Building a Safer Society
through Science and Technology

Ministry of the Interior and Safety

Korea Institute of Public Administration

UNDRR
UN Office for Disaster Risk Reduction

Building a Safer Society through Science and Technology

A Compendium of Korea's Science and Technology-based Disaster Management

Ministry of the Interior and Safety

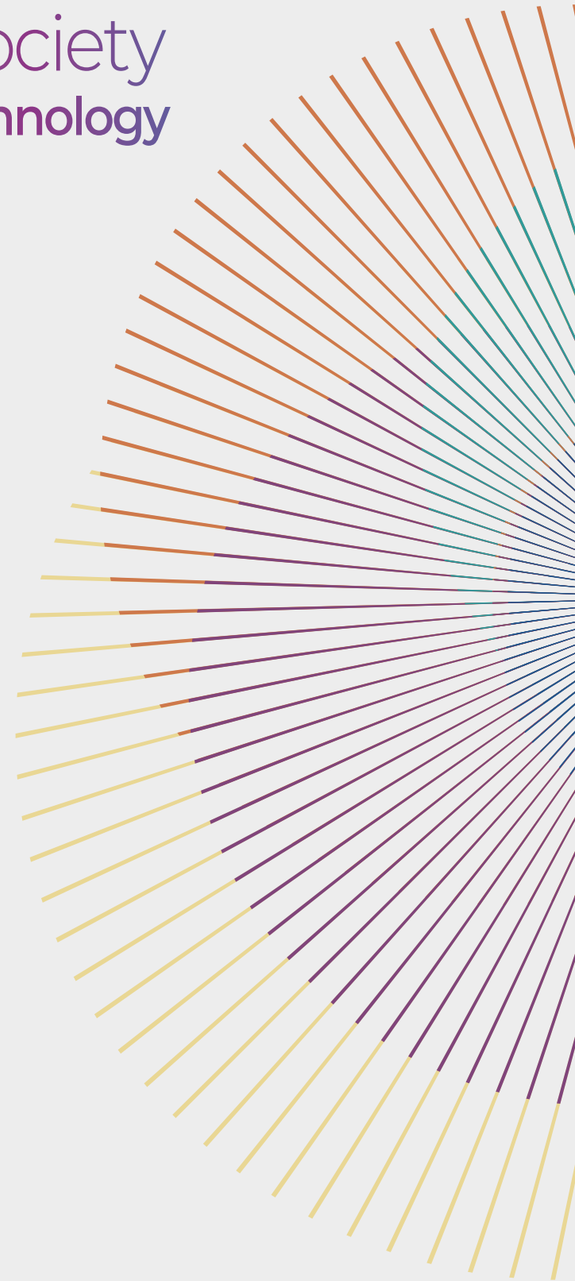
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The authors of the 24 case studies included in this compendium may change due to personnel rotations. If you are unable to contact the designated focal point for a particular case, please direct your inquiry to the international cooperation officer of the Disaster Management Policy Division, Ministry of the Interior and Safety (MOIS), Republic of Korea (Tel: +82 44 205 5122; Email: sheenasong@korea.kr).

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Abbreviations

AI	Artificial Intelligence
APEC	Asia-Pacific Economic Cooperation
AP-STAG	Asia-Pacific Science, Technology and Academia Advisory Group
CBS	Cell Broadcast Service
DRR	Disaster Risk Reduction
EMS	Emergency Medical Services
EW4All	Early Warnings for All initiative
GIS	Geographic Information System
ICT	Information and Communication Technology
IoT	Internet of Things
KIPA	Korea Institute of Public Administration
KMA	Korea Meteorological Administration
KRMS	Korea Disaster Resource Management System
LLM	Large Language Model
ML	Machine Learning
MOIS	Ministry of the Interior and Safety (Republic of Korea)
NDMI	National Disaster Management Institute (Republic of Korea)
NDMS	National Disaster Management System (Republic of Korea)
ODA	Official Development Assistance
PS-LTE	Public Safety LTE
STI	Science, Technology and Innovation

Building a Safer Society through Science and Technology

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A Compendium of Korea's Science and Technology-based Disaster Management

Forewords

Ministry of the Interior and Safety (MOIS)



Kim Gwang-yong

Vice Minister for Disaster and Safety Management
Ministry of the Interior and Safety

Entering the 21st century, disasters have grown in scale and become increasingly difficult to predict due to complex factors such as climate change, urbanization, and the expansion of a hyper-connected society. In Korea as well, various disasters including heatwaves, torrential rainfall, landslides, and wildfires, are occurring with greater frequency, and climate change is now widely recognized as a part of everyday reality.

The scale of disasters is increasing, extending beyond temporary damage to threaten lives and safety and lead to social and economic losses that are difficult to recover from. As a result, it has become more important than ever not only to respond swiftly when disasters occur, but also to predict and prevent them systematically. The key instrument enabling this shift is "Science and Technology-based Disaster Management." To reduce disaster losses, it is essential to proactively analyze and forecast disaster risks by leveraging a wide range of scientific and technological tools, including big data, artificial intelligence (AI), the Internet of Things (IoT), and sensor technologies. At the same time, strengthening inter-agency collaboration through platforms and communication networks, and enabling communities to participate in risk management through digital communication are equally important.

Since June, the Lee Jae Myung administration has presented a national vision of becoming one of the world's "Top Three Global AI Powers", promoting innovation across public administration, society, and the economy through science and technology. In government policy and public services, the administration is transforming policies and citizen-facing services under a new vision of an "AI Democratic Government Model," which seeks to realize both popular sovereignty and government innovation through AI.

In line with this direction, the Ministry of the Interior and Safety aims to more actively apply AI and other scientific and technological innovations to disaster management, strengthening both predictive and response capacities and establishing a proactive and science-based disaster management system. Science and technology-based disaster management will serve as a core policy direction for realizing a "life-respecting society that is safe from disasters and accidents."

This compendium presents major policies and exemplary cases of science and technology-based disaster management implemented in Korea to date. Building on its successful experience in e-government and digital government, Korea has driven innovation across all phases of disaster management-prevention, preparedness, response, and recovery-by introducing scientific and technological solutions. We hope this compendium will help readers better understand these policies and practices and serve as a practical reference for shaping future policy directions, including AI-based disaster prediction. It is also intended to provide guidance to other countries seeking to introduce science and technology-based disaster management systems.

As the title of this compendium suggests, the Government of the Republic of Korea will continue to do its utmost to build "a safer society powered by science and technology."

Korea Institute of Public Administration (KIPA)



Kwon Huck-ju

President
Korea Institute of Public Administration (KIPA)

We are experiencing a period of profound societal transition driven by rapid and multidimensional changes in technology, the environment, and demographic structures. We face a climate crisis whose impacts exceed previous expectations, while structural shifts such as population aging and decline pose additional challenges. Amid these difficulties, the rapid advancement of technologies, including artificial intelligence (AI), offers the potential to transform crises into opportunities.

In particular, disaster management enhanced by advanced technologies presents a critical opportunity to reduce loss of life. Digital platforms enable the public to receive risk information and communicate with one another; deliver essential information for disaster response quickly and accurately; and conduct search, rescue, and recovery operations more efficiently and safely. Given its direct role in protecting lives and health, the societal value and ripple effects of applying technology in disaster management surpass those in most other sectors.

At the Korea Institute of Public Administration (KIPA), we conduct extensive research to ensure that the use of AI and other scientific and technological tools in the public sector responds proactively to policy needs and strengthens national capacity. In disaster safety management, scientific and technological solutions must be applied in ways that align with contextual realities, and their effectiveness depends heavily on user capabilities. For this reason, research on the policies, institutions, and governance structures that underpin technology use is essential. Disaster safety management is a field in which balancing intuition and experience-based decision-making with science and evidence-based approaches is particularly important. Accordingly, KIPA is conducting in-depth studies on the domains, methods, and procedures through which technology can enhance the effectiveness of disaster management.

Science and technology-based disaster management is also receiving widespread global attention. KIPA is expanding its network with international organizations and leading overseas research institutions on disaster management. We share Korea's advanced practices in science and technology-driven disaster management while exploring how these experiences can be applied internationally to support developing other vulnerable countries in addressing climate-related risks.

This compendium provides a comprehensive overview of the outcomes of Korea's science and technology-based disaster management one of the nation's foremost policy priorities. It is designed to offer a clear understanding of Korea's experience while presenting insights for countries seeking to benchmark advanced practices.

I would like to express my sincere appreciation to the Ministry of the Interior and Safety and the UNDRR Regional Office for Asia and the Pacific for jointly planning and publishing this compendium. I hope it will contribute to raising broader awareness of Korea's achievements in disaster management and science and technology, and to further advance cooperation within the international community.

UNDRR Regional Office for Asia and the Pacific (UNDRR ROAP)



Marco Toscano-Rivalta

Chief
UNDRR Regional Office for Asia and the Pacific

The Asia-Pacific region is among the most disaster-affected regions in the world. Climate change is intensifying extreme events, including heatwaves, floods, typhoons, and droughts, while geophysical hazards remain highly active across seismic and volcanic belts. High population density, rapid urbanization, demographic shifts such as accelerated population ageing, and uneven disaster response capacities among countries further widen disparities in disaster losses. These interconnected factors are increasing both the scale and complexity of disasters, making it clear that traditional response-centered approaches are no longer sufficient. A shift toward scientific and evidence-based disaster risk reduction (DRR), with a strong emphasis on anticipation and prevention, is more urgent than ever.

UNDRR has consistently underscored the critical role of science, technology, and innovation (STI) in reducing disaster risk. The Sendai Framework for Disaster Risk Reduction 2015–2030 established the global foundation for policy direction by positioning science and technology as essential tools for understanding risk, enabling early warning, and informing decision-making. This direction is further advanced through the United Nations Secretary General's Early Warnings for All (EW4All) initiative, which aims to ensure universal access to early warning systems by 2027.

The Republic of Korea has been at the forefront of the digital transformation of disaster management, building on its strong achievements in e-government and digital government. Korea's sustained digital policy efforts, maintained consistently across administrations, are particularly noteworthy. Science and technology are now applied throughout the entire disaster management cycle, yielding measurable outcomes in risk reduction and loss mitigation. Recognizing the value of Korea's experience and its relevance to other countries, I welcome the development of this compendium so that Korea's model can be shared across the Asia-Pacific region and the global DRR community. I believe that many countries can draw practical lessons from Korea's journey.

This compendium documents Korea's policy cases and technological advancements directly as presented by the practitioners responsible for major programmes and initiatives. It offers a practical reference for countries considering science and technology-based DRR systems. Unlike academic reports, the field-level applicability and operational insight contained here will be especially valuable for latecomer countries.

I extend my sincere appreciation to the Ministry of the Interior and Safety for its leadership and longstanding partnership, and the Korea Institute of Public Administration for its strong support for this publication. I hope this compendium will be widely used by disaster management officials and experts, and that science and technology will continue to play a greater role in reducing disaster risk. Ultimately, I hope that more people will be able to live safer and more resilient lives.

At-a-Glance: Science and Technology-Based Disaster

What is Science and Technology-based Disaster Management?

Science and technology-based disaster management (hereinafter "ST-based disaster management") refers to an approach that enhances the effectiveness of disaster risk management across all phases-prediction, prevention, preparedness, response, and recovery-by leveraging IoT, sensors, communication networks, digital platforms, data management and analytics, and artificial intelligence (AI).

Its goal is to minimize disaster losses and strengthen resilience across society. As the global importance of applying science and technology to disaster management continues to grow, the Republic of Korea has rapidly institutionalized ST-based disaster management by building on its successful e-government experience, advanced digital infrastructure, systematic policy implementation, and strong technological capacity and collaboration with the private sector.

Why ST-based Disaster Management Matters

The increasing scale and complexity of disasters are causing severe and often irreversible impacts around the world. To effectively reduce disaster losses, it is becoming increasingly important to anticipate risks in advance, disseminate warnings rapidly, and strengthen inter-agency cooperation and citizen participation roles in which science and technology play a critical part.

Since the 1990s, both the frequency of disasters and the scale of economic losses have steadily increased worldwide. At the same time, the number of disaster-related deaths has declined, suggesting that advances in ST-based disaster management have contributed to reducing human losses.

Key Strengths of ST-based Disaster Management

1 Data-Driven Disaster Risk Analysis and Forecasting

Advanced data collection and processing technologies, combined with artificial intelligence (AI), enable the early detection of hazard signals and enhance disaster risk analysis and forecasting capabilities.

2 Real-Time Sharing and Dissemination of Disaster nformation

Real-time collection, analysis, and dissemination of disaster information support timely decision-making and help prevent or reduce disaster related losses.

3 Field-Centered, Effective, and Coordinated Disaster Response

Communication networks and digital platforms enable coordinated decision-making and unified response across agencies, even in rapidly evolving disaster situations.

4 Whole of Society Disaster Management Capacity through Public Participation

Access to essential disaster information empowers citizens to actively participate in disaster management and strengthens whole-of-society resilience.

Case Studies by Pillar

Pillar 1

Real-Time Risk Monitoring and Rapid Dissemination

Through ST-based disaster management that utilizes digital technologies such as AI, big data, 5G, sensors, and smartphones, systems have been established to detect disaster risks more accurately in real time and disseminate alerts quickly in a user-centered manner. This has shifted disaster management from being "response"-oriented to focusing on "prediction" and "prevention," contributing to reducing disaster damage.



1.1 AI-Powered Detection of Key Safety Risks (AI-based CCTV Monitoring System)

This system uses AI to analyze CCTV footage for changes such as smoke, flames, and falls, automatically alerting monitoring staff in real time. Efforts by the central and local governments to secure training data, establish legal grounds, and replace infrastructure with AI CCTVs have expanded AI CCTV nationwide, improving detection accuracy and response speed.

1.2 Preventing Crowd Incidents through Big Data (Data-driven Crowd Alert System)

Although crowd incidents were historically rare in Korea, the Itaewon tragedy in October 2022 highlighted the urgent need for systematic prevention. In response, the government introduced the Crowd Alert System, which analyzes crowd density in real time using telecommunications and traffic data and automatically issues alerts when risk levels are reached. The system is currently in operation across 100 locations nationwide where crowd congestion is a concern.

1.3 Emergency Text Alerts: Cell Broadcasting Service (CBS)

Introduced in 2005, CBS emergency text alerts have become a key means of rapidly informing the public of disaster risks via mobile phones, reaching the largest number of people in the shortest time. With technological advancements, the targeting area has been refined to the township level, message length has been expanded to allow more information, and multilingual support has been introduced. The system continues to be upgraded to improve the accuracy and timeliness.

1.4 Severe Weather Alerts One Step Ahead (KMA Heavy Rain Emergency Alerts)

Previously, the Korea Meteorological Administration (KMA) could not send disaster text alerts directly and had to relay them through the Ministry of the Interior and Safety (MOIS) or local governments. As extreme weather events have become more frequent, KMA began sending alerts directly in 2025, enabling residents to receive and respond to severe weather information more quickly.

1.5 Disaster Alerts Without Language Barriers for Foreigners (Safety Stepping Stone & Emergency Ready App)

The "Safety Stepping Stone" smartphone app was developed to allow anyone to receive disaster text alerts via mobile devices. The app provides disaster information notifications designed to support vulnerable groups, including foreign residents, persons with disabilities, and other vulnerable groups, through five foreign-language support (English, Chinese, Vietnamese, and others) and a text-to-speech (TTS) function. Users can designate areas of interest to receive localized disaster alerts and access a range of safety information, such as disaster response guidelines by hazard type and nearby shelter information.

1.6 Integrating Legacy Disaster Warning Systems into a Unified Digital Platform (Local Government Integrated Disaster Forecast and Warning System)

To manage over 24,000 disaster forecast and warning facilities nationwide (speakers, electronic display boards, etc.), the "Multimedia Integrated Issuance Platform" was introduced. Previously, local governments had to operate each medium separately; now, a single login enables simultaneous issuance across multiple media, and metropolitan governments can utilize warning facilities operated by lower-level local governments. Pilot projects were completed in eight local governments between 2022 and 2023, with nationwide expansion planned by 2029.

1.7 Predicting Landslide Risks 48 Hours in Advance (Digital Slope Integrated Landslide Information System)

To address the increasing landslides caused by heavy rainfall, the Korea Forest Service developed a system that forecasts landslide risks up to 48 hours in advance, extending the previous forecast window of 24 hours. By integrating dispersed slope-related data and diverse datasets, including landslide hazard maps, the system enhances forecasting accuracy through simulation-based analysis, with further advancements planned to incorporate AI.

1.8 AI-Enabled Early Flood Forecasting and Warning

Using more than ten years of hydrological data, AI-powered systems now issue flood warnings with greater accuracy and speed, expanding monitoring coverage from major rivers to tributaries (from 75 to 223 locations). Location-based notifications provide clearer flood risk information, while navigation alerts deliver real-time updates on flooding conditions to drivers.

Pillar 2

Integrated Disaster Management based on Smart Technologies

Smart technologies, including digital platforms, communication networks, sensors, and AI enable integrated disaster management by facilitating communication and cooperation among relevant ministries, local governments, related organizations, and private-sector actors. Real-time information and data sharing support timely decision-making in emergency situations, enabling rapid and coordinated actions that enhance disaster response effectiveness.



2.1 A 24/7 Nationwide Disaster Monitoring and Response Coordination System (National Disaster and Safety Status Control Center)

Operating around the clock, the National Disaster and Safety Situation Status Control Center (NDSSCC) collects, analyzes, and disseminates disaster information, acting as the control tower for nationwide disaster response during major emergencies. The center manages real-time disaster data from 80 monitoring management systems and CCTV feeds, and supports initial response operations through video conferencing and the disaster and safety communication network.

