% | 책상 1.11% |
| 의자 19.61% | 주방기구 0.00% | 관리용품 (HPPA-L) 9.23% | 의자 0.05% |
| 의자 0.68% | 의자 0.00% | 사기 7.37% | 의자 0.15% |
| 자동차부품 1.43% | 냉동기 0.00% | 세탁기 (건조기) 2.43% | 주방기구 0.14% |
| 냉동 1.40% | 의자 0.00% | 의자 1.80% | 의자 0.14% |
| 의자 1.21% | 가동냉동기 0.00% | 냉동 1.08% | 의자 0.11% |
| 냉동 1.05% | 의자 0.00% | 의자 0.03% | 의자 0.08% |
| 주방기구 (냉장고) 0.88% | 책상 0.00% | 의자 0.76% | 침대 0.07% |

UI for AI object recognition and object recognition management of Eunpyeonggu-office, Seoul

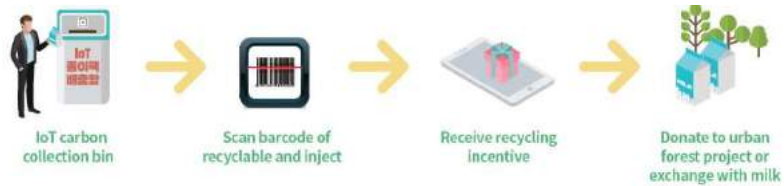


* Source: KLID(2017). 2017 Smart-Nation Service Catalog

6-2 IoT-based Carton Recycling and Incentive Payment Service

About the Service

- An “IoT waste separation bin” recognizes the disposed recyclables (i.e. used milk cartons) with a barcode reader and pays the user an incentive (refund) via mobile app.



Key Technology Areas

- IoT recognition of recyclables:** Through weight detection, and use of barcodes, IoT waste separation bin is able to identify the type and shape of recyclables. This data is used to determine load volume and full-load cycle.
- Incentive processing device and mechanism:** (1) user recognition data; (2) disposed waste recognition data; and (3) communication for data collection and transmission.



Service Implementation Cases

- In Dec. 2017, 30 IoT carton separation bins were installed in Gangnam-gu and began service in nine apartment complexes.
- Carton collection bins were also installed and operated in Songpa-gu Office (Seoul) and Geumjeong-gu Office (Busan)



* Source: KLID(2017). 2017 Smart-Nation Service Catalog

6-3 Smart Trash Bin Service

About the Service

- Improved trash collection and management with accurate trash bin status data collection using ICT technologies.



Key Technology Areas

- Solar-powered trash compressor:** Compatible with standard 120L or 240L wheeled trash bins. Trash level monitored for automatic trash compression.
- Ultrasonic trash level sensor:** Powered either by battery or solar panel, the sensor can be installed in all types of bins for real-time monitoring of trash load status.
- Real-time data analysis:** Collected data is sent in real-time via wireless network to Clean City Networks, a smart waste management platform, for monitoring of trash load status and recommendation of optimized collection path.

* Source: KLID(2017). 2017 Smart-Nation Service Catalog

Service Implementation Cases

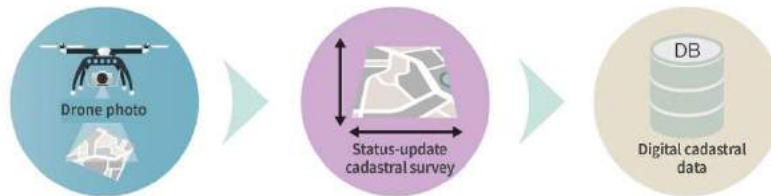
- Seoul introduced smart trash bins in 2016 in the city's heavy traffic areas including Bukchon of Jongno-gu and Seodaemun-gu.
- Seoul conducted a project for the installation of smart trash bins in pilot regions by a specialized contractor.
- Daegu introduced solar-powered automatic compression trash bins.



