Improving Interagency Collaboration for an Innovative Emergency Response System: The Daejeon Smart City Operation Center, 2010–17

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Executive Summary

Facing a rise in crime and emergency situations, Daejeon—the fifth-most populous city of the Republic of Korea—collaborated with the national government to implement a "smart city" solution that enabled real-time sharing of information for criminal investigations and emergency responses. Reorganizing government agencies and integrating municipal technology infrastructure (such as closed-circuit televisions) presented significant coordination challenges. From when implementation began in 2008, Daejeon had to overcome multiple institutional barriers to enable real-time sharing of data.

In 2013, Daejeon finally opened its Smart City Operation Center, which brought 10 departments with related responsibilities together from different public agencies. A year later, the Ministry of Land, Infrastructure, and Transport (MOLIT) selected Daejeon to pilot the research and development of a smart platform for emergency responses at a national level. Together, MOLIT and Daejeon city officials integrated information systems and introduced a holistic system of smart emergency responses. The national government provided technical, financial, and institutional support to fill gaps in the local government's authority and capacity.

The smart emergency response system helped boost citizen safety in Daejeon. Integrated communications systems decreased the average emergency response time in Daejeon from about 7.5 minutes to less than 6.0 minutes. Crime in the city decreased by 5.0 percent, and the arrest rate increased by 7.7 percent. Daejeon became a national model, with dozens of other Korean cities implementing similar systems by 2021.

FIGURE 1. SOARING DEMAND FOR EMERGENCY SERVICES (1996–2008)
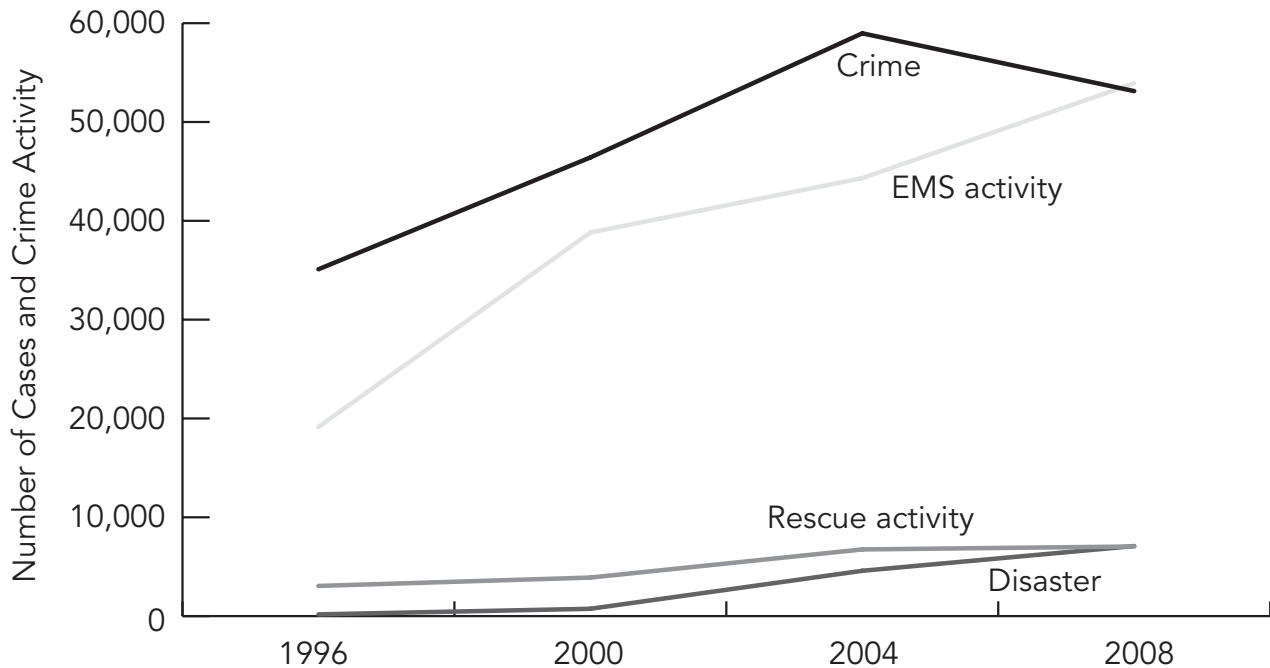
Source: Daejeon City Hall (2000, 2010), Daejeon Sejong Research Institute (2019).
Note: EMS = emergency medical services.

Introduction

From 1996 to 2008, Daejeon faced a leap in demand for emergency services. Even though the city's population grew only 13 percent, from roughly 1.3 million to 1.5 million people, the number of crime cases soared from about 35,000 per year to more than 53,000 per year. Emergency medical services—for example, emergency treatments, counseling, or patient transportation—nearly tripled. Rescue activities to protect the life, body, and property of a person in need of urgent assistance increased from 3,000 to 7,000 cases, and incidents related to natural disasters such as floods and landslides surged from 175 to 7,000 reported cases (figure 1).