2.2 Enhancing Disaster Response with Digital Manuals (Digitalization of Disaster Management Manuals)

MOIS has digitized more than 10,000 disaster management manuals, enabling users to search and access them at any time. This has significantly improved version control and the updating process. During emergencies, personnel can verify procedures instantly on their smartphones, and the system allows users to directly contact officials in central and local governments, thereby strengthening inter-agency communication.

2.3 Seamless Collaboration via the Disaster and Safety Communication Network (PS-LTE Disaster Safety Network)

This dedicated disaster communication network enables major response agencies-the police, fire services, and coast guard-to share voice, video, and data in real time within a single network. Independent of commercial networks and providing nationwide coverage, it ensures stable operation even during large-scale disasters.

2.4 Closing Underpasses before Flooding (Inter-Agency Collaboration System for Underpass Safety)

To protect lives from underpass flooding during extreme rainfall, safety standards have been strengthened, and local governments monitor conditions in real time using CCTV and sensors, enabling timely activation of barriers and public warning announcements. Safety managers have been designated for each underpass to ensure clear accountability.

2.5 AI Detects Flood Risks First and Navigation Systems Notify Drivers
(AIoT-based Underpass Flood Prediction and Navigation Linking)

The AIoT-based flood prediction system collects real-time water-level and weather data through sensors. AI analyzes the data to predict potential flooding, enabling the system to block vehicle entry and issue warnings when risks are detected. The system was successfully demonstrated in Busan in 2024. The government also collaborated with private companies to provide real-time risk notifications to drivers through vehicle navigation systems within 1.5㎞ radius of flood warning points.

2.6 Future of Wildfire Response Transformed by Data and AI
(AI-based Wildfire Spread Prediction System)

To prepare for the increasing risk of wildfires driven by climate change, Korea integrated weather, terrain, fuel conditions, and historical wildfire data into a national database, enabling an AI-based model to predict wildfire spread and optimize the deployment of aerial firefighting resources through real-time analysis.

2.7 Securing the Golden Hour with Cloud-based Collaboration
(119 Emergency Smart System)

This cloud-based system integrates emergency medical systems nationwide, linking central and regional systems to improve speed and accuracy of emergency response. It transmits patient information to multiple hospitals simultaneously, checks capacity in real time, and introduces QR-based management for mass casualty incidents.

2.8 Addressing Disaster Resource Shortages through Real-Time Sharing
(Korea Disaster Resource Management System)

KRMS registers and manages approximately 80 million disaster resources across 803 categories nationwide, enabling rapid mobilization and real-time tracking from storage to deployment. Using GIS-based search functions and supply chain and logistics management technologies, the system allows the entire process from storage to transportation to deployment to be tracked in real time. KRMS represents a case of addressing shortages of disaster resources through the concepts of the sharing economy and platform technology.

Pillar 3

Building Safer Communities through Digital Participation

Digital technologies and platforms enable residents to report hazards and access local disaster and safety information. This fosters a new disaster management ecosystem in which local communities and society as a whole participate in information sharing and direct engagement in prevention and response.



3.1 Protecting Community Safety through Citizen Digital Reporting
(Safety e-Report)

Launched in late 2014, this platform allows residents to report local hazards via mobile devices or PCs. It has integrated other reporting systems, expanded report categories, and provided rapid follow-up, surpassing 12 million reports in 2024.

3.2 All Disaster Safety Information Integrated in One Place
(National Disaster and Safety Portal)

This portal provides one-stop access to disaster response guidelines, shelter information, alert histories, and damage reports, with 410,000 monthly visits. Services for vulnerable groups and foreign residents have been enhanced through an English-language site and accessibility certification. Future improvements include the introduction of GIS-based visualization and automatic translation in 19 languages.

3.3 Breaking Down Language Barriers in Emergency Calls
(Direct Emergency Call App)

Supporting five languages and providing an intuitive visual interface, the Emergency Ready App helps foreign residents and persons with hearing impairments to easily place emergency calls to 112 or 119. As of 2024, the app had been downloaded about 280,000 times, and outreach programmes for vulnerable groups.

3.4 Curious About How Safe Your Community Is?
(Safe Map: Daily Safety Information Service)

This map-based service provides around 130 types of safety-related information, including disaster histories, high-crime areas, and six-sector safety grades for local governments, as well as safety information on key facilities. It supports both public awareness and evidence-based policymaking.

Pillar 4

Systems and Global Expansion of ST-based Disaster Management

Korea provides national-level support for data management and the development of disaster safety technologies and products essential for ST-based disaster management. It also operates a system to identify and manage potential disaster risks in preparation for unforeseen events. In addition, Korea supports countries in need of early warning technologies by transferring its systems and expertise to help reduce disaster losses.



4.1 Data Management: Foundation of ST-based Disaster Management
(Disaster and Safety Data Sharing Platform)

Since 2025, MOIS has operated a platform that links 84 systems from 53 institutions, providing over 1,800 datasets in multiple formats, including APIs, for use in all phases of disaster management and for the development of private-sector safety services such as shelter location information.

4.2 Developing Disaster and Safety Technology and Industry as a National Priority
(Disaster and Safety Industry Support System)

The disaster and safety industry has emerged as a key sector supporting public safety across the disaster management cycle. Korea institutionalized industry support through the Act on Promotion of Disaster and Safety Industry (2022) and the First Basic Plan (2024-2028). It promotes advanced technologies and products through specialized facilities, designation systems, and the Korea Safety Expo, while supporting access to both domestic and international markets.

4.3 Proactive Disaster Management through Emerging Risk Analysis
(Centre for Disaster Risk Identification and Assessment)

The National Disaster Management Research Institute (NDMI) established the Centre for Disaster Risk Identification and Assessment in 2023 to identify and assess potential disaster risks. The Centre conducts biannual analyses and provides early advisory support to relevant authorities to facilitate preventive action. To date, 15 emerging risks, including electric vehicle battery fires, have been identified, supporting the development of safety measures.

4.4 Enhancing Flood EWS in Developing Countries
(ODA Projects for Disaster Risk Reduction)

In line with the UN's Early Warnings for All initiative, Korea has supported the Philippines, Laos, Fiji, and other Asian developing countries in establishing flood early warning systems (EWS). These systems integrate rainfall and water-level monitoring, web-based visualization platforms, alert mechanisms, and community training.

Directions of Change in ST-based Disaster Risk Management

ST-based disaster risk management has already become a core policy direction and a key component of disaster management systems not only in the Republic of Korea but also in many countries worldwide. This approach has contributed to strengthening the proactiveness, collaboration, inclusiveness, and data-driven nature of conventional disaster management.

❶ Transition to Proactive Disaster Management

Rapid and accurate risk detection using AI, sensors, and big data, combined with automated alert systems, enables real-time monitoring and rapid alerts.

❷ Advancement of Cooperative Disaster Management

The expansion of digital communication networks and integrated platforms helps overcome information silos among institutions and supports data-driven collaboration and predictive decision-making.

❸ Strengthening Inclusive Disaster Management

The spread of two-way platforms such as mobile reporting tools and disaster information applications enables the public to participate as producers of risk information and active response actors, rather than passive recipients.

❹ Establishment of Data-Driven Disaster Management

The development of data-sharing frameworks, promotion of the disaster safety industry, analysis of emerging risks, and expansion of international cooperation enhance the sustainability of ST-based disaster risk management.

Notable changes and impacts that Korea has achieved through science and technology-based disaster management across four thematic areas are summarized below.

Pillar	AS-IS (Conventional Disaster Management)	TO-BE (ST-based Disaster Management)
❶ Real-time Risk Monitoring and Rapid Dissemination	• Human centered observation and step-by-step reporting causing delays in information delivery	• Real time risk detection based on AI, data, and sensors
	• One way alert systems limiting rapid and tailored responses	• Automated and customized alerts enabling rapid, accurate dissemination and early action
❷ Integrated Disaster Management based on Smart Technologies	• Fragmented, institution specific systems hindering collaboration	• Government wide collaboration and communication based on integrated platforms
	• Experience and intuition-based decision making reducing consistency	• Predictive and collaborative decision making grounded in data
❸ Building Safer Communities through Digital Participation	• One way, government-centered information provision	• Expanded two way communication through citizen participation platforms
	• Limited participation and accessibility for vulnerable groups and local communities	• Inclusive disaster information services with multilingual support and assistive functions, strengthening community based prevention and response capacity
❹ Enabling Environment for Science-based Disaster Management	• Dispersed data and insufficient R&D and industry support systems	• Integrated data management systems and structured disaster safety industry support
	• International cooperation focused on individual project support	• Expansion of international cooperation centered on technology transfer and policy sharing

Key Drivers of the Development of ST-based Disaster Management in Korea

Korea's ST-based disaster management can be understood as the result of long-term accumulation of a national foundation that enables rapid adoption and diffusion of technology, rather than technology alone. Its key driving forces are:



(1) Experience and Legacy of Successful National Informatization Policies

Korea has consistently pursued national informatization and e-government as core long term policies, ensuring policy continuity and a whole of government implementation framework. Through these efforts, the country established nationwide digital infrastructure, standardized administrative procedures, information sharing practices across ministries and between central and local governments, and a culture of public private collaboration based on open government public data has taken rootwere established. These elements have provided the administrative, institutional, and cultural foundation for the rapid adoption and diffusion of AI, data, and platform-based technologies into disaster management.



(2) Government Commitment and Institutionalization of Scientific Disaster Management

The government has embedded ST-based disaster management within national strategies and institutional frameworks, while continuously expanding disaster and safety R&D and digital transformation initiatives. By institutionalizing systems to foster the disaster safety industry, the government has supported the full cycle from technology development and certification to field application and market diffusion. This approach enables science and technology to function as a permanent operational pillar of disaster management rather than as one-off projects.



(3) Digital Public Participation and a Virtuous Cycle of Engagement

The expansion of digital participation platforms and high levels of public engagement have enabled citizens to contribute throughout the disaster management cycle as both providers of risk information and active response actors. At the same time, the government has enhanced portals and services and strengthened public education to improve access to and understanding of disaster safety information. As a result, repeated cycles of citizen reporting of local risks, such as through the Safety Report System, and prompt, responses by central and local governments have accumulated trust and efficacy, reinforcing the sustainability of participatory disaster management.



(4) Strong Private Sector Capabilities and the public-private collaboration ecosystem

Building on its advanced ICT capabilities and industrial base, Korea has developed mechanisms that actively involve the private sector in the development, testing, and scaling of disaster safety services. Open government data, API utilization, partnerships with telecommunications and platform companies, and institutional support for standards and data management by specialized agencies have collectively strengthened the public private collaboration ecosystem, enhancing both the speed and sustainability of digital transformation in disaster management.

Future Challenges for ST-based Disaster Management

While ST-based disaster management has enhanced effectiveness and efficiency of disaster management systems, its application and expansion still involve several unresolved issues. Addressing these issues will require continued research and discussion, alongside policy efforts by governments and cooperation across the international community.



(1) Enhancing the Reliability of Disaster Information

The effectiveness of disaster management is highly dependent on the reliability of disaster information and data. Korea has continuously strengthened the accuracy and timeliness of disaster information through long-established standardized data management systems and platform-based real-time data integration. Going forward, discussions on governance and international standards to enhance the reliability of disaster-related information on social media, alongside improved data quality management, will be essential.



(2) Utilizing Trustworthy Artificial Intelligence (AI)

AI is a key tool for advancing risk prediction and decision support, but black-box models and data bias may introduce new risks. Therefore, the effective application of AI in disaster management requires the establishment of a trustworthy AI framework based on explainable AI, clear accountability, and human-in-the-loop decision-making structures.



(3) Digitalization of Inclusive Disaster Management

The digitalization of disaster management may create information gaps for older persons, persons with disabilities, and foreign residents, potentially leading to wider safety disparities. Both Korea and UNDRR emphasize the importance of hybrid approaches that combine inclusive digital services with traditional alert mechanisms. Future efforts should focus on building inclusive digital disaster management systems that incorporate universal design principles from the planning stage.





(4) Strengthening Public Disaster Knowledge and Safety Awareness

ST-based disaster management cannot be effectively expanded without sufficient public understanding of disasters and strong safety awareness. Strengthening disaster knowledge and safety awareness through schools, workplaces, lifelong learning, and trusted information delivery is essential, along with fostering institutional environments that recognize safety as a fundamental societal value that takes precedence over competing interests such as economic gains.



(5) Reviewing and Redesigning Processes Beyond Technology

UNDRR highlights the importance of infrastructure investment for proactive risk prediction and prevention in the era of extreme climate events, and Korea is also moving toward proactive risk management by introducing systems to identify and manage emerging risks. Looking ahead, disaster management processes will need to be reviewed and redesigned to strengthen prediction and prevention as new technologies are adopted, while institutional and infrastructure are improved in parallel to reflecting changed risk environments.

For ST-based disaster management to be successfully institutionalized and to contribute meaningfully to disaster risk reduction, a qualitative and comprehensive transformation is required - one that encompasses not only new technologies, but also institutions, culture, governance, and operational processes.

Building a Safer Society through Science and Technology

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A Compendium of Korea's Science and Technology-based Disaster Management

Chapter 1

Significance and Strategic Value of ST-Based Disaster Management

1

Core Concept and Strategic Value of ST-Based Disaster Management

Core Concept and Fundamental Importance

Science and Technology-based (ST-based) disaster management refers to an approach that enhances the effectiveness of disaster management by applying scientific methods and digital technologies across the entire disaster management cycle: prediction, prevention, preparedness, response, and recovery. As established by the Sendai Framework for Disaster Risk Reduction (2015–2030), the global normative framework for disaster risk governance, disaster risk arises from complex interactions. To understand and address this complexity, the application of science and technology is indispensable.

This concept is recognized internationally in various frameworks, including "Science-based Disaster Risk Management" (UNISDR 2016; UNDRR 2019) and "STI-based Disaster Management" (AP-STAG 2022). More recently, the rapid advancement of digital technologies has drawn attention to the *Digital Transformation of Disaster Management* (Fischer-Preßler et al., 2024).

Accuracy and speed, the dual pillars of effective disaster response, are significantly enhanced through science and technology. Innovations such as Artificial Intelligence (AI), the Internet of Things (IoT), sensors, data platforms, high-speed communication networks, and cloud systems increase the precision of risk prediction, accelerate the dissemination of critical information, and enable coordinated, multi-agency response actions to minimize loss. This approach serves as a critical mechanism for enhancing the effectiveness of disaster management authorities and first responders. Beyond immediate response, science and technology provide the foundation for strengthening long-term disaster resilience across society.

By operating across all phases of the disaster cycle, science and technology enable seamless communication and collaboration among central and local governments, the private sector, and the public. This provides the necessary framework for policy innovation, ST-based disaster governance, and an integrated, data-driven national disaster management system.

Evolving Disaster Landscape and Growing Role of Science and Technology

The imperative for ST-based disaster management is intensifying as the global disaster landscape undergoes rapid transformation. Climate change, hyper-connected societies, rapid urbanization, and demographic shifts are fundamentally altering the nature of hazards, leading to increased uncertainty and greater scale and complexity in disaster impacts.

According to the Global Assessment Report on Disaster Risk Reduction 2025 (GAR 2025), annual global disaster losses are estimated at approximately USD 202 billion (as of 2023) based solely on direct damage.

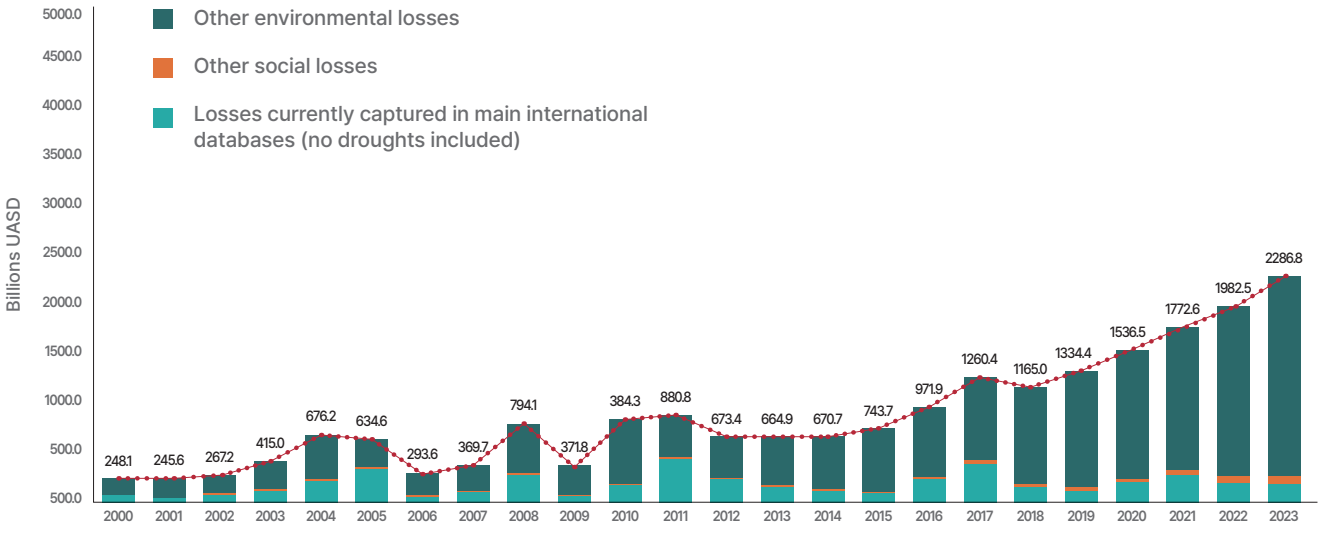
However, when cascading and indirect impacts, including supply chain disruptions, health-related expenditures, and the loss of ecosystem services, are factored in, the total annual cost exceeds USD 2.3 trillion. This underscores the vast hidden losses that traditional international statistics often fail to capture (UNDRR, 2025a).