7-1 Cadastral Surveying using Drones

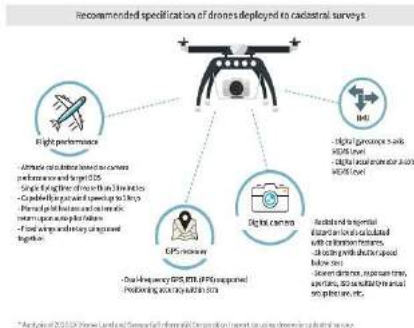
About the Service

- Cadastral surveying conducted using drone-captured images for construction of cadastral map and digital cadastral information.



Key Technology Areas

- Performance of the drones must meet a certain level in order to be used for cadastral surveying.



Service Implementation Cases

- Chungbuk Province launched a cadastral survey for status update in 2012 and started using drones for improved efficiency in 2015.
- The Land Information Division of Chungbuk Province introduced drones to generate orthophotos.
- Other local government offices have also adopted drones in their cadastral surveying.

Case study: Drones used in cadastral survey of local governments



* Source: KLID(2017). 2017 Smart-Nation Service Catalog

7-2 AI-based Chat Service for Delivery of Basic Legal Knowledge

About the Service

- AI-based chatbot service that provides basic legal knowledge via website and social media sites.

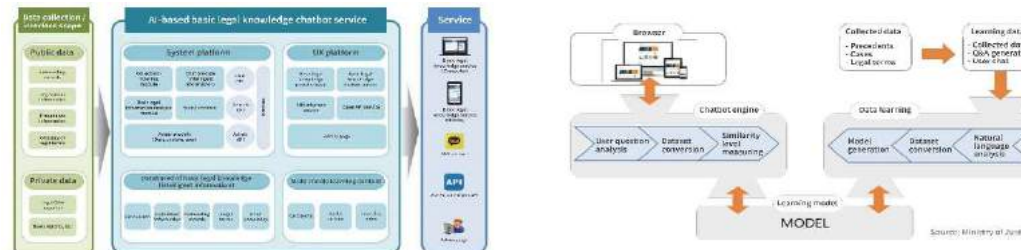


Service Implementation Cases

- In 2016, the Ministry of Justice launched a project to introduce AI-based chat service for delivering basic legal knowledge, and as of 2018, second generation legal knowledge chatbot service “Bubbi” is serviced online.
- Lexical analyzer and chat engine optimized for legal conversions were developed open-source based, applying latest natural language processing technologies, supervised learning-based machine learning and AI neural network deep learning technologies.

Key Technology Areas

- Legal Q&A database containing dialogue-structured knowledge and legal advice data established by combining law and case databases, legal terms dictionary and consultation case databases.
- Chat service accurately analyzes the user’s intentions and provide adequate answers.
- Legal knowledge learning model was developed, and machine learning and deep learning technologies were applied.



* Source: KLID(2017). 2017 Smart-Nation Service Catalog

7-3 IoT-based Cultural Heritage Management Service

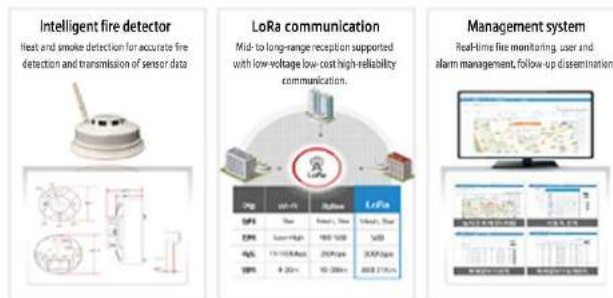
About the Service

- Data including temperature, humidity, smoke and human presence collected in real-time with sensors are analyzed and used for emergency responses.