The sharp rise in crime and emergency incidents alarmed Daejeon's citizens. According to Sanghun Lee, a research fellow in the Smart City Research Center of the Korea Land and Housing Institute,[1] citizens also demanded stronger public security measures because they felt threatened by a global trend of rising transnational crime and terrorism in the early 2000s.[2]

To address those concerns, Daejeon drew on its advantage as Korea's hub of science and technology. A global leader in developing and implementing high-tech solutions, Daejeon is home to the Daedeok Research Complex, where 19 universities, 30 government-funded research institutes, and 400 affiliated research corporations are supported by about 15 percent of Korea's research and development funds. Many of the national government's technology-related offices are also located in the city, including the Intellectual Property Office, National Statistical Office, and Public Procurement Service (KTIPA 2019).

Daejeon saw an opportunity to develop a technological solution to its growing demand for urban safety. Not only would such a project enhance the city's competitiveness and quality of life, it would also bring more attention to the city's research institutes and companies and would strengthen Daejeon's reputation as a "smart city," a term the city government defined as a city that used state-of-the-art nformation and communications technology (ICT) to enhance urban competitiveness, public services, and citizens' quality of life (ITU 2014; Glasmeier and Nebiolo 2016; Gaffney and Robertson 2018; Woetzel et al. 2018; MOLIT n.d.).

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1   The Korea Land and Housing Institute is the research arm of Korea's largest public land development corporation.

2   Author interview with Sanghun Lee in Daejeon, September 9, 2019.

Daejeon officials hoped that a smart city solution would help them address challenges faced by first responders. Police attending crime scenes often arrived after criminals had escaped to the city's undeveloped areas or crowded downtown. Moreover, fire engines, ambulances, and police cars had trouble locating reported emergencies because of the city's rapid development. Ponghyeon Ji, a deputy director of the Urban Economy Division at MOLIT said, "Most people calling emergency services were unable to accurately describe the scene, partly because they were calling from unfamiliar locations, and partly because of the difficulty of providing clear descriptions in the face of an emergency."[3]

To improve the safety of the city, Daejeon needed a solution that would enable emergency responses to be more efficient and effective. This goal would be accomplished by facilitating cooperation between national and local emergency services and government agencies, including both citywide offices and the offices for each of the city's five administrative districts.

Delivery Challenges

The integration of municipal technology infrastructure to enable real-time data-sharing required Daejeon to overcome significant coordination challenges as well as other institutional barriers.

Coordination and Engagement

The smart emergency response system required Daejeon to integrate infrastructure and services dispersed within preexisting operations systems, such as the city's closed-circuit television (CCTV) systems. The district sanitation offices installed and operated one CCTV system to catch illegal dumping, the citywide traffic management department operated another to detect illegal parking, and every elementary school managed its own CCTV system for safety purposes. Each CCTV camera cost about ₩20 million (US$17,000) and required costly installation, support, and control systems. There had been no cost-sharing effort to economize spending. Daejeon City Hall faced the challenge of achieving coordination among a wide range of government offices and agencies to integrate the systems and implement a combined CCTV system.

Establishing the system also required integrating ICT infrastructure between City Hall, Daejeon's five district offices, the police, the firefighters, the emergency response services, and the Daejeon Office of Education. The project also required coordination between the local and national government, given the strong centralization of Korea's government (despite the national policy of decentralization that had begun in the mid-1990s). Daejeon, like most Korean cities, relied on central government funding for more than half of its budget (KOSIS 2019).

Institutional barriers added to the challenges of interagency coordination. Developing a system for real-time information sharing during emergencies required access to highly secure information systems such as the national police database. The Korean constitution made the police an exclusively national agency, and no local governments in Korea had ever had direct access to the police's closed network and security system.

In addition, Korea's privacy laws—considered to be some of the strongest in Asia—made it difficult for government agencies to share the CCTV images and data that they collected (Constance 2013; Graham and Whonil 2014). Citizens could request and verify their own personal information, but public offices and other organizations had to take complicated steps to get others' information, including having to ask the police to open an official investigation.

Tracing the Implementation Process

Daejeon's Smart City Operation Center grew out of a CCTV control center launched in Doan New Town, a new urban area built in Daejeon. Daejeon then adapted the control center into a smart operation center that integrated CCTV and other ICT infrastructure citywide. The smart operation center benefited from a wider CCTV network and a new smart emergency response system, which was developed with national-level cooperation.

Adapting a Pilot Project to Serve the Whole City

In 2008, Daejeon had launched an urban development project called Doan New Town, which included a CCTV

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3   Author interview with Ponghyeon Ji in Sejong, September 11, 2019.

control center to collect and provide visual information for security and traffic management within the Doan area. The project was managed by the Council of New Town Affairs, which was chaired by the deputy mayor of Daejeon and consisted of two city officials, three public corporation managers, and five advisory committee members. A working group of 15 city officials and six project implementers helped the council review and evaluate project details. MOLIT approved the council's plans in April 2010, and the Doan New Town CCTV control center began construction in July 2010.