Conversely, global disaster-related mortality has demonstrated a significant downward trend. During the decade preceding the Sendai Framework (2005–2014), the death and missing person rate was 1.61 per 100,000 population. Following its implementation (2014–2023), this figure fell to 0.79, a reduction of more than 50% (UNDRR, 2025a).

This progress highlights that advancements in ST-based disaster management, including the expansion of Multi-Hazard Early Warning Systems, robust risk monitoring frameworks, and ICT-enabled response capacities, have played a decisive role in saving lives (WMO, 2023; UNDRR, 2023a).

The United Nations' Early Warnings for All (EW4All) initiative aims to reduce loss of life from climate-related hazards by enhancing risk understanding and forecasting, while ensuring the rapid dissemination of critical information. At its core, the initiative prioritizes ST-based risk forecasting and information delivery, promoting the expansion of early warning systems worldwide (UNDRR, 2023b; WMO, 2023). Full implementation of the EW4All initiative by 2027 is expected to solidify the global decline in disaster-related mortality, ushering in a new era of science and technology-driven disaster resilience.

Figure 1.1.1 The Costs of Disasters: Official, Social and Environmental Dimensions (2000–2023)



※ Source: UNDRR (2025a, p. 3)

Strengths of ST-based Disaster Management

1 Data-Driven Disaster Risk Analysis and Forecasting

As disaster patterns become more unpredictable and are shaped by complex, multi-factor interactions, understanding and predicting disaster risks has become increasingly challenging. Science and technology help overcome the limitations of human predictive capacity, enabling proactive disaster management by making previously unattainable forecasting a reality.

Rapid advancements in technologies capable of processing massive datasets, such as cloud computing, the Internet of Things (IoT), big data analytics, and artificial intelligence (AI), have significantly enhanced the collection, analysis, and predictive capabilities essential for sophisticated disaster management.

Traditionally, static data, including socio-demographic information, vulnerable population distribution, and historical disaster records, has been utilized for preparedness planning and vulnerability-based response frameworks. However, such data is limited in its ability to support real-time situational awareness. In contrast, dynamic data collected in real time through IoT sensors, CCTV, satellites, and social media is now widely integrated into disaster management frameworks, supported by cloud infrastructure and high-speed communication networks. This dynamic data plays a critical role in detecting early signs of disasters and monitoring evolving situations in real time, thereby minimizing damage (Zlatanova et al., 2009).

Furthermore, AI-based disaster management systems can simultaneously process diverse streams of unstructured data, including text, audio, and imagery, supporting every phase of disaster management, from damage prediction and situational recognition to resource allocation and recovery planning (Velev & Zlateva, 2023). These systems can also detect complex or cascading hazards that may elude human recognition, thereby helping prevent compound disasters and secondary impacts.

2 Real-Time Sharing and Dissemination of Disaster Information

During disasters, decision-makers must act swiftly despite incomplete data and reporting delays. Science and technology enable the rapid acquisition and analysis of field data, filtering out distorted information and helping decision-makers access meaningful insights quickly (Stieglitz, Mirbabaie & Fromm, 2017).

As disasters become more complex and fluid, real-time situational awareness is essential for an effective response. All stakeholders involved-from response agencies to affected communities and at risk individuals -must understand the risk levels to coordinate their actions effectively.

It is essential that all parties involved in disaster response, including responsible authorities, stakeholders, and at-risk populations, recognize potential hazards and prepare accordingly. This collective understanding forms a crucial foundation for minimizing damage. A disaster situation room, equipped with real-time monitoring and information dissemination systems, acts as a central hub for sharing situational data and communicating decisions based on that information. Korea's National Disaster and Safety Status Control Center (Case 2.1) exemplifies this effective approach.

Given the growing scale of recent disasters, the rapid dissemination of evacuation-related information to residents has become even more important. Community-generated reports via social media help share real-time site conditions, while disaster text alerts enable authorities to communicate risks quickly and reduce potential casualties.

3 Field-Centered, Effective, and Coordinated Disaster Response

Field response demands that personnel make informed, rational decisions as situations evolve, ensuring that resources and personnel are deployed to the right locations at the optimal time. Multiple agencies, including fire, police, and medical services, operate in synchronization, requiring continuous communication with decision-makers to ensure effective resource allocation.

In this process, automated systems and platforms, along with GIS-based visualization tools and dashboards, support data-driven decision-making by consolidating relevant information into accessible and easily understandable formats. In addition, advances in shared platforms and communication network technologies used by multiple agencies, such as disaster and safety communication networks, enable seamless communication even in time-critical situations, thereby supporting the consistent operation of unified command and control structures.

Digital devices have also become essential tools for the public to access risk information and request rescue. AI-powered mobile platforms are increasingly being applied to emergency medical services, for example, Korea's 119 Emergency Smart System (Case 2.7), which supports hospital selection and patient routing.

In the recovery phase, technologies such as drones and thermal-imaging cameras enhance search and rescue operations, while 3D printing is used for temporary housing and infrastructure. The Korea Disaster Resource Management System (Case 2.8) demonstrates how a platform-based approach can increase efficiency by enabling the shared use and real-time tracking of disaster resources across agencies.

4 Whole-of-Society Disaster Management Capacity through Public Participation

Citizen science refers to voluntary public participation in scientific activities, such as data collection, analysis, and hypothesis testing, which contribute to problem-solving and knowledge creation through collaboration between experts and the public (Pettibone et al., 2017; Bonney et al., 2009). Among various fields, disaster management particularly benefits from citizen science because it empowers the public to utilize science and technology for self-protection, leading to highly tangible impacts.

Residents can easily access disaster-risk information through digital platforms such as the National Disaster and Safety Portal (Case 3.2) or emergency text alerts (Case 1.3). Public participation via digital devices, such as submitting hazard reports through the Safety e-Report (Case 3.1), provides authorities with early warnings of local risks that might otherwise go unnoticed. Citizens not only report hazards but also sometimes propose highly practical alternatives, demonstrating how digital participation improves the effectiveness of disaster management.

The advancement of digital technologies enables the public to go beyond passive consumption of risk information, taking on more active roles as producers and disseminators. This shift facilitates a participatory, two-way disaster management framework that moves beyond the traditional government-centric approach, cultivating a more informed and safety-conscious public.

Figure 1.1.2 Importance of ST-based Disaster Management

1 Data-Driven Disaster Risk Analysis and Forecasting

Advanced data collection and processing technologies, combined with artificial intelligence (AI), enable the early detection of hazard signals and enhance disaster risk analysis and forecasting capabilities.

2 Real-Time Sharing and Dissemination of Disaster Information

Real-time collection, analysis, and dissemination of disaster information support timely decision-making and help prevent or reduce disaster related losses.

3 Field-Centered, Effective, and Coordinated Disaster Response

Communication networks and digital platforms enable coordinated decision making and unified response across agencies, even in rapidly evolving disaster situations.

4 Whole of Society Disaster Management Capacity through Public Participation

Access to essential disaster information empowers citizens to actively participate in disaster management and strengthens whole of society resilience.

2

Objectives and Structure of the Compendium

Objectives of the Compendium: Contributing to the Global Expansion of ST-based Disaster Management

Korea has advanced from e-government to digital government and is now moving toward AI-enabled government, achieving notable success in IT-driven administrative innovation. Building on this foundation, Korea has emerged as a global leader in implementing ST-based disaster management. This compendium aims to share Korea's major achievements in this field, both to reflect on progress made to date and to provide practical insights for those seeking to adopt similar approaches.

The objectives of this work are twofold.
First, it provides a comprehensive review and systematic documentation of policy achievements. This volume organizes and presents the transition and key examples of ST-based disaster management pursued by Korea, sharing its successes, limitations, and future challenges with a broad audience, including the public, academia, and officials. While the digital transformation of disaster management has consistently been a top policy priority, systematic documentation and review have remained limited. Consequently, this compendium serves as both a policy reference and a collection of case studies that systematize Korea's efforts, providing a foundation for informed discussion and future policy improvement.

Second, the document aims to contribute to the international community by sharing Korea's experience with countries seeking to benchmark and adopt similar frameworks. It is designed to support countries, international organizations, and donor governments by offering practical insights to inform policy formulation and project design. In particular, the compendium presents 24 cases in which science and technology have been successfully applied, documented directly by the practitioners responsible for implementation. These accounts detail not only the key outcomes but also the real-world challenges and how they were addressed.

Additionally, the compendium analyzes the implementation processes and key success factors underlying Korea's technology-driven approach. Given the scarcity of systematic documentation and analysis of real-world practices, this compendium is expected to serve as valuable reference for advancing disaster risk management policies globally.

Overview of the Cases Included in the Compendium

This volume highlights 24 cases of Korea's ST-based disaster management, organized across four thematic pillars. Each entry details the background of technology adoption, implementation strategies, field effectiveness, and future development plans-illustrating the deep integration of digital transformation into national disaster management.

1 Real-Time Risk Monitoring and Rapid Dissemination

8 cases

The initial theme focuses on the early detection of hazards, such as floods, landslides, and crowd-safety incidents using real-time data collected from sensors, satellites, CCTV, and AI. These examples highlight systems designed to deliver timely, tailored alerts to the public. The selected cases illustrate how 5G networks, smartphone applications, and digital warning systems ensure risk information is disseminated without gaps, specifically addressing the needs of foreign residents and vulnerable groups.

2 Integrated Disaster Management based on Smart Technologies

8 cases

This category examines the role of smart technologies in enhancing information sharing, decision-making, and field response during time-critical events. As disasters grow in scale and complexity, the need for accurate prediction, data-driven decisions, and cross-agency collaboration becomes paramount. By leveraging AI, IoT, big data, communication networks, cloud platforms, and integrated systems, Korea has transitioned toward a smart disaster response framework that is significantly faster, more coordinated, and more proactive.

3 Building Safer Communities through Digital Participation

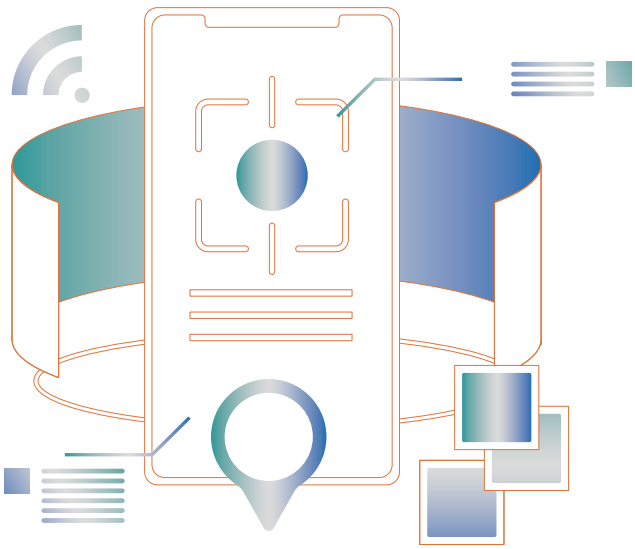
4 cases

Beyond government-led initiatives, ST-based disaster management in Korea has evolved to prioritize citizen and community engagement. This area showcases how residents utilize digital platforms to access safety knowledge and submit direct hazard reports. Such participation enables communities to identify and resolve risks early and foster stronger localized resilience.

4 Systems and Global Expansion of ST-based Disaster Management

4 cases

The final section illustrates the institutional and technical foundations that sustained Korea's ST-based policies and industries. It encompasses data-driven policy frameworks, disaster safety R&D, and certification systems. Additionally, it highlights the digital-based risk monitoring and management and Official Development Assistance (ODA) initiatives that support developing countries, particularly through the expansion of early warning systems.



Building a Safer Society
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Chapter 2

Case Studies of ST-Based Disaster Management by Pillar

Chapter 2

Pillar 1

Real-time Risk Monitoring and Rapid Dissemination

1.1 AI-Powered Detection of Key Safety Risks
1.2 Preventing Crowd Incidents in Advance through Big Data
1.3 Emergency Text Alerts: Advanced Cell Broadcasting Service (CBS)
1.4 Severe Weather Alerts One Step Ahead
1.5 Disaster Alerts without Language Barriers for Foreigners
1.6 Integrating Legacy Disaster Warning Systems into a Unified Digital Platform
1.7 Predicting Landslide Risks 48 Hours in Advance
1.8 AI-Enabled Early Flood Forecasting and Warning

1.1 AI-Powered Detection of Key Safety Risks

(AI-based CCTV Monitoring System)

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Background and Development

CCTV systems operated by local governments are widely used not only for public safety and traffic management but also for disaster monitoring. However, when a single monitoring officer supervises hundreds of CCTV feeds, even experienced staff may miss critical risk situations. To overcome these limitations and ensure comprehensive monitoring of risk factors, AI-based CCTV systems, which automatically detect hazards such as flames or smoke and trigger alarms, have emerged as a key solution.

In April 2023, the government included support measures for converting local governments' CCTV systems to AI-based monitoring in the Comprehensive National Safety System Reform Plan. In July 2024, the Digital Platform Government Committee adopted the 「Plan for Establishing AI-based CCTV Monitoring Systems for Local Governments」 as a flagship national AI project. To implement these initiatives, the Ministry of the Interior and Safety (MOIS) has been promoting legislative and institutional improvements, including amendments to the Disaster and Safety Management Act and related subordinate regulations, the introduction of new guidelines and manuals to strengthen standardized monitoring capacities, and a project to support the establishment of AI-based monitoring systems for local governments by 2027.

Key Features

Establishing a System and Data Management Framework for AI Learning Based on Real Video Footage

High-quality training data from real disaster situations is essential for advancing AI-based CCTV monitoring. However, due to legal restrictions, it has been difficult to secure sufficient datasets. The AI training data previously provided by the government consisted mainly of staged videos rather than actual disaster footage. Moreover, in the absence of a legal basis, central and local governments could not respond to private companies' requests for video footage of real disasters.

To address these challenges, in December 2024, MOIS amended the Framework Act on Disaster and Safety Management to provide a legal basis for utilizing CCTV footage originally installed for other purposes, such as traffic management and, crime prevention, in disaster management. It also facilitated the establishment and operation of integrated

monitoring centers and the application of AI technology. In March 2025, subordinate regulations were revised to, enable the systematic collection and use of raw video footage from local governments during disaster situations.

MOIS is currently developing a real-video-based training data management system that systematically collects, refines, and anonymizes CCTV footage to ensure the ethical use of AI. Four pilot municipalities have been selected for IT infrastructure support to collect diverse disaster event footage, with the plan to expand to 45 municipalities by 2027. To further enhance accessibility, the ministry will link this dataset with open government data platforms such as AI-Hub and the Public Data Portal in close collaboration with relevant agencies.

Supporting Local Governments' Capacity for AI-based CCTV Monitoring

Local governments are currently utilizing AI-enabled CCTV systems that can detect six types of risks: loitering, collapse, violence, crowd density, heavy rainfall, and urban fires. However, the consistency of performance varies across companies due to varying standards and levels of technology. Additionally, AI-based detection technologies for risks such as sinkholes, extreme crowding, and wildfires are still in the early stages of development.

To address these issues, the government is focusing on standardizing AI CCTV technologies and speeding up the development of delayed technology. Between August 2023 and December 2024, MOIS and the National Research Foundation of Korea studied the standardization of basic detection models for six identified risk types. This included, tested the models through pilot projects in Cheongju (Chungbuk Province) and Dongnae District (Busan Metropolitan City), with plans for nationwide expansion.

In parallel, diverse pilot projects are being implemented to enhance disaster detection capacity using different various AI CCTV models: vehicle-mounted AI CCTVs for detecting illegal parking and fires in Seodaemun District (Seoul); multimodal[1)] AI systems for identifying crowd congestion, crime, and fires in Gwangjin District (Seoul); generative AI for creating flood and fire datasets in Paju City (Gyeonggi Province); and wildfire detection and prediction Gunwi County (Daegu Metropolitan City).

Expanding Local Governments' AI CCTV Infrastructure

In 2024, MOIS supported the replacement of 6,106 outdated, low-resolution (under 2 megapixels) CCTV units nationwide. In 2025, approximately 2,400 new CCTVs were installed across 893 blind spots posing risks to threatening residents' safety, such as parks and walking trails. Moving forward, MOIS will continue to expand infrastructure and provide both administrative and financial support for local governments' AI CCTV operations.

1) Multimodal AI technology combines text, images, video, and other data types to learn and process their interrelationships.

Key Achievements

Establishing a Legal Basis for AI CCTV Utilization

Local governments' integrated CCTV control centers had previously been operated under local ordinances rather than national legislation. To address this gap, the government established a legal framework for their installation and operation and enabled CCTV footage to be used and shared for disaster and safety management. The revised framework also provided clear legal and institutional grounds for using artificial intelligence to analyze video data.