Key Technology Areas

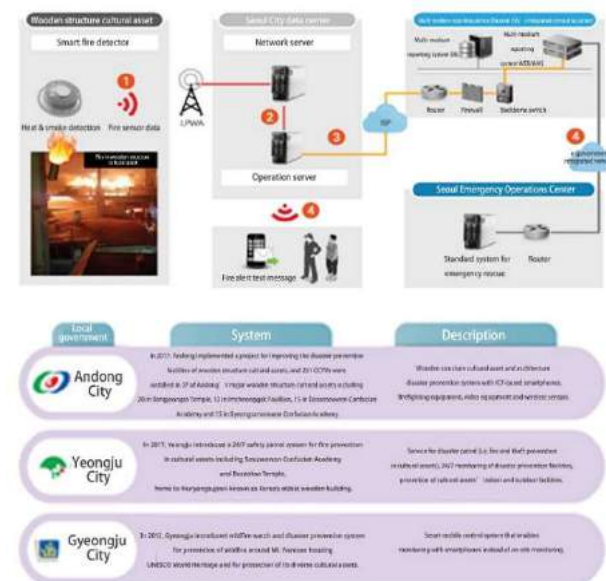
- Heat and smoke detecting sensors installed in important cultural assets for immediate response in emergency events such as fire.
- Key areas include intelligent fire detectors, LoRa communication system and service management system.



* Source: KLID(2017). 2017 Smart-Nation Service Catalog

Service Implementation Cases

- In Seoul, the service is in pilot operation in three locations including Bukchon Culture Center, Hanok Service Center and Hanok of residents.
- Hanok Team of Seoul's Housing and Architecture HQ is managing the overall service.
- Similar services and systems were also introduced by local governments of Andong, Yeongju and Gyeongju.



7-4 Digital Tax Filing Service

About the Service

- Public administration service that allows taxpayers to file taxes online at home or office without visiting the tax office.



Key Technology Areas

- Tax Integrated System (TIS) link all tax offices in a single computing network, and enable online processing of tax filing, tax survey, and etc.



Service Implementation Cases

- Hometax, an electronic tax payment system, was first introduced by the National Tax Service and the Ministry of Economy and Finance in Apr. 2002 for payment of value added taxes. In Jun. 2002, the online system was expanded to all tax items, and taxpayers can now easily pay taxes through wire transfer.
- For online requests, users can register online as business operators and use the issued operator number to handle various tasks.
- Transparency of tax administration is enhanced through prompt and accurate public administration.

* Source: KLID(2017). 2017 Smart-Nation Service Catalog

7-5 KnowRe, an AI Math Learning Platform

About the Service

- Platform that provides customized math learning service to help users learn math by completing each stage, like playing a game.



Maximize Instruction Time

KnowRe provides resources and tools so that teachers can spend more time focusing on what they love - teaching!



Standards Aligned Content

Our curricula are standards-aligned and our lessons, problems, and videos are developed by experienced math teachers.



Easy to Use

Flexible and user-friendly interface enables teachers to easily integrate KnowRe into their curriculum and classroom.

Key Technology Areas

- Web-based service uses cloud server, and schools can use the service by purchasing a license. Teachers can check the dashboard and easily review the learning status and weak areas of students.



KnowRe's Teacher Dashboard shows student achievement at a glance so teachers can quickly identify students who may need extra help.

In just three steps, teachers can assign lessons and review problems to one, several, or all students and set submission dates.

Service Implementation Cases

- The service was launched in the U.S. in Feb. 2014, followed by official introduction in Korean schools.
- After giving a lecture, teachers use KnowRe to demonstrate how to solve math problems.
- Problem-solving conditions are dynamically analyzed to determine the proficiency level and to provide optimized math problems.



* Source: KnowRe website

7-6 Open Geographic Information System (National Spatial Data Infrastructure Portal)

About the Service

- Building, house, land and facility (Point of Interest) data owned by related government agencies is interfaced based on the address provided in LOD (Linked Open Data) format so that it can be used in various services related to spatial information and for application development.