Soon after construction began on Doan New Town, work stopped for nine months because the state-owned construction firm suffered a liquidity crisis and had to cancel or reduce many of its projects. In November 2010, the company asked Daejeon to reconsider the planned project expenses and services for Doan New Town.

The Daejeon city government salvaged the plan by revising the project design and adding more funding. After six council meetings and countless informal negotiations within the working group, the project restarted in October 2011 with three major changes. First, the city reduced the project budget from ₩38.4 billion (US$33 million) to ₩24.3 billion (US$21 million), including ₩1.2 billion (US$1 million) in city funds to construct the CCTV operation center. Second, the city expanded the project to cover the whole city of Daejeon, rather than just Doan New Town. Third, the city decreased the number of services that the center covered so it could prioritize delivering services on a citywide scale.

One factor in the Daejeon officials' decision to expand the project citywide was a 2010 visit to a new town built in the city of Hwaseong, which was similar in context to the Doan project. The officials were disappointed to learn that the Hwaseong project's newly established CCTV control center covered only a small area and had no dedicated staff of its own. Since taxes from across the city of Daejeon were contributing to the Doan New Town project, officials insisted that their integrated operation center in Daejeon should provide equal services to all of Daejeon's citizens. Focusing on only one specific area such as Doan would benefit only public safety and property values near that area.

"Daejeon concentrated on the basic principle of universal public services," said Dongkyu Choi, a team manager of the Smart City Division in Daejeon City Hall. "We wanted to serve all citizens equitably and to operate services sustainably. We have found that in many cases at home and abroad, smart city solutions using expensive technology that don't serve citizens equitably are unsustainable because they lack the justification for expansion of operations."[4]

Expanding the geographic reach of the project required a streamlining of its services from 16 services across six sectors (traffic, environment, crime prevention, disaster prevention, culture, and health) to 5 services in two sectors (traffic and security) in order to cover the whole city. City officials prioritized transportation and security services because the services were widely used and had urgent coordination issues, and because connecting Doan New Town to the rest of the city would benefit both sectors. For example, an innovative smart city project called the Intelligent Traffic Service, which MOLIT and Daejeon had launched in 2002, would benefit from the inclusion of traffic services in the Doan New Town area because the project would use real-time information to harmonize traffic signals and improve traffic flow.

National and city agencies combined financial resources and ICT infrastructure to support the project, and the details were negotiated by the Council of New Town Affairs and the working group from 2010 to 2013. The Ministry of the Interior and Safety offered to pay half of the cost to construct district-level CCTV control centers, as well as 12 percent of construction costs for the Smart City Operation Center, to better protect child safety. City Hall covered 25 percent of the cost of the CCTV equipment and 55 percent of the construction budget. The five districts paid for the remainder of the CCTV equipment costs, after receiving permission from the national government to pool their grant funding. The construction company paid for the rest of the construction costs after negotiating with the city to resolve the liquidity issues that had halted the public enterprise's operations during the development of Doan New Town.

The Ministry of the Interior and Safety and the Daejeon Office of Education split the cost of installing eight CCTVs for each of Daejeon's 150 elementary schools. City Hall covered the costs of operations and building maintenance, while the five district offices and the Office of Education proportionally divided CCTV monitoring and maintenance costs on the basis of camera distribution. The city also used ₩1.25 billion (US$ 1 million) from its MOLIT pilot grant to complete the project.

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4   Author interview with Dongkyu Choi in Ilsan, September 5, 2019.

Integrating ICT Infrastructure into the Daejeon Smart City Operation Center

Initially, one of the district offices in Daejeon objected to extending the integrated operation of the CCTV center to cover the whole city, because officials in that office worried the project would encroach on their own power and authority. To win over resistant district officials, city officials turned to other government employees who supported the consolidation, such as the police stationed in the same district. City officials also argued that combining each district's data, traffic control, and CCTV operations would be more efficient than maintaining separate offices and networks that would require the district to support its own facilities, equipment, personnel, and data operations.

Just as construction neared completion in 2013, difficulties arose because the various facilities in the operation center technically belonged to the district offices and city divisions that had funded each of them. City officials had to go through complicated administrative procedures to get permission to use the operation center jointly and to complete the inspection and acquisition processes.

By the time the building was completed—after five years of construction delays and project plan changes— its ICT equipment was already obsolete. Server equipment had a short service life of about five years, and some other equipment used models already discontinued by manufacturers. City Hall and the district offices negotiated with the construction company to update the equipment agreed upon in 2008 when the purchase contracts were signed. However, replacing the outdated equipment would have doubled costs for the contractor, so instead most of the outdated equipment was installed in 2013 only to be replaced immediately after the relevant departments took over.

Reorganizing Operations

The relevant organizations and departments worked together to win approval to use the operation center in October 2013. The operation center began preliminary operations in December 2013 and had its opening ceremony in March 2014.