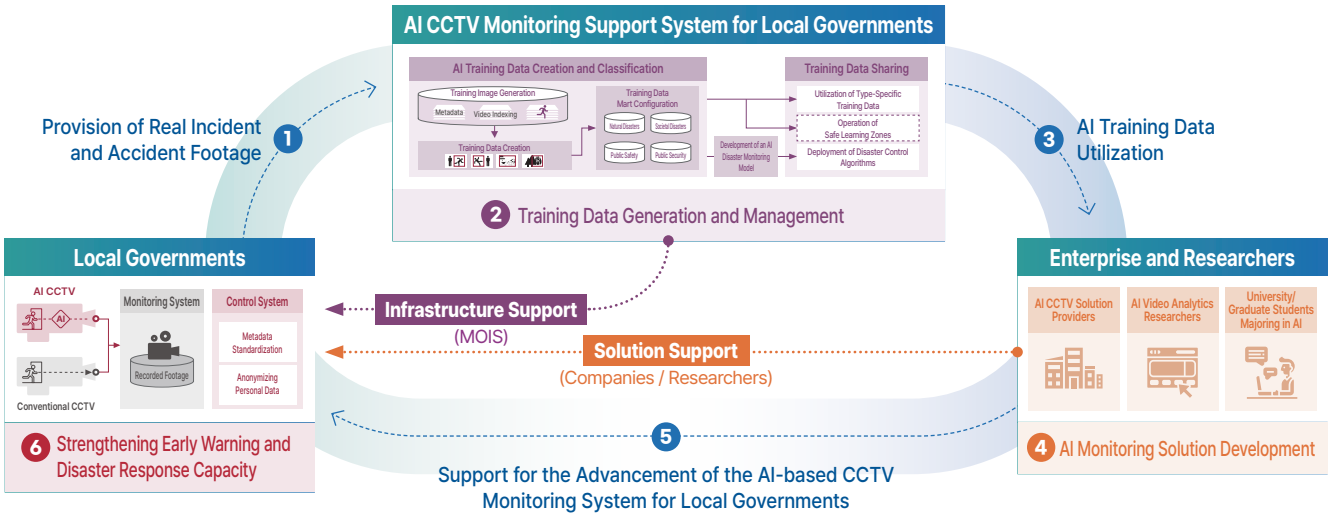
Enabling the Use of Disaster Safety Data

Recent institutional improvements have facilitated the sharing and utilization of disaster safety data, which were previously limited by legal, technical, and cultural barriers. These changes enable the sharing of video data not only within organizations but also across agencies, such as from CCTV control centers to disaster and safety situation rooms, as well as among multiple situation rooms. Relevant datasets can be shared between the government and the private sector for training AI. This increased openness in data sharing promotes better integration of data across government agencies and between the public and private sectors, which is expected to further enhance South Korea's disaster prediction capabilities.

Future Directions

The AI-based CCTV monitoring system project is expected to create a virtuous cycle that strengthens public safety while fostering the development of related industries and technologies. MOIS plays a central role in overseeing the system: local governments generate real-video-based training data through their CCTV operations; companies develop AI technologies tailored to field and municipal needs; and local governments apply AI to enhance disaster prediction and response, thereby strengthening everyday safety for residents. Positioned at the heart of this ecosystem, MOIS will continue to incorporate feedback from local governments, companies, and field actors into policy and institutional improvements to ensure the system functions smoothly.

Figure 2.1.1 Expected Outcomes of AI CCTV Monitoring System



1.2 Preventing Crowd Incidents in Advance through Big Data

(Data-driven Crowd Alert System)

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Background and Development

Crowd incidents at sports stadiums, festivals, and religious gatherings around the world typically occur when the density of people exceeds a critical threshold. Such incidents are preventable if crowd congestion is monitored in advance and timely warnings are delivered to the public. For this reason, real-time monitoring is especially crucial in crowd-related disasters.

Although Korea had not experienced a major crowd crush incident before, the Itaewon tragedy in October 2022 underscored the urgent need to strengthen monitoring and predictive capabilities for crowd congestion. In response, the government introduced legal and institutional reforms and launched the ICT-based Crowd Alert System in late 2023, which analyzes crowd density in real time and provides early warnings to prevent crowd-related accidents.

Major Milestones

2023 – August
- Legal and regulatory framework established, allowing the system to access and use data from mobile network base stations through a law revision and the issuance of a government notification

December
- The system officially launched in 100 designated high-risk locations across the country

2024 – May
- Risk-level categories revised for clarity, changing from "Normal–Attention–Caution–Alert–Severe" to "Spacious–Normal–Slightly Crowded–Crowded–Highly Crowded"
- Recipients of alerts were expanded to enhance local accountability, now including deputy mayors, senior officials, and relevant departments within MOIS

Key Features

The system automatically monitors crowd density using diverse data sources and issues alerts to local governments when thresholds are exceeded.

Crowd Density Monitoring Using Mobile Network Data

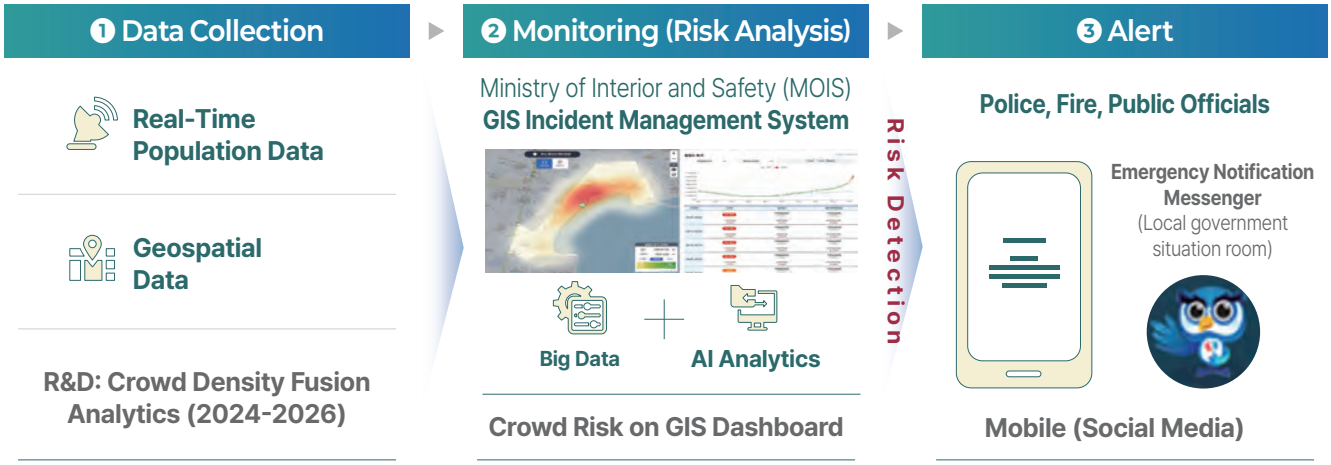
Population mobility data* provided by mobile network operators and public transportation usage data, such as subway and bus ridership, are used as key datasets for monitoring crowd density. In addition, telecommunications and spatial data are utilized to collect and analyze crowd-congestion risks within designated management areas. The results are visualized as heat maps on a GIS dashboard, allowing authorities to monitor crowd conditions in real time.

* Population mobility data are collected and analyzed every five minutes from mobile network operators (SKT and KT) at a spatial resolution of 50x50m grid cells.

Advance Alerts Indicating Crowd Congestion Levels

Congestion levels are classified into five stages: Spacious, Normal, Slightly Crowded, Crowded, and Highly Crowded. When the level reaches “Slightly Crowded” (Stage 3 of 5) or higher, automated alerts are sent via situation reports to local governments and mobile messages to users. Local governments then verify the situation using CCTV footage and coordinate with the police and fire departments if needed.

Figure 2.1.2 Operational Process of the Crowd Alert System



Key Achievements

Crowd congestion incidents are most likely to occur in urban areas or during large festivals and events. However, due to limited administrative resources, monitoring all potentially vulnerable locations was not feasible. To adopt a more focused strategy, the government conducted a nationwide survey of local governments to identify areas at risk for crowd congestion. Based on these regional risk assessments, a selection committee designated 100 crowd management areas across the country. Additionally, five rounds of training were conducted for local government officials responsible for operating the system, with a total of 500 participants trained.

Since the system's official launch of the service, 161 crowd density alerts at Level 3 (Slightly Crowded) Crowded or higher have been issued (66 in 2024 and 106 in 2025). All incidents were managed according to established response procedures, and no accidents, even minor ones, occurred. These outcomes demonstrate that the policies and initiatives implemented so far, including the development of the crowd management system, the establishment of a data utilization framework, and user training for practical application, are functioning effectively.

Future Directions

Currently, the crowd management support system helps authorities quickly grasp on-site conditions by issuing crowd congestion alerts for areas that may otherwise fall outside routine monitoring. However, the system relies on a single data source, telecom data, which still faces technical limitations in integrating and utilizing a wider range of real-time field data.

To overcome these limitations these limitations, efforts are needed to connect multiple data collection methods, such as CCTV, Wi-Fi, IoT devices, and drones. Additionally, integrating AI-based data analysis and predictive technologies is essential. These improvements will lead to the development of customized management systems that are specific to municipalities taking into account local conditions and characteristics.

1.3 Emergency Text Alerts: Advanced Cell Broadcasting System

(Advanced Cell Broadcasting Service (CBS)

Responsible Department | MOIS, Disaster Information and Communication Division
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Background and Development

The Disaster Text Message Broadcasting Service, also known as the Cell Broadcasting Service (CBS), was introduced in May 2005 to provide rapid alerts through mobile phones. Traditional communication channels such as television, radio, and electronic billboards have limitations in terms of coverage, making mobile phones the most effective tool for reaching large numbers of people quickly. With the spread of smartphones and advancements in telecommunications, CBS has developed into Korea's most critical alert system, addressing not just natural disasters but also societal incidents, civil emergencies, and missing person cases.

Since its introduction, the government has continuously improved the system's functionality. Improvements have included refining the broadcast coverage to township level (eup/myeon/dong), and expanding the allowed message lengths for more detailed information, and establishing dedicated systems tailored to different types of disasters. These upgrades have allowed for faster, more accurate, and situation-specific alerts.

Key Features

CBS Disseminates Emergency Alert Messages through the Following Process:

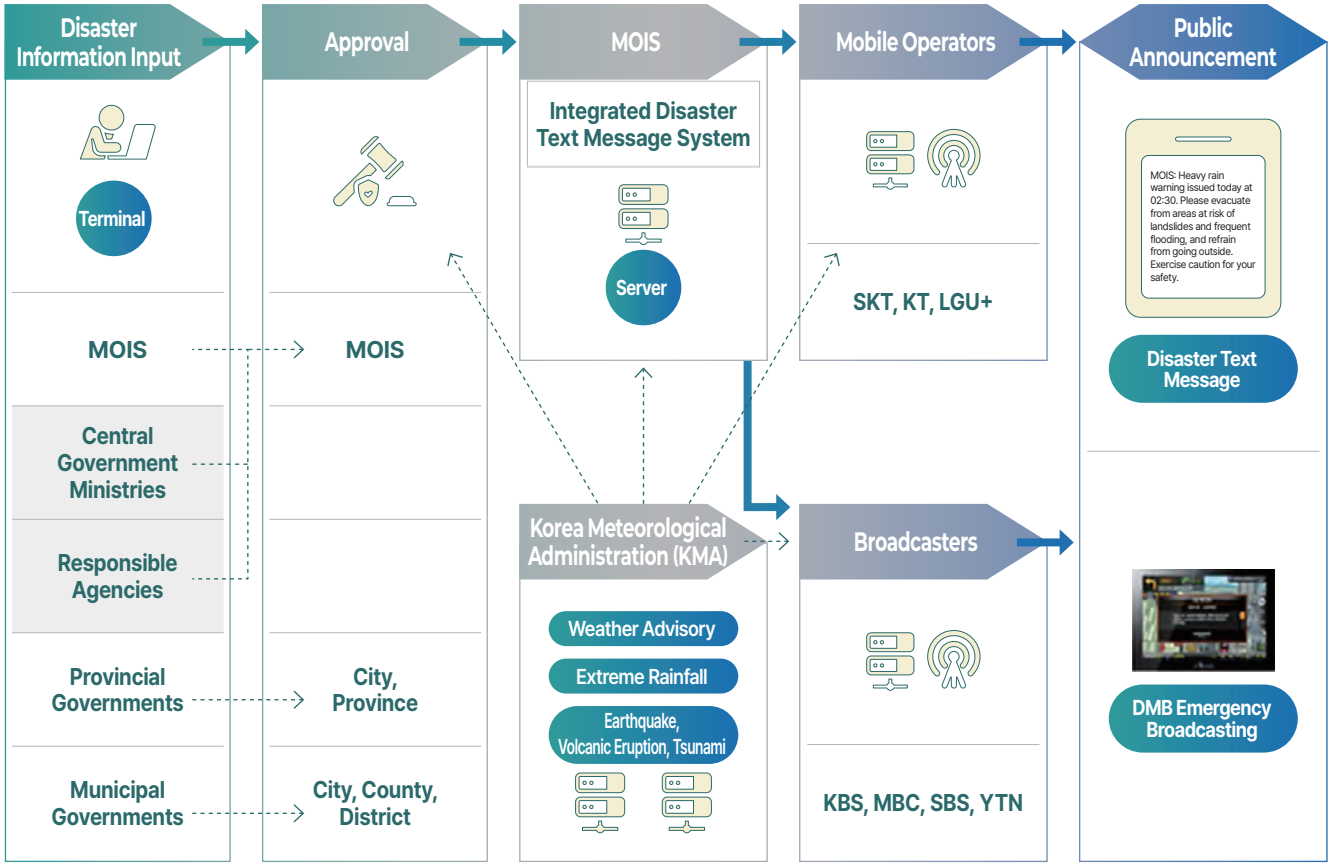


Disaster management agencies (e.g., local governments, the National Police Agency, KMA) assess the disaster situation and draft the alert message.

A request to transmit the message is submitted to MOIS or the relevant local governments with authorized broadcasting authority.

The alert is broadcast to residents in the affected area through mobile base stations operated by the three major telecommunication providers (KT, SKT, and LGU+).

Figure 2.1.3 Transmission Flow of the Cell Broadcasting System (CBS)



CBS is operated Paragraph2, under Article 38 of the Framework Act on Disaster and Safety Management, and its operational standards and policies are managed by an operational coordination committee. Previously, all CBS messages were transmitted through a single system. Today, however, systems are operated separately by responsible agencies according to disaster type, including MOIS, the National Police Agency, and the Korea Meteorological Administration.

Table 2.1.1 Emergency Text Alert Systems by Disaster Type

Type of Text Alert	Responsible Agency	System
Disaster Alerts	MOIS	Integrated Text Alert System
Civil Defense Alerts		
Missing Person Alerts	Korea Police Agency	Missing Person Alert Transmission System
Severe Weather Alerts (Heavy Rain, Heavy Snow)	Korea Meteorological Agency	Weather Emergency Alert System
Earthquake & Tsunami Alerts		Earthquake & Tsunami Alert System

Key Achievements

Rapid, Field-oriented Response

In 2024, a total of 19,050 disaster messages were issued, with 68% transmitted directly by municipal and county governments (si/gun/gu). This indicates that a locally responsive warning system has become well-established. By type, natural disasters accounted for approximately 63% of all alerts, while other incidents made up about 37%. Notably, alerts regarding seasonal hazards such as heatwaves, heavy rains, snowstorms, landslides, and missing-person cases were issued frequently.

The CBS system has shown remarkable responsiveness. For example, during the 2017 Pohang earthquake, disaster alerts were sent out only 23 seconds after the earthquake struck, which is an exceptionally fast response time by global standards, considering the unpredictable nature of earthquakes.

Table 2.1.2 Disaster Alert Message Broadcasting Statistics (2024)

(Unit: cases, %)

No. of Broadcasts	Disaster Type		Issuing Authority		
	Natural Disasters	Societal Disasters and Others	Central Government	Metropolitan/ Provincial Governments	Municipal Governments
19,050	11,916(62.6%)	7,134(37.4%)	4,286(22.5%)	1,895(9.9%)	12,869(67.6%)

Disaster Alert Message Broadcasting by Type							
Category	Total	Heatwave	Heavy Rain, Typhoon, and Flood	Missing Person	Water-Related Incident	Heavy Snow	Land Slide
No. of Broadcasts	**19,050**	4,950	3,330	3,109	2,088	1,286	648
Proportion(%)	**100.0%**	26.0%	17.50%	16.30%	11.00%	6.80%	3.40%
Dam Discharge	Cold Wave	Fire	Civil Defense	Strong Wind	Traffic	Wildfire	Others
528	507	399	279	228	233	174	1,291
2.8%	2.7%	2.1%	1.50%	1.20%	1.20%	0.90%	6.80%

※ Source: MOIS

Recipient-centered Service Improvement

To date, the government has continuously implemented measures to reduce public inconvenience and improve access to information:

- **December 2023**
  The coverage areas were refined from the existing 243 city, county, and district levels to approximately 3,600 township units, enabling the precise transmission of alerts focused on areas where actual risks occur.
- **Since May 2021**
  The Emergency Ready App has provided alerts in five languages. Starting in February 2024, key information such as disaster type and earthquake magnitude has been available in English, even without installing the app.
- **From late 2025**
  From later 2025, the character limit will expand from 90 to 157, allowing more practical safety guidance.

Table 2.1.3 Comparison of Disaster Alert Message: Then and Now

Category	2005	2026
Sending Agency	MOIS (central government only)	MOIS, local governments, Police, KMA
Coverage Area	226 municipalities (si/gun/gu units)	3,600 townships (eup/myeon/dong units, implemented in Dec. 2023)
Language	Korean only	Up to 5 languages via Emergency Ready App (since May 2021)
Message Length	90 characters	157 characters

Future Directions

The government plans to improve the CBS quality of the system further to meet public needs. To address the inconvenience experienced by residents who receive disaster alerts for neighboring areas, geo-fencing technology is being developed to enable more precise targeting of alert recipients.