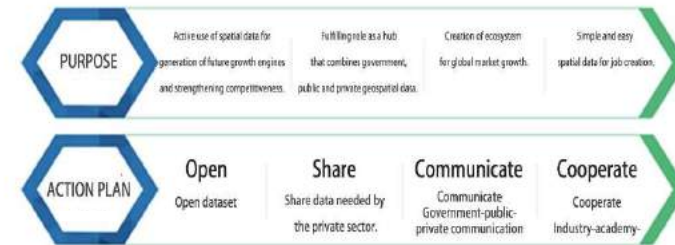
Key Technology Areas

- The National Spatial Data Integrated System (NSDIS) was built by linking the central government's spatial data system to enhance the system's role as the control tower for use of national spatial data.
- The system was developed to interface, share and use national spatial data.
- NSDIS was scaled up as a big data system
 - Analysis model developed for 3D analysis, time-series analysis and others.
 - Spatial big data platform applied in specific areas of public administration for service development and provision.

* Source: National Spatial Data Infrastructure Portal

Service Implementation Cases

- The National Spatial Data Infrastructure Portal (NSDI) service was launched in Dec. 2015 (MOLIT)
- Spatial data produced by the government, and public and private sectors are shared (map service, spatial data open market, real estate service, open API, etc.).



7-7 Online Administrative System for Construction (Digital Permit for Land Use and Construction)

About the Service

- National standard information system built to handle administrative processes related to construction. The public can easily apply for permit online, and public officials can easily process the overall administrative processes (permit, construction launch, lot sales, completion check, demolition, etc.)

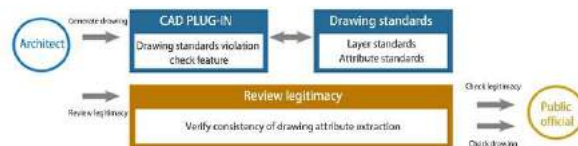


Service Implementation Cases

- Online administrative system for construction (Seumteo) was launched nationwide in 2008 and is currently in service. An upgraded intelligent system was developed following Seumteo Upgrade Plan established in 2009.
- In addition to handling permits, the system provides information of a building throughout its lifecycle, enables efficient building management with cutting-edge IT, and supports various areas including urban planning and energy-saving.
- Target services: Preliminary diagnosis, preliminary deliberation, intelligent permit handling, building safety management, on-site public administration support, and building maintenance.

Key Technology Areas

- Intelligent system for reviewing the legitimacy of construction processes:** Consisted of legal rule model for legitimacy review, legitimate drawing standards and CAD Plug-in for drawing-based review, integrated legitimacy review tool for step-by-step legitimacy review by applicants and public officials, and design document registration tool. Add-on feature of Seumteo system that is used for permit application and processing.



* Source: Seumteo

7-8 Online Permit Application Self-Check Service

About the Service

- For 99 types of permits, the service enables users to check regions that issue the permit and regulation information along with a map, and to review requirements that must be met for application.

– In the previous system, those applying for a permit must visit or call responsible government offices to make inquiries.



Key Technology Areas

- The service displays information about regulations according to the type of application, allows users to check the permit and administrative disposition status of their industry, offers a self-evaluation feature to check one's eligibility for the permit, informs whether a building permit can be issued for each floor, and notifies any nonpayment of local taxes.



* Source: Gonggam Map System

Service Implementation Cases

- Online permit application self-check feature that had been serviced as a part of Gonggam Map of the Ministry of the Interior and Safety (MOIS) launched pilot operation in Feb. 2012 and was up-scaled nationwide in Aug. 2012.
- The service is helpful for startups as users can check permit-related information (document list, related laws, non-payment of local taxes, etc.) and analyze commercial zones by viewing the locations of similar businesses.
- Direct and indirect costs of approx. 8.3 billion won saved annually.