From 2014 to 2016, 10 related offices joined the Daejeon Smart City Operation Center: 4 City Hall departments, 5 district offices, and 1 department of the Daejeon Office of Education. In March 2014, the Information Division of

City Hall moved to the operation center and set up the Smart City Management Center on the first floor. Soon after, staff from the five district offices and the Office of Education established the CCTV Control Center. Thus they were able to monitor all CCTVs for illegal parking and security—including the surveillance CCTVs in the 150 elementary schools. The CCTV Control Center supported other departments by sharing visual information in real time around the clock for citizens' safety.

In June 2015, the Transportation Policy Division of City Hall moved into the operation center and set up the Smart Traffic Information Center to control city traffic CCTVs and facility maintenance, assisted by six police officers. The traffic-monitoring police officers adjusted traffic lights to ease traffic congestion and instructed traffic police in the field to respond to situations onsite. They allowed citizens to get real-time traffic information through roadside variable message signs, as well as radio, internet, and smartphone applications. Bus riders could track bus delays and arrival times through electronic bulletin boards installed at each bus station.

In November 2015, Daejeon created the Local Information and Cyber Security Center, which managed data resources and cyber defenses. The center integrated network protection and cyber security for 240 public organizations, including City Hall, district offices, state-owned companies, and research institutes. The center allowed all of the offices to share technology costs, such as data storage and service platform maintenance, to increase efficiency. By the end of 2016, the center had 33 city officials, 14 district officials, 10 police officers, 53 monitoring staff members, and 17 information technology specialists.

In January 2017, Daejeon established a Smart City Division of the city government to run the operation center with more autonomy. The division included teams for geographic information, information management, and video monitoring, each led by an executive director.

Expanding CCTV Systems

From 2010 to 2017, Daejeon rapidly expanded the number of public security CCTVs from 1,281 to 4,288.[5] The city government took charge of hiring, training, and managing the CCTV monitoring staff. Through training, monitoring staff learned to monitor multiple

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5   The installed number of CCTVs for security in the city was 1,281 in 2010; 1,594 in 2011; 1,985 in 2012; 2,318 in 2013; 2,703 in 2014; 2,918 in 2015; 3,461 in 2016; and 4,288 in 2017.

FIGURE 2. THE CCTV CONTROL CENTER IN THE DAEJEON SMART CITY OPERATION CENTER

Source: Daejeon City Hall (2019).

cameras efficiently. By 2017, each staff member could simultaneously monitor 329 CCTVs, up from 200 CCTVs per staff member in 2014 (figure 2).

District security CCTVs were typically placed according to citizens' requests and on the basis of perceived risk. Final selection and placement was determined by the district office and local police station. The police placed additional CCTVs in the city after analyzing crime data. CCTV installation required an administrative notice of 20 days, but requests rarely met opposition. Each of the five districts added 10 new CCTVs monthly, on average. The national government subsidized most of the cameras, although the city and police also contributed.

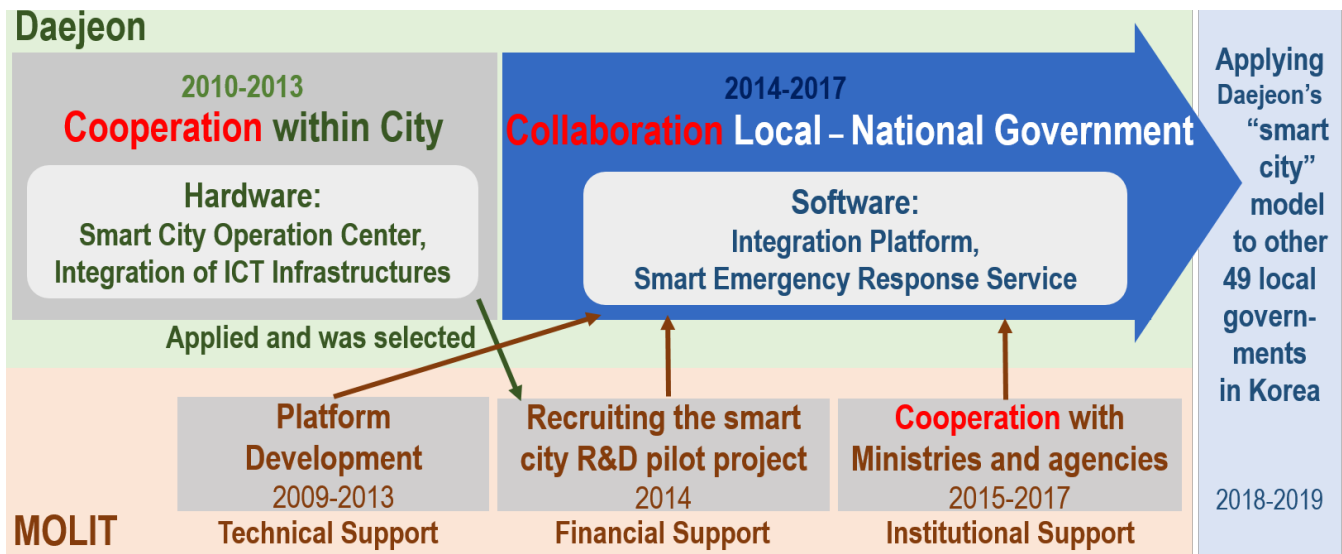## Creating a Smart Emergency Response System with National-Level Cooperation