In addition, plans are in place to further enhance information accessibility through expanded multilingual support and the application of introducing intuitive alert symbols, ensuring that foreign nationals are not excluded from warnings. These measures aim to make CBS the most effective and reliable disaster information channel for everyone in Korea, including foreign nationals and vulnerable populations.

1.4 Severe Weather Alerts One Step Ahead

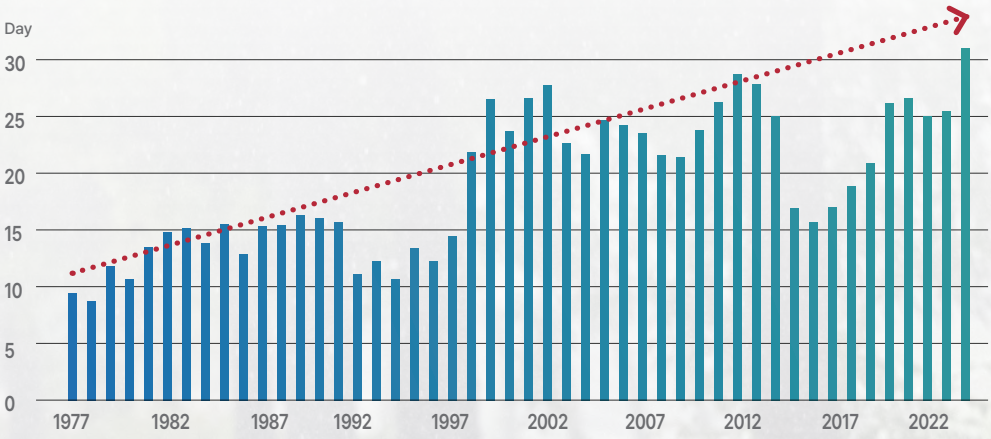
(Emergency Heavy Rain Alerts by the Korea Meteorological Administration)

Responsible Department | Korea Meteorological Administration, Forecast Policy Division
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Background and Development

In Korea, the number of days with extremely heavy rains exceeding 50㎜ per hour has doubled over the past 50 years. Between 1973 and 1982, such events occurred an average of 12 days per year, while in the past decade (2015–2024), the figure rose to 26 days annually. As global warming intensifies, atmospheric water vapor is expected to increase, leading to more frequent and intense rainfall.

Figure 2.1.4 Number of Days with Hourly Rainfall Exceeding 50㎜ (1973–2024)



※ Source: KMA

In the past, the Korea Meteorological Administration (KMA) only provided weather information to enable central and local governments to issue disaster alerts. However, in response to more frequent extreme rainfall, the KMA introduced a new system that would directly send emergency alerts to the public, warning them of dangers more quickly.

The KMA successfully implemented a system for directly sending emergency alerts for heavy rain in the Seoul metropolitan area in 2023, and to Gyeongbuk and Jeonnam provinces in 2024, and began scaling up nationwide in 2025.

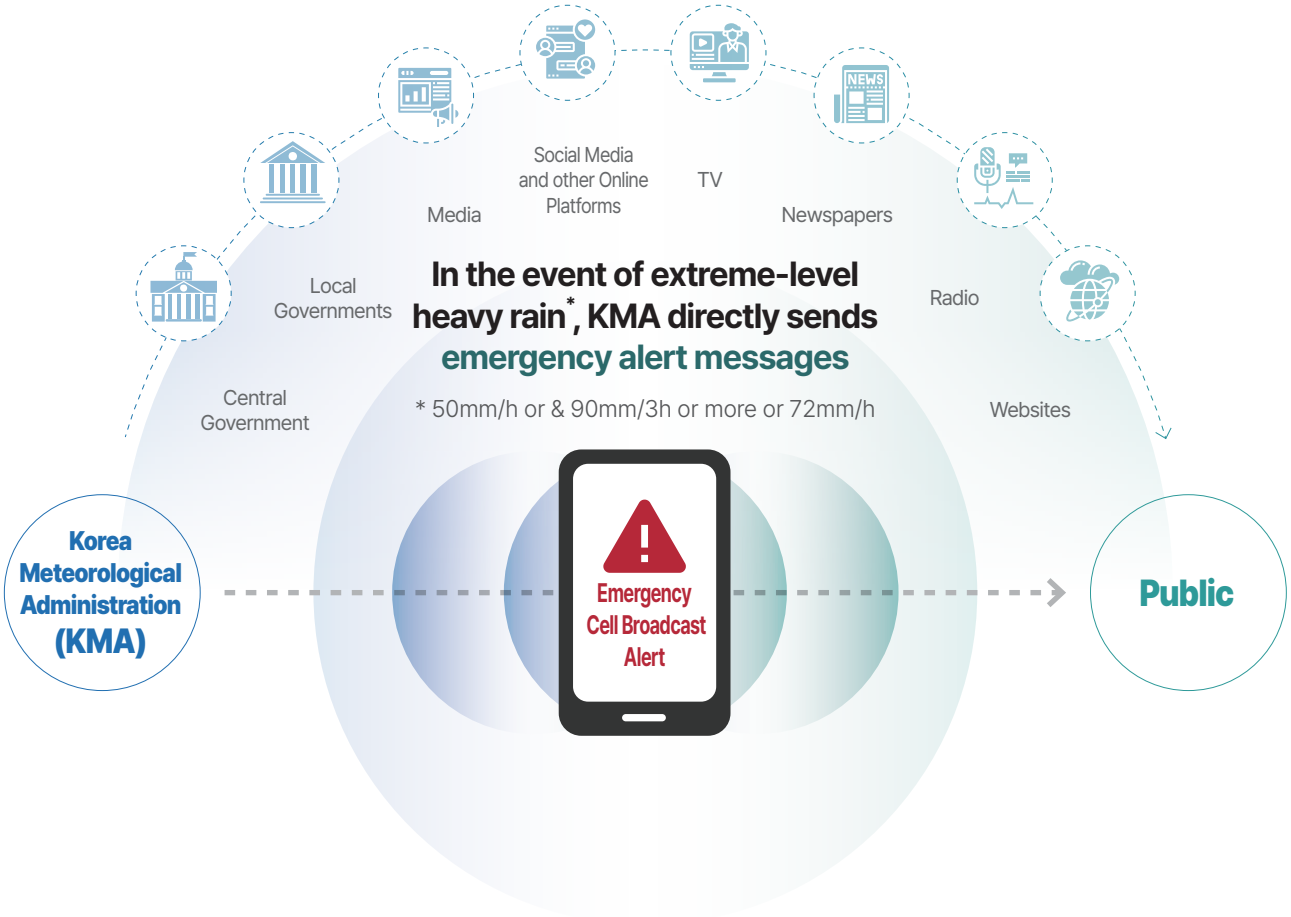
Key Features

The KMA Heavy Rain Emergency Alert Message System is a service provided by the KMA, which is best equipped to detect hazardous weather conditions. This system enables the KMA to send emergency text messages to residents in areas experiencing heavy rain that exceeds specific thresholds.

The KMA sends out heavy rain emergency alerts when one of the following conditions is met: the cumulative rainfall in one hour reaches 50㎜ or more, the cumulative rainfall reaches 90㎜, or more, or very heavy rain is observed with a one-hour cumulative rainfall of 72㎜. These alerts are delivered with a warning sound of at least 40㏈ or higher and a vibration signal ensuring immediate attention.

One of the key benefits of this system is that alerts are tailored to specific regions, allowing for targeted warnings at the eup, myeon and dong levels where heavy rain is occurring.

Figure 2.1.5 KMA Heavy Rain Emergency Alert Message System



Key Achievements

The KMA's heavy rain emergency alert messages enabled the KMA, with its unmatched speed in accessing hazardous weather information, to notify residents directly without going through central and local governments, maximizing the speed and effectiveness of disaster alerts. Time that would otherwise have been spent on inter-agency communication and coordination was redirected to what mattered most: giving residents time to prepare and evacuate.

Heavy rain emergency alerts were issued six times in the Seoul metropolitan area in 2013. 129 times across the metropolitan, Gyeongbuk, and Jeonnam provinces in 2024, and 271 times nationwide in 2025. The system has been widely credited with significantly reducing casualties. In the Seoul metropolitan area, where the system operated in both 2023 and 2024, not a single casualty was reported. In Gyeongbuk and Jeonnam provinces, which came under the system in 2024, only one casualty was recorded.

Residents also reported positive outcomes: A resident in Andong, Gyeongbuk Province shared, "I live at the foot of a mountain and was asleep, unaware that it was raining heavily at dawn. But after receiving the heavy rain emergency alert, I woke up and evacuated with my neighbor, a hearing-impaired elderly woman living alone." In Pyeongtaek, Gyeonggi Province, an elementary school principal stated, "I received the heavy rain emergency alert while on my way to work and the school's start time to ensure student's safety."

Future Directions

After successfully implementing heavy rain emergency alert messages, the KMA plans to gradually expand the system to include heavy snow events through various policy studies. Additionally, the KMA aims to improve weather forecasting by expanding its weather observation network.

This will enhance the emergency alert system, allowing for region-specific alerts that consider differences in regional rainfall patterns and local disaster capabilities.



1.5 Disaster Alerts without Language Barriers for Foreigners

(Safety Stepping Stone & Emergency Ready App)

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Background and Development

With a smartphone penetration rate exceeding 95%, the Republic of Korea is one of the most connected countries in the world. In this context, the Safety Stepping Stone app was launched in 2013, enabling users to quickly access disaster and safety information anytime and anywhere through their smartphones. The app provides effective guidance on how to respond to disasters by following official safety guidelines.

Since its launch, the app has undergone continuous upgrades to facilitate communication and ensure that disaster information to vulnerable groups, including foreigners, the visually impaired, and the hearing impaired. Additionally, foreign residents and visitors in Korea can access disaster and safety information in five languages: English, Chinese, Japanese, Thai, and Vietnamese through the Emergency Ready App.

Figure 2.1.6 Safety Stepping Stone App: Promotional Materials for Foreigners



Key Features

No One Left Behind in Emergency Alerts

The Safety Stepping Stone app enables users on older smartphones, which may not receive disaster alerts, to obtain notifications about disaster events specific to their location. Users can also register up to ten additional "areas of interest", such as the residence of parents or children, to receive disaster alerts for those locations. The foreign-language disaster alert service is available in five languages: English, Chinese, Vietnamese, Thai, and Japanese. For persons with disabilities, the app offers a Text-to-Speech (TTS) function that converts disaster alerts into speech.

Disaster and Safety Information for Preparedness and Response

The app provides information on risk factors specific to certain regions. For example, citizens can access continuously updated information and historical records regarding disasters that have occurred in their place of residence or areas of interest, such as landslide risk, river rainfall data, and information on potential disasters in areas of interest to prepare in advance for specific disasters.

It also provides practical information to protect lives and property during disasters. To ensure citizens can remain calm, prepare, and take necessary actions when facing specific disasters, the service provides essential information, including public safety guidelines for each disaster type-earthquakes, typhoons, heavy rain, heavy snow, cold waves, and heatwaves-along with the locations of necessary facilities, such as civil defense shelters, tsunami evacuation sites, and heatwave or cold wave shelters.

Key Achievements

The Most Reliable Early Warning System in the Mobile Era

As most people carry smartphones at all times, acquiring and disseminating risk information via mobile devices has become the most effective means of early warning. Since its launch in 2013, the Safety Stepping Stone app has been downloaded more than 5.2 million times as of 2024. Its excellence has been recognized through multiple national and international awards including: the Grand Prize at the Outstanding Public Mobile App (Korea, 2014), First Prize at the Best mGov Award (United Arab Emirates, 2015), and the Grand Prize at App Award Korea (2017).

Inclusive Disaster Information Delivery

In many countries, disaster text alerts are only provided in the national language, leaving foreigners in a vulnerable position. By contrast, the Safety Stepping Stone app supports disaster alerts in five languages including English, and also provides a TTS function so that persons with hearing impairments can understand the content of alerts. This ensures that no one is left behind functioning as an "inclusive disaster information system" that makes disaster alerts accessible to all.

Future Directions

The Safety Stepping Stone app has been developed and operated to deliver critical disaster information to foreigners and others at risk of being left in an information blind spot. To further fulfill this mission, continuous improvements will be pursued.
First, the design of the app will be revamped to align with modern trends, making it more intuitive and user-friendly so that essential information can be quickly accessed even in emergencies. Second, reflecting the increase in foreign visitors and residents due to the spread of Korean culture, the current multilingual disaster alert service (five languages) will be expanded to cover 19 languages in the near future.

1.6 Integrating Legacy Disaster Warning Systems into a Unified Digital Platform

(Local Government Integrated Disaster Early Warning System)

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Background

Before disaster text alerts were introduced, local communities in Korea relied on various analog notification methods such as electronic display boards as well as speakers installed in villages and along rivers. Approximately 24,000 of these devices are still in use nationwide, providing risk information along rivers, roads, and coastlines. While these traditional systems remain valuable for many residents, their fragmented operation by individual municipalities and different media types has limited the speed and consistency of disaster risk messaging.

Table 2.1.4 Status of Local Government Disaster Warning Facilities (As of January 2025)

Type	Total	Automatic Voice Notification	Automatic Rainfall Warning	Disaster Text Display Boards
Facilities (units)	24,441	21,103	2,024	1,314

※ Source: MOIS

To address these limitations and improve the efficient use of existing alert and warning facilities, MOIS developed a Multi-Channel Multimedia Disaster Information Delivery Platform and carried out pilot projects, thereby promoting the digital integration of conventional warning systems.

Key Features

The state of early warning systems and their transformation through the integrated platform can be summarized as follows:

Before

Fragmented Operation of Individual Early Warning Systems

- Automatic Voice Notification System

  When disaster control room staff enters text messages, the system converts them into speech via Text-to-Speech (TTS) and broadcast through speakers.

Figure 2.1.7 Automated Voice Notification System (Amplifiers and Loudspeakers)

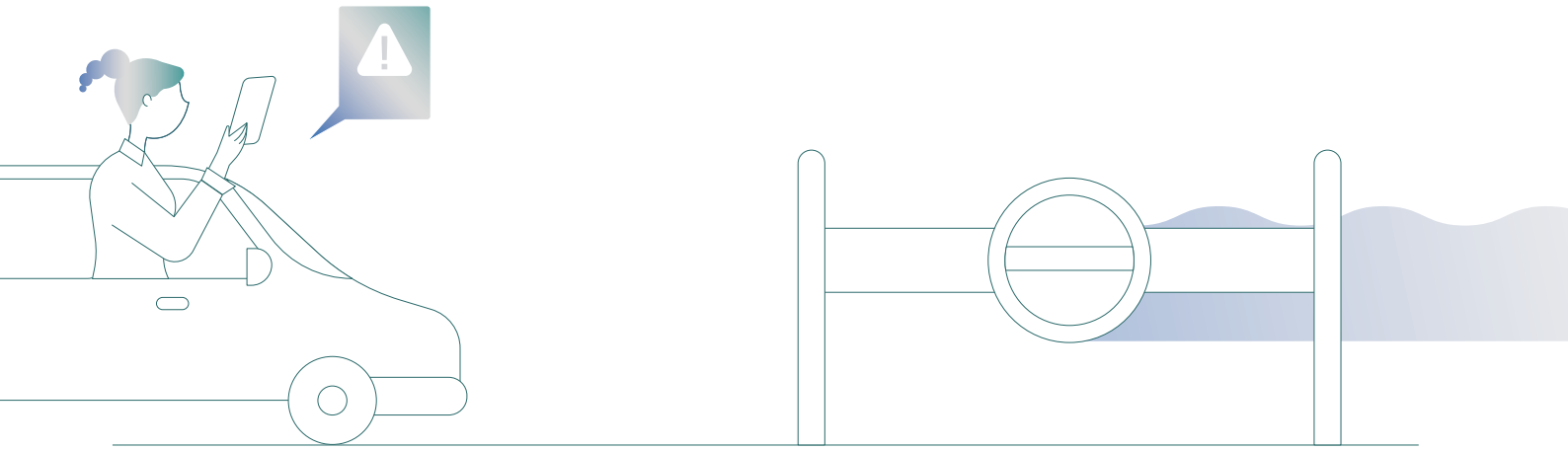


- Disaster Text Alerts Display Board System

  When information such as disaster situations or weather advisories is entered into the disaster situation room, it is displayed as text on electronic boards installed in the city.