- Go to website** - Select "online permit self-check" menu from Gonggam Map portal or Minwon24
- Select target location** - Search and fill in the type of permit that the user is planning to request permit (e.g. restaurant permit)
- Enter location information
- Run self-check** - Fill in checklist
- Search status of permit, administrative disposition, non-payment of local taxes.
- View results** - Check enforced regulations on map.
- Check permit eligibility (regulations, ordinances, administrative disposition, non-payment of local taxes, building diagnosis for each floor)

8-1 Blockchain-based Local Currency Service

About the Service

- Mobile virtual money app service designed to issue local currency that can be used in the community (including public facilities) to residents for their voluntary service, donation, etc.



Key Technology Areas

- Platform for servicing blockchain-based virtual local currency: A blockchain-based system for handling No-Won, the unforgeable local currency of Nowon-gu of Seoul, and for displaying transaction records.
- Mobile app that handles Nowon's local currency: App built and serviced for residents to join as members, pay with the provided QR code and also exchange No-Won with other members.



Service Implementation Cases

- Nowon-gu Office, Seoul, announced in Sep. 2017 its plan to introduce a local currency with blockchain technology. In Feb. 2018, the office developed its local currency No-Won and launched the service.
- Development conducted by the Administrative Support Division of Nowon-gu Office.

Example of how Nowon's local currency is used

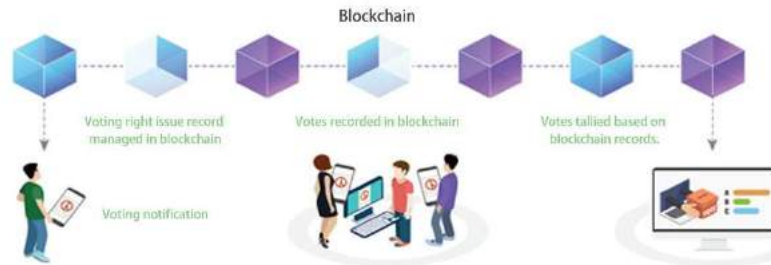


* Source: KLID(2017). 2017 Smart-Nation Service Catalog

8-2 Blockchain Evaluation for Local Community Project Selection Process

About the Service

- Online evaluation feature serviced using the unforgeable characteristics of blockchain technology.



Key Technology Areas

- **Blockchain distributed ledger:** Technology that stores and manages ledgers containing transaction data in P2P network instead of a central service.
- **Encryption technology:** With Public Key Infrastructure-based digital signature infrastructure, a pair of Public Key Infrastructure and Private Key ensures safe transaction without the need for a centralized authentication authority
- **Development of a mobile evaluation app:** Users can scan the QR code to fetch their voting right and cast a vote. Serviced both in Android and iOS environments.

Service Implementation Cases

- Gyeonggi Province's Ttabok Community Program introduced a blockchain-based online voting system for selection of local community projects. On Feb. 23, 2017, onsite and online evaluations were conducted for selection of local community projects.



* Source: KLID(2017). 2017 Smart-Nation Service Catalog

8-3 Smart Civil Complaint Management System

About the Service

- A system that allows users to file a civil complaint by uploading photos of public facility with maintenance issues, viewing automatically generated location data and providing additional information about the facility's conditions and problems.

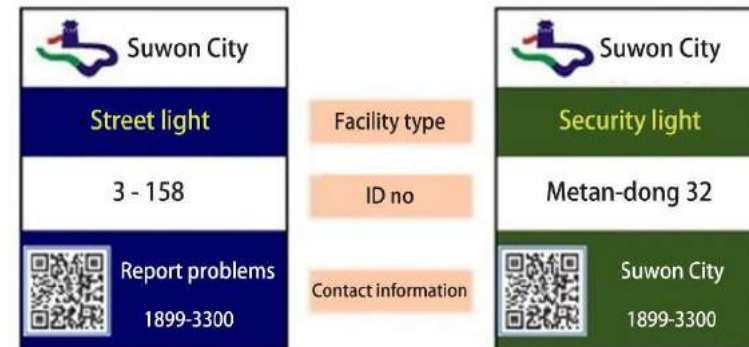


Key Technology Areas

- By using the camera, GPS, gyro sensor, azimuth sensor of a smart device, the location-based and GIS data of the reported facility are interfaced to collect location data.
- App and website use the sensor technology and algorithm of smart devices.
- Cloud-based maintenance platform was built by creating a database of facilities information and by mapping the data on a map.