From 2009 to 2013, while Daejeon was building its Smart City Operation Center and expanding its CCTV network, MOLIT spent ₩10 billion (US$ 8.4 million) to develop a virtual hub for CCTV data-sharing and opened a nationwide competition to recruit a pilot city for this new platform. In 2014, the Daejeon city government won the open competition and received technical, financial, and institutional support from MOLIT to customize the platform and to develop a smart emergency response system at the national level (see figure 3).

MOLIT's persistent efforts to gain support from related ministries and agencies at the national level helped improve the institutional environment for the smart emergency response system. Cooperation between the ministries was not easy at the beginning—not until the aftermath of the April 2014 Sewol ferry disaster, which focused government concern on improving emergency services management. The disaster, which killed 304 people including 250 high school students on a field trip, led to public outcry over the failure of the poorly coordinated rescue efforts (Herim 2018).

MOLIT responded to the tragic disaster by working to develop a cooperative emergency response system. MOLIT persuaded relevant ministries and agencies to establish a single platform for integrating national safety systems with local governments, police forces, fire departments, and disaster relief agencies.

FIGURE 3. COLLABORATION BETWEEN THE LOCAL GOVERNMENT AND THE NATIONAL GOVERNMENT

Daejeon

2010-2013
Cooperation within City

Hardware:
Smart City Operation Center,
Integration of ICT Infrastructures

Applied and was selected

2014-2017
Collaboration Local – National Government

Software:
Integration Platform,
Smart Emergency Response Service

Applying Daejeon's "smart city" model to other 49 local govern-ments in Korea

Platform Development
2009-2013
Technical Support

Recruiting the smart city R&D pilot project
2014
Financial Support

Cooperation with Ministries and agencies
2015-2017
Institutional Support

2018-2019

MOLIT

Source: Author.

Note: ICT = information and communications technology; MOLIT = Ministry of Land, Infrastructure, and Transport; R&D = research and development.

In July 2015, MOLIT and the National Police Agency negotiated a memorandum of understanding (MOU) to enable information sharing. The MOU enabled the Smart City Operation Center to provide CCTV videos of crime scenes and criminal suspects from police calls and emergency dispatches. For example, the footage helped authorities trace the escape routes of criminal suspects through different cameras. In September 2015, MOLIT made a similar agreement with the Ministry of Public Safety and Security to share real-time footage and information (such as traffic data) during fires, rescue operations, and other emergency situations.

Next, MOLIT signed an agreement with private communications companies in July 2016 for emergency cases involving children, patients suffering from dementia, and senior citizens living alone. The government focused on those groups because they were less capable of making emergency calls on their own to communicate their location or needs. The Smart City Operation Center could access photos, location information, and other data from private companies to identify a citizen's location and situational information with CCTVs, and then the center could take appropriate actions such as notifying police or other emergency responders.

Upgrading Services

After opening the Smart City Operation Center, Daejeon continued to develop and upgrade services by analyzing performance data. The city analyzed CCTV images that

had been requested by the police or fire departments and used that data to determine which areas required more CCTVs. Daejeon also gathered feedback from the police and fire departments to enhance the quality of services and procedures. Through continuous feedback and corrections, agencies improved information flow in real time.

Daejeon also implemented the Smart Emergency Response System, which integrated real-time emergency cooperation services through the operation center including emergency dispatch and patrol services and onsite video support, disaster safety response services, and support for children and the elderly (figure 4). "Investigation of incidents and maintenance of security using CCTVs is very innovative," said Daejeon police inspector Guhyun Ryu. "It is very useful in real-life situations."[6]

First responders often used the emergency dispatch service, which was developed from July 2015 to September 2016, for citizen safety. Nojung Park, a team manager of the Gung Town 119 Safety Center, said, "After introducing the real-time cooperation service, firefighters working in the field could get more information about the site and type of fire. It helped them strategize how to handle the emergency situation".[7]

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6 Author interview with Guhyun Ryu in Daejeon, September 9, 2019.
7 Author interview with Nojung Park in Daejeon, February 18, 2020.