Figure 2.1.8 Disaster Text Alerts Display Boards





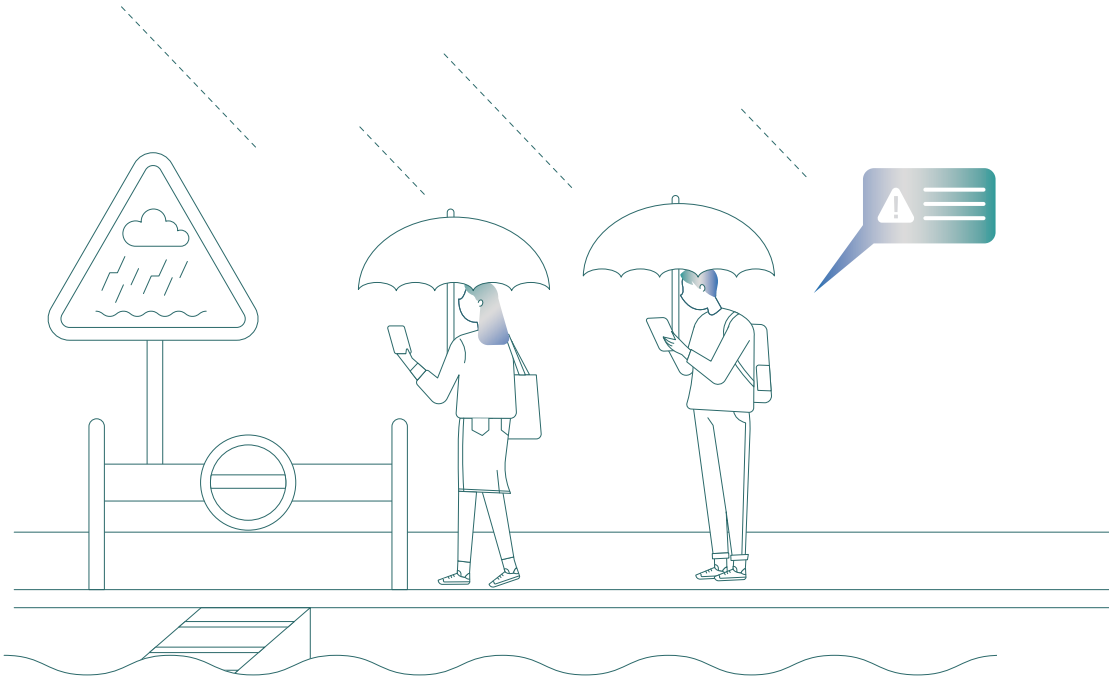
• Automated Rainfall & Water-Level Alert Flow

This system measures rainfall using rain gauges installed in upstream valleys and water level gauges on bridges. When predefined thresholds are reached, voice alerts are automatically transmitted through speakers (warning stations) located downstream along the river.

Figure 2.1.9 Configuration of the Automatic Rainfall Warning System

Rainfall in valleys and river water levels are measured and transmitted to monitoring and control equipment. The information is relayed through intermediary devices and finally broadcast as public warnings.





Improved

Integrated Multimedia Alerts and Municipality-Wide Simultaneous Broadcasting

The new Integrated Disaster Warning Platform streamlines the alerting process by eliminating the need to log into multiple systems or issue alerts separately. With a single login, authorities can send out alerts simultaneously across various media channels at the municipal level. The platform also enables linkage with additional media sources, such as Bus Information Systems (BIS) and traffic display boards. Furthermore, the authority for issuing early warning has been expanded from basic local governments to metropolitan governments, enabling provinces and major cities to provide unified risk information across wider areas.

Figure 2.1.10 Evolution of the Integrated Disaster Warning System



Key Achievements

Development and Validation of an Integrated Multimedia Platform

In collaboration with the Electronics and Telecommunications Research Institute (ETRI), MOIS developed a “Standard Platform for Integrated Multimedia Alerts” with an R&D investment of KRW 6 billion. Pilot projects were conducted in eight municipalities between 2022 and 2023, successfully integrating 10,368 devices across eight different media platforms. This new system allows public officials to access all systems through a single login, enabling them to transmit messages and broadcast alerts simultaneously across multiple channels without needing to log into each system separately.

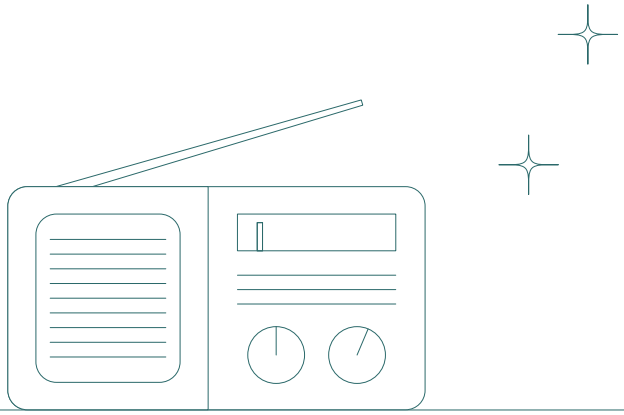
International Dissemination of Korean Disaster Safety Technology

ETRI, which developed the Integrated Disaster Warning Platform, signed a technology cooperation agreement on ICT-based disaster management with the National Emergency Management Agency (NEMA) of Mongolia in May 2024. In addition, technologies similar to the Automatic Rainfall Warning System have been implemented through Official Development Assistance (ODA) early warning projects in the Philippines (2007-2012, 2015-2017), Indonesia (2020-2023), and Mozambique (2021-2025).

Future Directions

This initiative demonstrates that digital transformation does not eliminate or discard existing technologies and equipment; rather, it enhances their effectiveness through integration and improvement. Following the successful pilot projects in eight municipalities, the program will be expanded nationwide with the aim of implementing the integrated platform across all local governments by 2029.

Additionally, a central-local integrated management system will be established so that not only municipal and provincial governments but also central authorities can operate and monitor local warning facilities, ensuring better-coordinated nationwide management of disaster alerts.



1.7 Predicting Landslide Risks 48 Hours in Advance

(Digital Slope-Integrated Landslide Information System)

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Background and Development

Korea's geographical and climatic conditions make the country highly vulnerable to landslides, especially during the summer monsoon season. In recent years, the frequency and severity of landslide damage have increased due to climate change and urbanization. To minimize loss of life, the Korea Forest Service (KFS) has continuously operated and improved landslide risk prediction and response systems.

The main challenge in predicting landslides is determining when, where, and at what scale they may occur. These systems have been steadily enhanced through technological advancements and accumulated case data.

In 2005, the Landslide Hazard Management System was developed. Following the devastating Umyeonsan landslide in Seoul in 2011, the system was upgraded into the Landslide Information System in 2013, which provided five-level hazard maps based on soil water index and logistic regression analysis.

In 2017, the concept of debris flow risk was introduced. By 2022, the Medium-range Landslide Forecasting System was launched, enabling forecasts up to 48 hours in advance. In 2024, the system evolved into the Digital Slope-integrated Landslide Information System which integrates slope data from multiple agencies. Through these improvements, Korea's landslide prediction capabilities have continued to enhance significantly.

Key Features

Feature 1

Korea Landslide Early Warning System (KLES)

The country is divided into 11 zones according to geological and rainfall characteristics. Using optimized parameters for each zone, KLES estimates soil water content (the proportion of moisture within soil) which is used to predict landslide risks.

Figure 2.1.11 Structure of the KLES Model and Zonal Classification

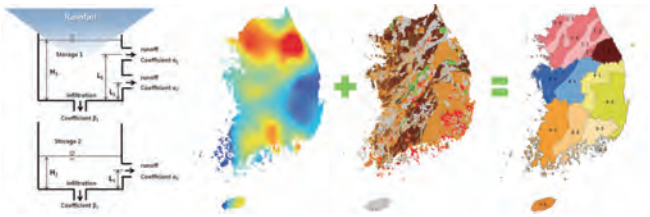
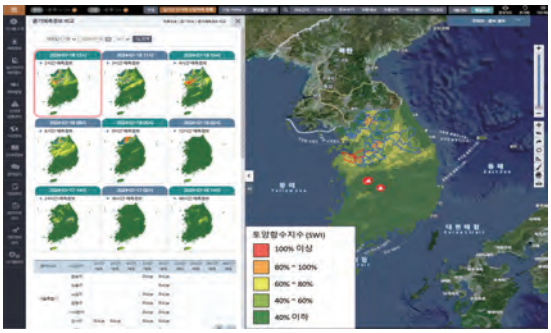


Figure 2.1.12 KLES in the Landslide Information System



KLES receives real-time and forecast rainfall data from the KMA, predicts soil water content over time. When predefined thresholds are exceeded, landslide alerts are issued in stages:

When soil water content exceeds 80% - Advisory

When it exceeds 90% - Preliminary Warning

When it reaches 100% - Warning

Feature 2

Landslide and Debris Flow Risk Maps

The Landslide Hazard Map classifies landslide susceptibility across forested areas nationwide into five levels based on logistic regression analysis using nine factors including topography, geology, forest characteristics, and soil conditions. It is developed at a spatial resolution of 10X10 meters. In addition, risk levels are updated annually for areas where forest conditions change, such as regions impacted by wildfires or alterations in land use.

On the other hand, the debris flow impact prediction map utilizes the Random Walk Model (RWM) to simulate the movement of debris flows and estimate the potential extent of damage. Moreover, the integrated debris flow risk map not only assesses the physical intensity of debris flows but also considers social vulnerability factors, such as the presence of elderly populations and sensitive facilities, to classify the expected damage risk into five levels.

Figure 2.1.13 Landslide Hazard Map

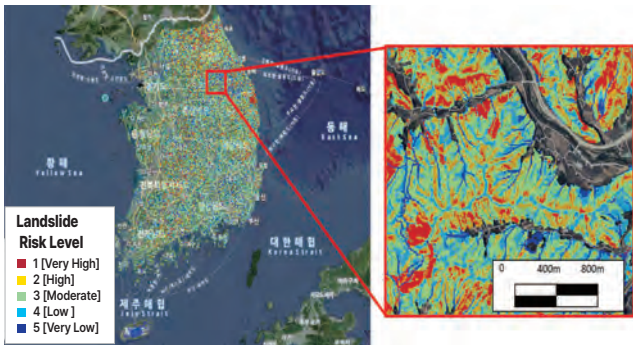
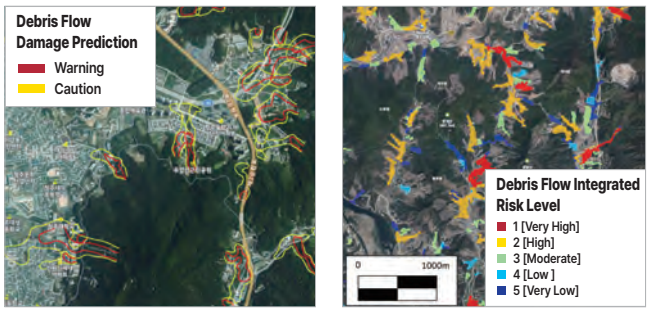


Figure 2.1.14 Debris Flow Impact Prediction Map and Integrated Risk Map

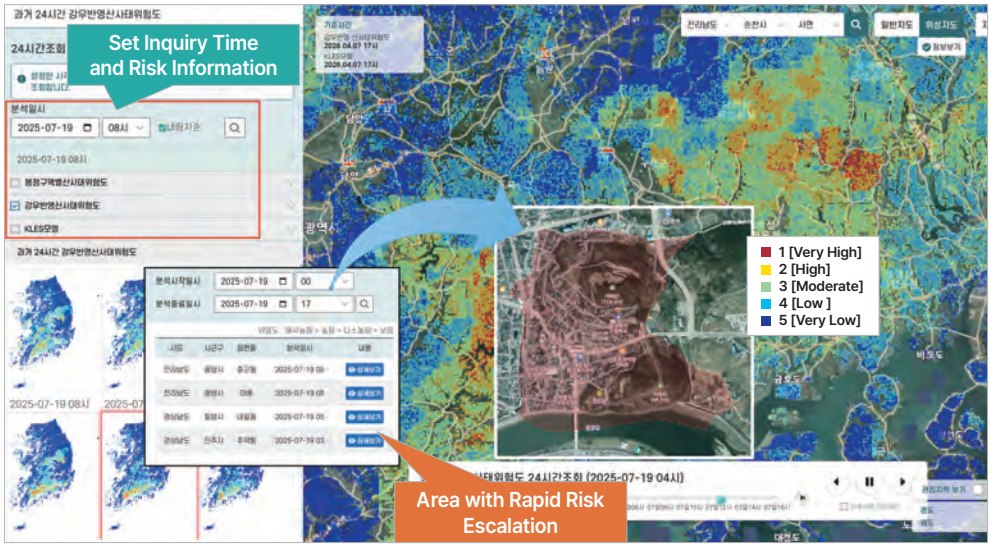


Feature 3

Real-Time Landslide Risk Assessment

The system assesses landslide risk in real time by combining a landslide risk map, which predicts spatial risk, with KLES-based soil water content information that forecasts temporal risk. This integration allows for more precise evaluation of landslide risk levels at any given moment, especially as rainfall conditions change.

Figure 2.1.15 Real-Time Landslide Risk Assessment



Feature 4

Digital Slope Integrated Landslide Information System

To facilitate a coordinated and government-wide response to landslides, the Korea Forest Service in collaboration with several relevant ministries including MOIS, the Ministry of Land, Infrastructure and Transport, and the Ministry of Agriculture, Food and Rural Affairs has developed. This system builds upon the existing landslide information framework and provides a unified platform for integrating and utilizing slope risk data that was previously managed separately by different ministries.

Figure 2.1.16 Digital Slope Integrated Landslide Information System



Key Achievements

Establishment of a Real-Time, Precise Landslide Early Warning System

By combining hazard maps with soil water content information, the system can analyze landslide risks in real time and operate an early warning system tailored to local conditions. While previous forecasts were limited to 24 hours in advance, the upgraded system now enables forecasts up to 48 hours ahead. This extended lead time allows for timely precautionary measures, such as resident evacuation and traffic control, thereby reducing disaster impacts.

Updating and Integrating Landslide and Slope Risk Information

We have developed a comprehensive risk mapping framework by consistently updating data related to changes in forests, including those caused by wildfires and human development. In addition, slope risk information previously managed separately by different ministries has been integrated, establishing a solid foundation for enhancing the accuracy of risk analysis and forecasting.

Future Directions

Landslide risk prediction has relied mainly on statistical and empirical models which have limitations in data collection, management, and utilization. In particular, slope risk information is scattered across different ministries making regular updates and integrated use challenging.

Going forward, slope risk data and forest change information will be integrated and updated in real-time through digital platforms. This will establish a cross-ministerial system for integrated risk management. In parallel, Artificial Intelligence (AI) technologies will be applied to enhance early warning and risk mapping. This approach will allow for more accurate predictions of landslides and facilitate a more proactive and science-based response to disasters.

1.8 AI-Enabled Early Flood Forecasting and Warning

(AI-Powered Smart Flood Forecasting System)

Responsible Department | Ministry of Climate, Environment and Energy, Water Hazard Response Division
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Background and Development

With the increase in extreme downpours exceeding 100㎜ per hour due to climate change, flooding-related casualties in vulnerable areas, such as underground parking lots, semi-basement residences, and underpasses, have risen significantly. Existing flood control infrastructure and early warning systems designed based on historical climate patterns have shown limitations in prediction accuracy and response timeliness.

Conventional flood forecasting systems primarily focused on major rivers, providing insufficient prediction and warning services for smaller tributaries and streams, often more vulnerable. Additionally, disaster alerts sent via text message alone made it difficult for individuals to intuitively assess their personal risk, and drivers found it challenging to check messages while on the road.

To address these challenges, the Ministry of Climate and Environment and Energy (MCEE) launched an initiative in 2020 to introduce an AI-based flood forecasting system. In 2024, significant milestones were achieved including the establishment of a public–private Task Force in January, the amendment of the Enforcement Rule of the Water Resources Act in May, the launch of AI-based flood forecasting and location-based safety alert services in May, and the introduction of flood warning information via navigation systems starting in July. These developments demonstrate rapid progress in improving both prediction and communication systems.

Key Features

AI-based Flood Forecasting System

MCEE trained AI algorithms using over 10 years of accumulated hydrological data collected at 10-minute intervals including rainfall, water levels, tidal levels, and dam/reservoir discharge volumes. This AI-based flood forecasting system now supports predictions of flood levels. By combining AI analysis results with traditional numerical models, the system enhances decision-making accuracy for forecasters when issuing flood warnings. The system expanded the geographical scope of flood forecasts beyond major rivers to include tributaries and small streams increasing designated flood warning points from 75 to 223-almost three times more. This expansion enabled early analysis and alerts for a greater number of areas. Since May 2024, the system has been officially deployed in field operations.