Service Implementation Cases

- Suwon City launched pilot service for smartphone-based resident-led public facility maintenance in Sungkyunkwan Univ. Campus.
- From May 2018, all street lights of Suwon were surveyed and labeled with an ID no. and QR code, and a smart civil complaint management system was launched in Aug. 2018.



* Source: KLID(2017). 2017 Smart-Nation Service Catalog

8-4 Wemap, a Community-based Online Platform for Public Engagement

About the Service

- O2O platform that enables users to work together on a community map. Residents post photos and location data of community issues, create theme-based community maps and share ideas.



Community watch service

Creating community maps

Key Technology Areas

- Public Participation GIS (PPGIS) facilitates communication of residents and provides valuable spatial information by combining GIS and social media so that spatial information can be used as resources.
- Photo and location information are included in records related to public administration issues, community landscape, used goods trading and lost and found.
- Residents can take a survey conducted based on spatial information or file a civil complaint using a feature interfaced with MOIS.

* Source: National Archives of Korea, Ministry of the Interior and Safety (MOIS)

Service Implementation Cases

- In 2015, Ansan City in its Good Community Project used Wemap, a community mapping solution of Linkhous developed for public engagement.



One photo transforms the city (town)

Post and share your day in the city or town by specifying location information. Beautiful landscape, problems that need attention, meaningful events, you can share them all with your neighbors.
#Urban renewal #Build a town #Spot your town
#Spatial information service #GIS

Space survey feature for local community survey

The collaboration between residents and the local government is crucial, as attested to by the fact that more than 80% of administrative decision-making concerns spatial information. Linkhous space survey feature is the most effective way to ensure active civil involvement.
#Survey #Civil involvement #Civil complaint
#Spatial information service

Automatic civil complaint filing feature

You can share on a map various community issues such as pedestrian road arrangements and traffic light failures by posting a photo, and also have a civil complaint automatically filed for a swift problem-solving process.
#Civil complaint #Minwon24 #Complaint processing
#Create civil complaints



Mobile app for simply map creation

Community Mapping encourages residents' voluntary and active participation, and speaks of the series of processes of making a map that portrays with social, environmental, cultural issues.



Inconvenience of paper maps all taken care of.

Users no longer have to worry about the inconvenience of paper maps and instantly make records on a map with their mobile phone.

- + Make entries on the spot with mobile phone.
- + The recorded spatial information is stored in server and can be shared with others.
- + Paper maps create a serious waste of spatial information due to its single-time information recording nature. Use Linkhous to store your records forever.

8-5 Digital Service for Citizens

About the Service

- Smart public administration enabled by combining all public administration information and ICT.
- Digital service for citizens that display in real-time all public administration information directly connected to citizens' lives such as traffic conditions, emergency sites and price of goods.



Key Technology Areas

- Important technologies include those needed for data collection, processing of collected data, database creation, database loading, database analysis and visualization.
- Big data storage needed for storing massive volume of source data.



* Source: Digital Citizen Mayor's Office, Seoul City

Service Implementation Cases

- In 2017, Seoul developed the world's first "Digital Citizen Mayor's Office" by combining all public administration information and ICT.
- Sixteen million public administration big data of Seoul's 290 systems including Open Data Square and TOPIC, CCTV images of Seoul's 1,200 CCTVs, and civil complaint data collected by Dasan Call Center were digitally integrated to implement the cutting-edge system.
- Two-way communication encourages citizens to participate in city affairs evaluation, and users can also share content in social media sites.
- Various types of information including real-time data, five key city affairs closely related to citizens' lives, 61 city affairs indexes, CCTV images of an emergency site, related news reports are provided.