FIGURE 4. THE SMART EMERGENCY RESPONSE SYSTEM
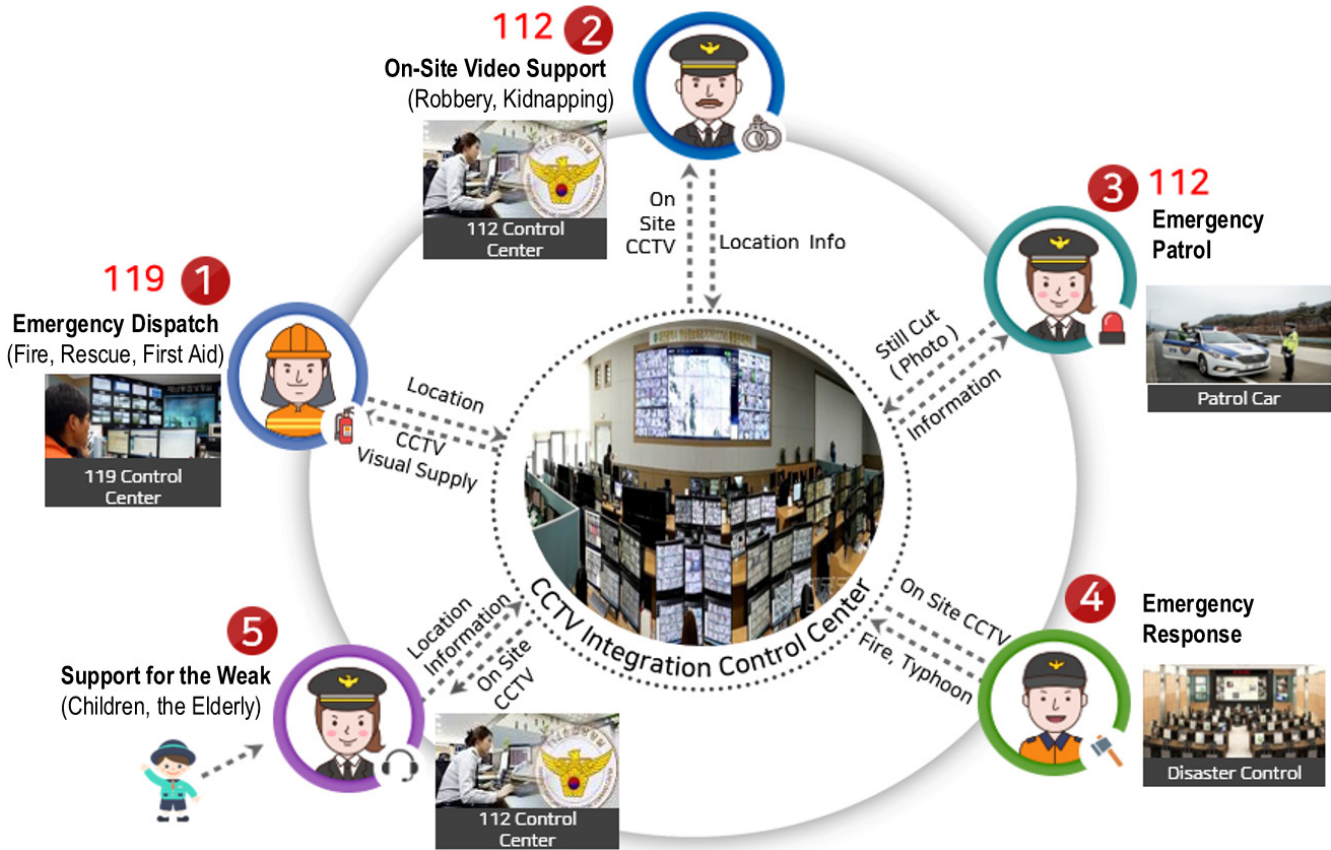
Source: Daejeon City Hall (2019).
Note: CCTV = closed-circuit television.

The 112 Emergency Patrol Service, which was designed from 2015 to 2017, helped police pursue criminals.[8] Police used the 112 On-Site Video Support Service, also developed from 2015 to 2017, to trace relevant visual data in the case of violent crimes. The Disaster Safety Response Service, developed from 2016 to 2017, helped in the case of a natural disaster or hazard such as a typhoon or wildfire. Youngmi Lee, an officer in charge of Daejeon's Smart Emergency Response System, said that during a flood in August 2017, the system helped use visual information to identify dangerous areas, to inform citizens of dangers, and to prohibit citizen access in designated areas to minimize harm.[9]

The protection services for children, the elderly, and the disabled—services developed in collaboration with Korean private telecommunication companies from 2016 to 2017—enabled police officers and emergency rescue teams to work together in real time to protect those vulnerable citizens.

Communicating with Citizens

Daejeon set up a showroom on the second floor of the operation center to show citizens and visiting officials from other cities how the government used CCTV systems to make the city safer and to make services more accessible. The showroom's design included glass windows overlooking the CCTV Control Center for visitors to see the real-time collecting and sharing of images and data. Visitors could also use test equipment to simulate emergency situations. By 2017, the center recorded visits by 4,077 people, more than half of whom were students.