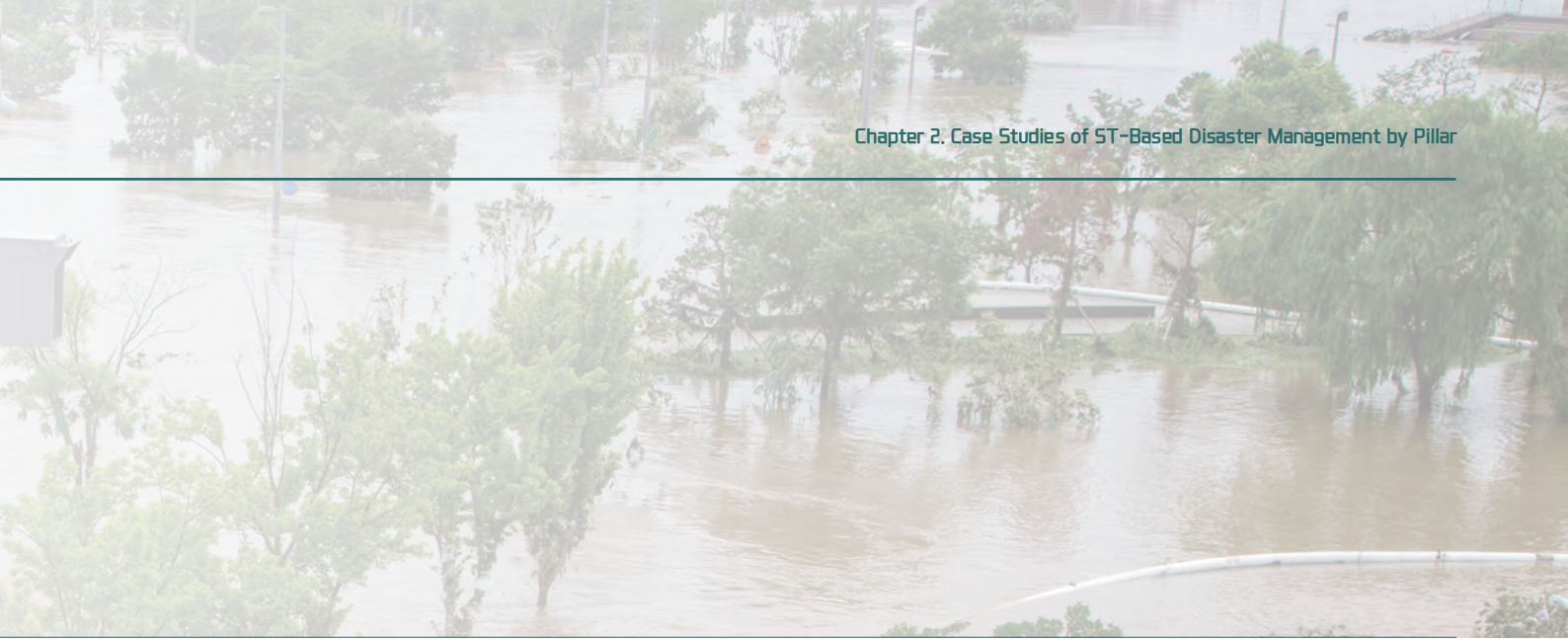


Figure 2.1.17 Expansion of AI-based Flood Warning Locations

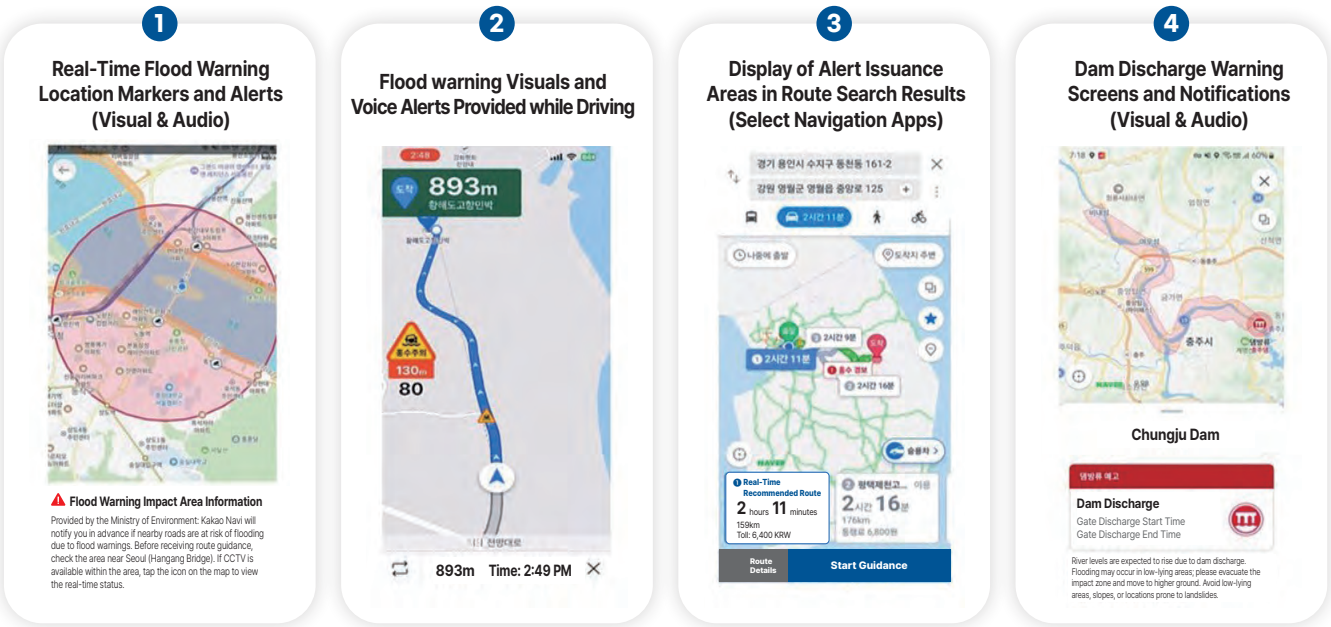


Location-based Safety Alert Messages and Navigation-Linked Services

Since May 2024, disaster flood alert messages issued during flood warnings have been enhanced to include location links, allowing the public to directly check flood warning points and areas at risk of inundation near their locations.

To address the challenges of checking text alerts while driving, a new system has been introduced to provide real-time flood warnings through navigation systems. In January 2024, a Task Force was established, involving MCEE, the Ministry of Science and ICT, the National Information Society Agency (NIA), and six private navigation providers to develop an integrated platform that enables real-time integration and display of government-provided flood information on private navigation systems. As a result, drivers can receive real-time flood risk notifications directly through their navigation devices, allowing them to take timely action to avoid potential risks.

Figure 2.1.18 Flood Risk Alerts using Navigation System



Key Achievements

Eliminating Blind Spots in Flood Information

The implementation of the AI-based flood forecasting system has led to a significant increase in the number of flood warnings issued. From an annual average of 34 over the past decade to 170 in 2024, nearly a fivefold increase. Notably local rivers which previously received limited warnings saw an increase from 9 alerts to 102, an elevenfold rise. This improvement has been crucial in providing the critical "golden time" for response during flood events.

The location-based alert service enables individuals to visually confirm their positions relative to flood-prone areas on a map. Between July and October 2024, navigation systems issued 105 real-time flood risk alerts for drivers including 41 flood warnings and 64 dam discharge notifications helping ensure safe driving.

Public–Private Cooperation for Service Stability

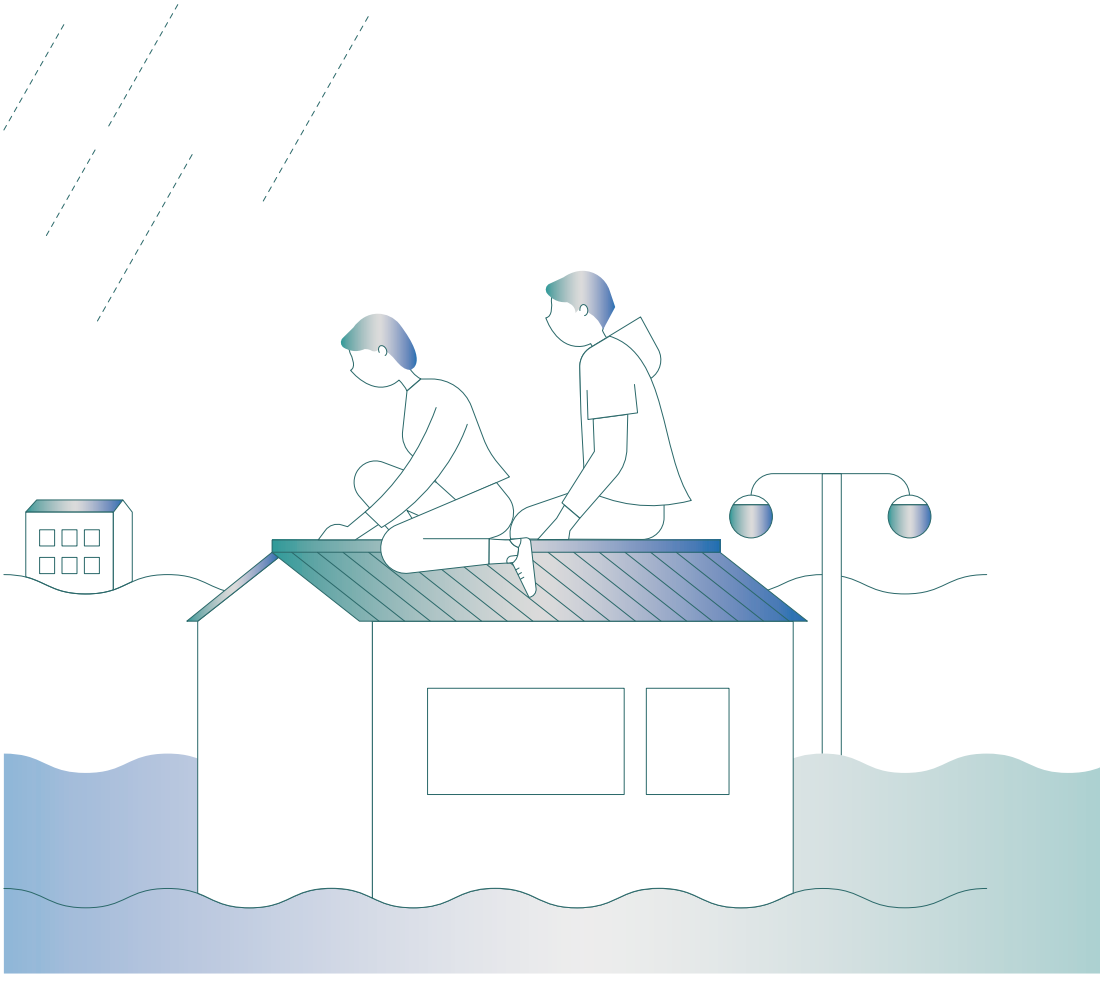
In 2024, a Task Force was successfully established a cooperative service delivery model. The MCEE provided disaster information, the Ministry of Science and ICT coordinated operational efforts, the NIA standardized data and built an intermediary system, and six private navigation companies implemented real-time service integration. These collaborative partnerships ensured the stable and effective delivery of flood risk alerts.

Future Directions

This initiative serves as a prime example of effective scientific disaster management, as it integrates both public and private data, utilizes AI technology to improve predictive accuracy, and establishes a collaborative framework for flood risk communication.

By moving beyond the traditional text-based alert system, warnings are now delivered through driver-friendly channels such as navigation systems, thereby significantly improving the accessibility and practical usability of disaster information. Moreover, flood warning zones have been further refined to enable more targeted alerts supporting adaptation to localized heavy rainfall and other impacts of climate change.

Looking ahead, MCEE will strengthen observation infrastructure by expanding water-level monitoring stations and operating dedicated water resource satellites. These efforts will bolster the reliability and usability of the AI-based flood forecasting system. MCEE will continue to improve prediction accuracy by continuously refining AI training datasets. In parallel, collaboration with the private navigation Task Force will be maintained to expand the range of information provided and advance delivery methods.



Chapter 2

Pillar 2

Integrated Disaster Management Based on Smart Technologies

2.1 24/7 Nationwide Disaster Monitoring and Response Coordination System
2.2 Enhancing Disaster Response with Digital Manuals
2.3 Seamless Collaboration through the Disaster Safety Communication Network
2.4 Closing Underpasses before Flooding
2.5 AI Detects Flood Risks First and Navigation Systems Notify Drivers
2.6 Future of Wildfire Response Transformed by Data and AI
2.7 Securing the Golden Hour with Cloud-based Collaboration
2.8 Addressing Disaster Resource Shortages through Real-time Sharing

2.1 24/7 Nationwide Disaster Monitoring and Response Coordination System

(National Disaster and Safety Status Control Center)

Responsible Department | MOIS, Emergency Management Office
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Background and Development

The Ministry of the Interior and Safety (MOIS) serves as the central government authority for coordinating disaster and safety management across both national and local levels. As the primary architect of Korea's disaster management system, MOIS ensures a unified and resilient response to all hazards.

At the heart of this framework is the National Disaster and Safety Status Control Center, which maintains a continuous, 24/7 operational posture. The Center operates as the national nexus for disaster intelligence. It is responsible for the real-time collection, analysis, and dissemination of critical information, providing a centralized hub for immediate emergency response.

The Center's current organizational structure and situation management framework were formalized in 2014 with the establishment of the Ministry of Public Safety and Security, a dedicated ministerial-level agency for disaster management. Since its inception, the Center has consistently evolved, scaling its operational capacity and enhancing its monitoring functions to address the increasing complexity of modern disasters and leverage cutting-edge technological advancements.

Key Features

Normal Operations

Prevention through Monitoring, Sharing and Training

- **24/7 Disaster Risk Monitoring**
  The Center maintains round-the-clock surveillance by integrating over 80 disparate management systems from MOIS and related agencies including the Ministry of Land, Infrastructure and Transport, Korea Meteorological Administration (KMA) and the National Fire Agency. By consolidating real-time CCTV feeds from national subway and railway networks, the Center ensures comprehensive situational oversight. Furthermore, a dedicated video-conferencing framework is established to facilitate immediate inter-agency coordination upon the detection of a disaster.

- **Information Sharing and Strategic Coordination**
  A comprehensive daily report titled "National Safety Management Status" is compiled information on disasters and accidents nationwide. This report is disseminated to central ministries, local governments, and relevant stakeholders, and is made accessible to the public via the MOIS website. Additionally, daily briefings, chaired by the MOIS Vice Minister for Disaster and Safety Management bring together department heads to review response measures for major incidents, refine countermeasures, and deliberate on core disaster and safety policies.

- **Capacity-Building and Preparedness Training**
  To ensure operational readiness, the Center conducts regular and ad hoc emergency response exercises. These simulations involve Center personnel, local government officials, and disaster management agencies. Fostering a culture of continuous improvement and strengthening collective capacity for effective crisis management.

Figure 2.2.1 Situation Management System Interface



Figure 2.2.2 Daily Situation Review Meeting



Disaster Operations

Mitigating Damage through Rapid Situation Assessment and Action

- **Detection and Situational Awareness**
  Upon the onset of a disaster, the Center rapidly assesses the situation using a multi-layered information network. This includes the integrated disaster information system, the Public Safety-LTE (PS-LTE) network, live feeds from CCTV, fire command vehicles, Coast Guard vessels, and Korea Forest Service helicopters.

- **Reporting and Rapid Dissemination**
  The information collected is immediately reported to the Office of the President and the Prime Minister's Office. Simultaneously, data is shared in real-time with relevant ministries and disaster management agencies to ensure a unified national response.

- **Initial Response and Life-Safety Measures**
  The Center directs local governments to implement initial response measures immediately including the issuance of disaster alerts and evacuating residents. With the prevention of casualties as the absolute priority, the Center facilitates swift evacuations and continuously monitors response agencies to ensure all necessary field actions are executed without delay.

Key Achievements

Control Tower of National Disaster Management

The Center serves as the strategic control tower for national disaster management, providing 24/7 oversight and synchronizing response efforts across central ministries and local governments. During large-scale emergencies, the Center rapidly collects and analyzes information on damages and disseminates real-time situational updates to ensure a unified national response. Through mechanisms such as the Central Disaster and Safety Countermeasures Headquarters, the Center facilitates the end-to-end review of the disaster lifecycle, from initial intervention to long-term recovery, enabling decisive and timely action. This framework ensures that national resources are effectively mobilized when a crisis exceeds the individual capacities of local or departmental authorities.

Data-driven Decision-making and Communication Framework

By maintaining a continuous stream of real-time disaster information, the Center provides a comprehensive operational picture that supports rapid, evidence-based decision-making. Information gathered from diverse sources, including IT systems, CCTV networks, field reports, and dispatched personnel, is consolidated into intuitive situational dashboards. This centralized data allows central and local authorities to jointly assess conditions, reach informed conclusions, and coordinate appropriate countermeasures with high precision.

Future Directions

In response to the increasing scale, complexity, and unpredictability of disasters, and in alignment with rising public expectations for a safer society, the Center is committed to advancing disaster risk monitoring and deepening cooperation with relevant agencies. As more local governments establish and operate 24-hour disaster situation rooms, the Center will institutionalize seamless, real-time communication and collaboration protocols with these local platforms, thereby reinforcing a truly integrated national response architecture.

Leveraging the rapid evolution of IoT, sensors, and AI, the Center will expand its use of the data ecosystem to encompass a broader range of real-time sources. This digital transformation aims to refine early-warning mechanisms and identify latent risks to public safety before they escalate. By optimizing information collection and analysis, the Center will further institutionalize data-driven decision-making, ensuring that high-fidelity intelligence is delivered to leaders for critical, time-sensitive interventions.



2.2 Enhancing Disaster Response with Digitalized Manuals

(Digitalization of Disaster Management Manuals)

Responsible Department | MOIS, Emergency Management Office
Contact (Email) | hewonp717@korea.kr

Background and Development

To effectively manage increasingly diverse and complex hazards, systematic manuals that define the specific roles, responsibilities and procedures for each disaster type are indispensable. As the disaster landscape has evolved, these protocols have become highly fragmented, resulting in the management of over 10,000 individual manuals across the nation.

Historically, these manuals were produced primarily as physical booklets, making them cumbersome to carry and difficult to navigate under the pressure of an active crisis. Identifying the specific duties of a particular institution or individual was often time-consuming. Furthermore, frequent personnel rotations within the public management sector made it challenging to maintain version control, track revision histories, and ensure that new officers were fully proficient in their designated response protocols.

To address these operational challenges, the transition toward the digitization and mobilization of disaster manuals was initiated. Following a preliminary planning phase in 2021, development of the Risk Management Manual System began in 2022, with the platform officially launched in May 2024.

Key Features

Mobile and PC Access

The system enables users to search and view approximately 15,100 registered manuals by disaster type or issuing agency via both PC and mobile applications. Manuals are also available for download in PDF or HWP (Hangul Word Processor) formats.

Manual Drafting and Approval Workflow

Users can draft new manuals within the system or import existing HWP files for editing. Once a draft is finalized, the system manages the entire submission and approval process for new manuals or revisions. Once approved, manuals are officially registered and made available for immediate reference.

Systematic Manual Inspection

For manuals subject to statutory inspections, the system supports the entire management lifecycle, from establishing inspection plans and managing checklists to reporting final results. This ensures that all disaster protocols are systematically maintained and compliant with regulations.