"The showroom is not just for understanding and experiencing the center, but also for educational impact," said Sanghun Lee of the Smart City Research Center. "By watching and adjusting the CCTV themselves in the showroom, citizens become aware of the enhanced city

8   While 112 is Korea's emergency telephone number for the police, 119 is the emergency number for fires and first aid.
9   Author interview with Youngmi Lee in Daejeon, September 9, 2019.

safety system and watch out for their actions. It would be a stepping stone to heighten the effectiveness of crime prevention and to amplify citizens' understanding and participation in smart cities".[10]

Protecting Privacy

Privacy issues made CCTV installation and data collection difficult, because the cameras exposed citizens' daily lives. Therefore, monitoring employees were trained to uphold strict privacy standards. Before entering the center, they were required to store personal belongings such as mobile phones in lockers. Laws prohibited the leakage of any personal information, and no violations were reported as of 2019.

The national government considered privacy issues in its design of the smart emergency response system. In accordance with Korea's Act on the Construction of Smart Cities, MOLIT received legal advice before planning the development of services related to the security system for issues such as image information provision, maintenance of records, authentication of data, and network separation. The Personal Information Protection Act allowed third parties to access personal information when there is a threat to life or physical property or when there is a criminal investigation.

Emergency service agencies could access confidential personal information when citizens reported crimes or other emergencies, or when persons suffering from dementia or children pressed emergency buttons. The police or firefighting center would notify the operation center of a caller's location information from the caller's mobile phone, and the operation center would immediately transmit nearby CCTV images for real-time cooperation. CCTV information could be used only in a strictly limited range of situations. When providing CCTV images, the local government followed standard procedures and kept records. Video images were stored for 30 days and then were deleted automatically, or they were destroyed after investigative use.

Private citizens and companies could request CCTV footage for certain legally permitted reasons, such as for resolving insurance claims. Citizens made a total of 481 such requests in 2017, of which 102 were granted.

Outcomes

From 2010 to 2017, the number of public CCTVs in Daejeon increased from 1,281 to 4,288, with their images and data collected and shared in real time through the Daejeon Smart City Operation Center. In 2017 alone, the operation center provided CCTV information to support 8,779 cases of police dispatches; 5,758 cases of emergencies; 438 cases of disaster relief; and 142 cases that involved finding missing persons, protecting children, or protecting adults suffering from dementia.

The Smart City Operation Center also may have contributed to a decrease in city crime. From 2015 to 2017, crime cases declined by 2,610 to a total of 46,983 cases, while the arrest rate for crimes increased 7.7 percent to a total of 88.2 percent (figure 5). In particular, major crimes (such as murder, robbery, rape, violence, and theft) decreased by 3,205 cases to a total of 15,785 cases between 2015 and 2017, with an 11.6 percent increase in arrest rate. The average response time for 119 emergencies was shortened by 88 seconds to be just under 6.0 minutes. The percentage of cases in which first responders arrived onsite within 7.0 minutes rose by 15.4 percent to a total of 78.5 percent in 2017.

Citizens tended to approve of the city's public security measures. Half of the Daejeon residents surveyed for the city's 2018 Social Indicators said that installing additional CCTV installations was the best way to improve city safety (Daejeon City Hall 2019a).[11]

In 2020, Daejeon collaborated with MOLIT to install 26 drone stations to compensate for blind spots between installed CCTVs (the CCTVs could cover only a 50-meter radius). Each drone could cover a radius of 2 kilometers and could provide more accurate and rapid information to support the smart emergency system. MOLIT funded the project with about ₩2 billion (US$16.8 million).

Daejeon's integration platform was expanded to handle 26 urban public services including hazardous facility protection and monitoring infectious diseases among animals. MOLIT planned to expand services over time as new opportunities arose. In 2020, for example, the smart city system was used in the country's COVID-19 response. The Ministry of Science, MOLIT, ICT, and

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10 Author interview with Sanghun Lee in Daejeon, September 9, 2019.

11 When asked about making the city safer, Daejeon citizens answered that they preferred installing more CCTVs (49.8 percent), strengthening local police patrols (18.7 percent), renovating street lamps (12.2 percent), managing unoccupied houses (7.2 percent), strengthening patrol volunteer activities (6.9 percent), and installing a guardian system for children (5.9 percent).

FIGURE 5. CRIME AND ARREST IN DAEJEON
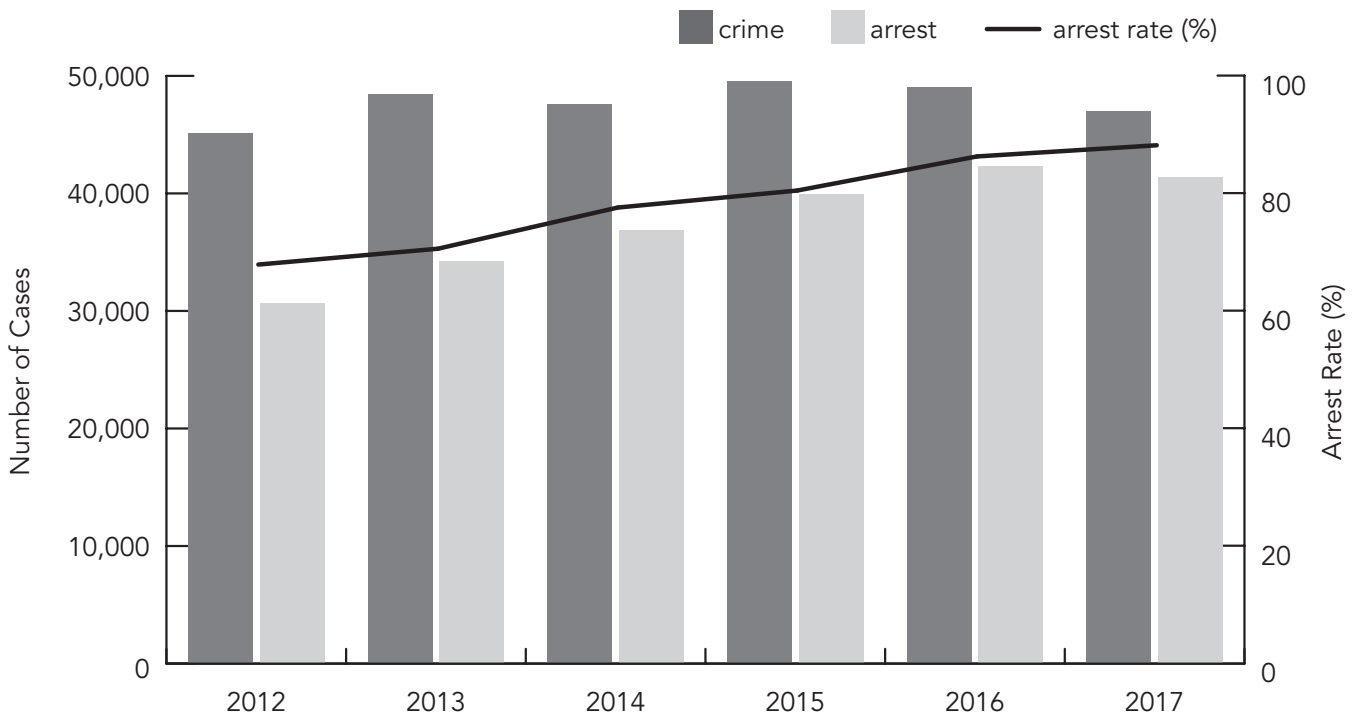
Source: Daejeon City Hall (2014, 2018).

Korea Centers for Disease Control and Prevention developed the COVID-19 Epidemiological Investigation Support System to help with contact tracing for COVID-19 cases and to locate transmission routes and hot spots through data analysis.

By 2019, Daejeon's smart emergency response system had spread to 49 local governments across Korea, and MOLIT planned to implement the model in 108 local governments by 2021.

Lessons Learned

Citywide Access and Education Initiatives Helped Win Public Support

In response to citizen demand, Daejeon decided to integrate ICT infrastructure citywide rather than to concentrate implementation in Doan New Town as had originally been planned. The city emphasized equity and operational sustainability, arguing that all taxpayers should benefit from public services, not just those within specific areas.

The Smart City Operation Center developed public outreach to help citizens understand and appreciate smart city technology, rather than having them fear or resent CCTV installations. To minimize citizen distrust and vandalism of CCTVs, Daejeon used educational efforts such as the interactive showroom to increase trust and transparency about how the system worked and how it benefited the city.

Collaboration between the Local and National Government Tapped the Strengths of Both

Daejeon had neither the resources nor the power to make the project work without support from the national government. To accomplish the smart emergency response system, Daejeon had to collaborate with MOLIT by working together toward shared outcomes rather than merely dividing work under a common leadership or plan. Daejeon and MOLIT overcame challenges together through MOUs among related ministries and agencies. The MOUs enabled complex coordination for issues such as budgeting, information sharing, and training. For example, the project required unprecedented access to national police information systems by local authorities.

Urban Issues Benefit from Comprehensive, Citywide Solutions

The smart emergency response system addressed a range of city problems by sharing resources and ideas. The Smart City Operation Center helped with fire suppression, emergency rescue, arrest, and protection of children and the elderly, as well as with the city's response to natural disasters under a holistic framework of emergency services for civil safety. The real-time information-sharing network enabled responses to be coordinated rather than treated as individual incidents, which lowered costs and increased speed and effectiveness.

Likewise, an aggregated data center addressed the challenges of data storage and cyber security for individual public institutions. This holistic data management system decreased the costs of labor, infrastructure, facilities, operations, and maintenance. Because of the large scale of data, Daejeon could work with professional data management companies and could negotiate better rates.

Smart City Plans Must Be Flexible to Accommodate Rapid Technological Changes

Rapid changes in technology can be a double-edged sword. On the one hand, it can increase costs as it did when Daejeon had to negotiate with contractors to replace equipment that became outdated as a result of delays in the operation center's construction. On the other hand, it can also increase efficiency, as shown by Daejeon's plan to use a fleet of drones to supplement fixed CCTV cameras. Project plans and contracts should anticipate technological changes and the rapid obsolescence of state-of-the-art equipment.

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