Figure 2.2.3 Digital Disaster Manual Access Screen (PC and Mobile)

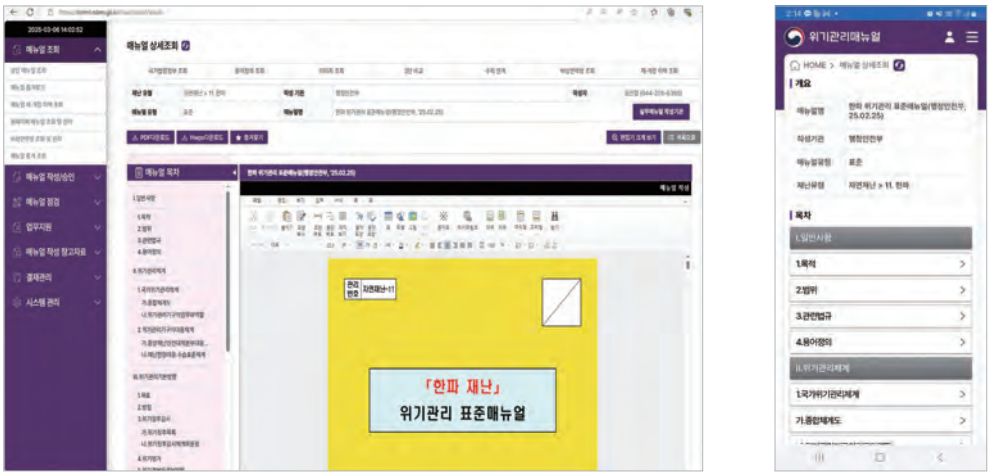
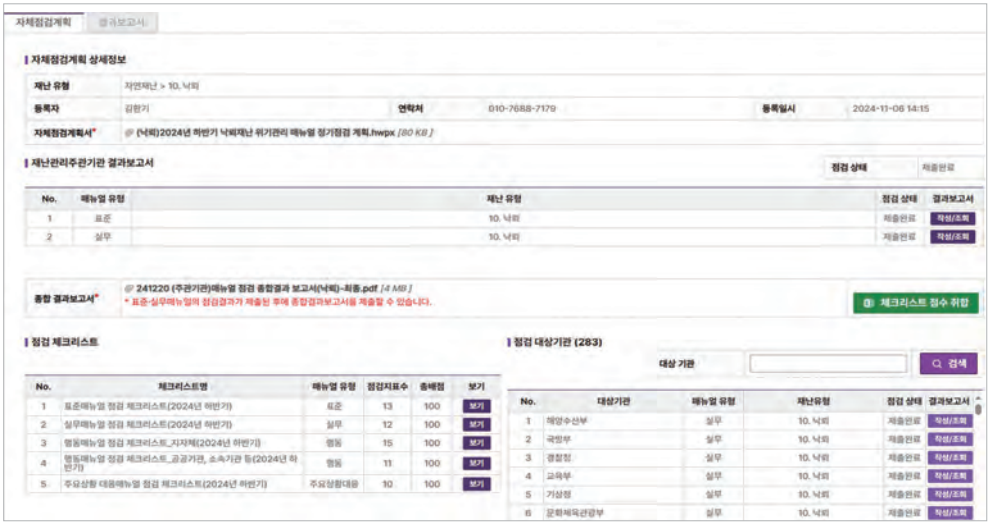


Figure 2.2.4 Manual Inspection Management Interface



Real-Time Emergency Contact Management

The system's contact directory is synchronized with the latest information from central and local government agencies. Through the mobile app, users can instantly connect with relevant personnel via a "one-touch" dialing feature. This enables rapid dissemination of situational information and coordinated inter-agency response, even in urgent disaster situations.

Achievements

Establishing a Manual Management System for the Digital Era

The transition to a digital platform has overcome the inherent limitations of paper-based manuals. Previously, physical booklets made it difficult to update content, track revision histories, and maintain accurate data following personnel rotations. The new system centralizes these processes, enabling automated version control and the efficient compilation of administrative statistics.

Strengthening On-Site Response through Mobile Access

The ability to search and view manuals via mobile devices has significantly enhanced portability and accessibility at disaster sites. By enabling the rapid verification of critical information, the system has greatly increased the practical utility of these manuals. In particular, the continuously updated emergency directory allows responders to instantly identify key partners during a crisis. The "one-touch" dialing feature further strengthens inter and intra agency collaboration by streamlining communication when it is needed most.

Future Directions

While traditional AI applications were primarily suited for structured data, the recent commercialization of Large Language Model (LLM) technologies has opened new possibilities for managing text-based disaster manuals. This shift offers significant potential to integrate AI into the drafting, review, and retrieval of response protocols.

Looking ahead, AI could be leveraged to perform quality reviews of complex manuals or to provide instantaneous, voice-guided instructions to responders in the field. While the application of AI to critical decision-making requires a balanced approach to accountability and reliability, its role in automating the administrative aspects of manual drafting and compliance inspection is expected to grow. This evolution will further enhance the agility and precision of Korea's disaster management framework.

2.3 Seamless Collaboration through Disaster Safety Communication Network

(PS-LTE Disaster Safety Network)

Responsible Department | MOIS, Disaster Safety Communication Network Division
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Background and Development

In urgent disaster situations, swift and accurate communication among primary response agencies, including the police, fire services, the coast guard, local and central government ministries, is paramount. The Sewol Ferry disaster of April 2014 underscored the severe consequences of fragmented inter-agency communication. At that time, agencies relied on separate radio systems (VHF, UHF, TRS, etc.), and these voice-centered and siloed communication methods hindered effective response within the critical "golden hour."

In response, the government identified the need for a unified and nationwide disaster safety communication network for joint agency use. This led to the launch of the Public Safety Long-Term Evolution (PS-LTE) network, which uses fourth-generation (4G) wireless technology. Following the finalization of the implementation plan in March 2015, pilot projects were conducted in three regions including PyeongChang (2015–2016).

Full-scale nationwide deployment commenced in 2018, with the service officially launched in May 2021. In June of the same year, the Disaster Safety Communication Network Act was enacted establishing the necessary legal framework for systematic operation and management.

Key Features

Mission-Critical Push-to-Talk (MCPTT) and Multimedia Group Communication

The PS-LTE network supports group communication that allows for the simultaneous transmission of voice, video, images and data. Communication groups can be configured for specific situations ensuring that voice, video or data transmitted by a single user is instantly shared with all group members. This capability enables multidimensional coordination that goes far beyond the limits of traditional voice-only radio.

Independent Network Architecture

The network is built as a standalone infrastructure separate from commercial networks. This ensures that response agencies maintain stable communication even during large-scale disasters when commercial networks may become unusable due to sudden traffic congestion.

Nationwide Coverage

In addition to approximately 17,000 fixed base stations, the system utilizes vehicle-mounted and portable mobile stations to maximize reach. By leveraging Radio Access Network (RAN) sharing technology to integrate with maritime (LTE-M) and railway (LTE-R) networks, the system effectively minimizes communication “dead zones” across the country.

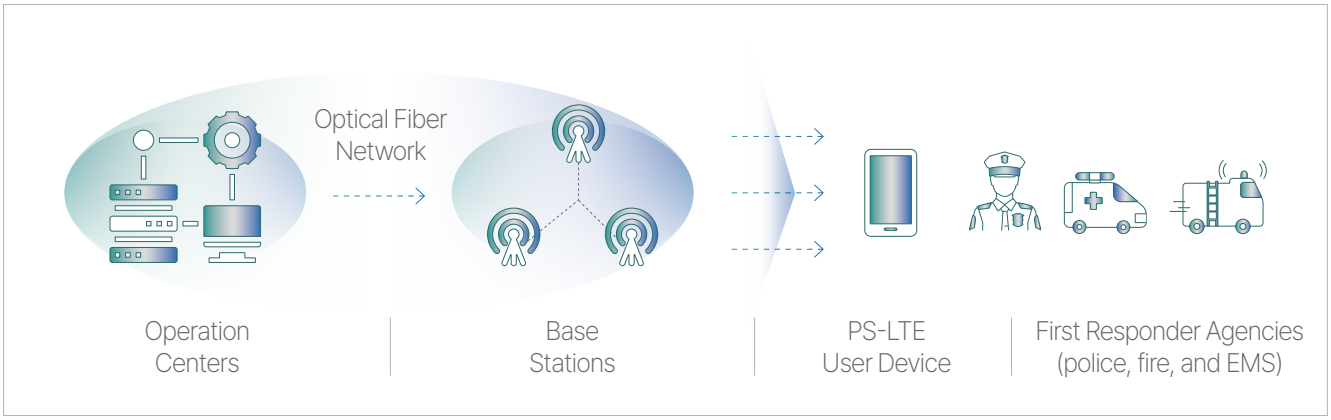
Triple-Tiered Operating System

Operation centers in Seoul, Daegu, and Jeju run 24/7, 365 days a year. The system is designed with a triple-tiered architecture so that if one center fails, the remaining centers can immediately assume operations, ensuring uninterrupted service.

Service Integration and Application Support

User agencies can develop customized applications and integrate them with the PS-LTE network, enabling use not only for disaster response but also for routine tasks such as daily patrols and facility inspections, thereby enhancing its utility in everyday public safety operations.

Figure 2.2.5 PS-LTE Disaster Safety Network Architecture



Key Achievements

Strengthening Integrated Response and Securing the Golden Hour

The PS-LTE network allows multiple disaster-related agencies to share information in real time on a unified system. High-speed transmission of voice, photos and video ensures that critical site data is disseminated rapidly and accurately. Agencies such as the police and fire services can now maintain situational awareness before arriving on scene, significantly improving the speed and precision of initial responses.

Furthermore, commands are transmitted simultaneously to all relevant recipients, preventing delays or distortions and ensuring unified command and control. Currently, the network facilitates seamless cooperation among police, fire services, coast guard, military, and local governments during floods, fires, crowd crushes and wildfires.

Enhanced Efficiency through Integrated Infrastructure

By consolidating fragmented wireless networks into a single system, the government has reduced investment and operating costs. The deployment of standardized handsets and joint training programs has established a more efficient operational foundation. Additionally, customized application services allow agencies to tailor functions to their specific needs, extending the network's use to routine tasks such as patrols and facility inspections. Notably, the Coast Guard (November 2022), the National Fire Agency (February 2023) and the National Police Agency (January 2024) have all successfully transitioned to the PS-LTE system as their primary communication network.

Future Directions

The Disaster Safety Communication Network serves as a core digital infrastructure for national disaster response, facilitating inter-agency collaboration. To ensure its effective use in disaster prevention and response, the government is focusing on three strategic priorities: specialized training, technological advancement and international cooperation.

Regarding operational readiness, mandatory training for all user organizations has been implemented since 2025, alongside customized education programs for provincial and municipal governments. The government also plans to expand scenario-based field exercises organized by both central and local authorities to further strengthen real-world disaster response capacity.

From a technological perspective, next-generation capabilities such as satellite communications, AI-based video analysis, and IoT sensor integration will be introduced into the PS-LTE system. This evolution aims to establish an intelligent response framework, transforming the network from a simple communication tool into an integrated platform for data collection, analysis, and prediction.

Finally, international cooperation will be actively pursued. Building on successful exports of terminals and solutions, Korea aims to support the global expansion of public safety networks through international conferences, technical seminars, and Official Development Assistance (ODA) projects targeting developing countries.

❖ Export Cases: Korean Disaster Safety Communication Network

- **Supply of terminals and solutions to the US, Canada, Australia, France, and the UK**
  - Samsung Electronics selected as a supplier for the UK public safety network (Jan. 2025, Electronic Times)
  - Export of Korean PS-LTE MCPTT solutions (MCPTT app, recording server, dispatch console, PTT server, etc.)
- **Supply of solutions and terminals to Singapore, Qatar, and Sweden**
  - Delivery of Terminals and MCPTT solutions by Korean companies (e.g., CyberTel Bridge)

2.4 Closing Underpasses Before Flooding

(Smart Technologies and Institutional Mechanisms for Underpass Safety)

Responsible Department | MOIS, Natural Disaster Response Division
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Background and Development

Underpasses are widely used urban structures globally, as they enhance traffic flow and preserve cityscapes by repurposing surface spaces for pedestrian walkways, parks, and parking lots. However, certain underpasses remain highly vulnerable to flooding during intense summer rainfall, particularly those near rivers or with concave (dipped) road structures.

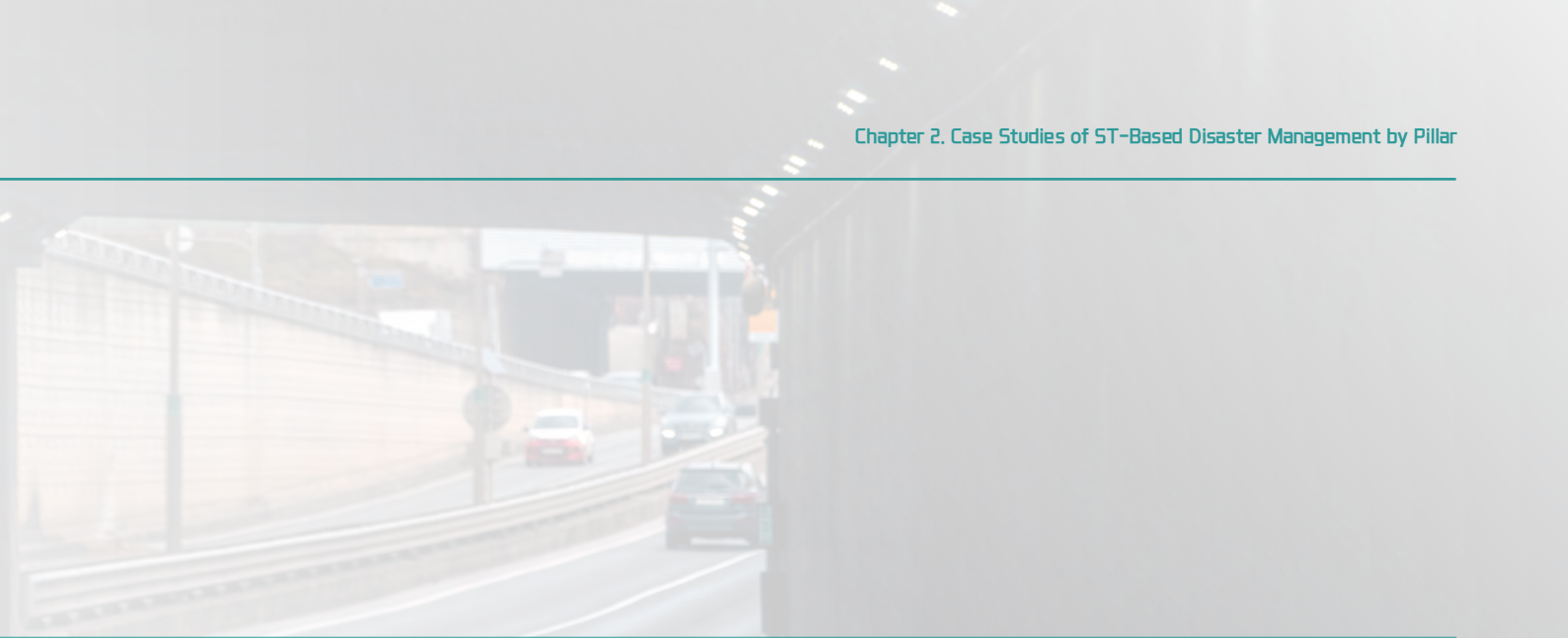
The vulnerability of such infrastructure was tragically demonstrated on July 15, 2023, when an embankment failure along the Miho River in Cheongju caused a localized underpass to flood, resulting in multiple casualties. This incident necessitated a comprehensive overhaul of existing underpass safety measures. In response, the central and local governments have updated safety standards, accelerated the deployment of automatic entry-blocking systems, and strengthened multi-agency governance to ensure seamless collaboration and operational reliability in preventing the recurrence of such disasters.

Major Milestones in Underpass Safety

2020s
- **Occurrence of casualties due to underpass flooding:**
  - 2020: Choryang-1 Underpass, Busan (3 casualties)
  - July 2023: Gungpyeong-2 Underpass, Cheongju (14 casualties)

2020 ~ 2024
- **Budgetary support for the installation of underpass entry-blocking systems (35.2 billion KRW for 129 locations)**

2024 — **April**
- **Institutional reforms for underpass safety**
  - Expansion of mandatory installation of automatic entry-blocking systems (431 locations)
  - Establishment of control criteria for flooding



Key Features

Institutional Reforms for Underpass Safety Management

Since underpasses are categorized as road auxiliary facilities, effective safety management requires close cooperation between the Ministry of Land, Infrastructure and Transport, the primary authority for road management, and MOIS, which oversees disaster safety policies and supports local governments. Through this inter-ministerial collaboration, new safety standards for underpasses were established:

- **Expansion of Mandatory Installation:** The government expanded the scope of underpasses required to install automatic entry-blocking systems, taking into account both the physical structure of the underpasses and their surrounding environmental conditions.
- **Establishment of Immediate Closure Criteria:** Clear standards were set to mandate the immediate restriction of vehicle entry if drainage pumps fail or if the inundation depth exceeds 15 cm. This threshold was determined based on the typical placement and safety considerations for electric vehicle (EV) batteries.

Preemptive Disaster Management through Automatic Entry-Blocking Facilities

If flooding occurs while a driver is already inside an underpass and caught in traffic congestion, it is extremely difficult for those inside to perceive external risks immediately. Furthermore, if vehicles become trapped at the entrances or exits, rapid evacuation becomes impossible, potentially leading to large-scale casualties.

To mitigate these risks, preemptive control measures that block vehicle entry before flooding occurs are of paramount importance. Accordingly, MOIS has provided administrative and financial support to local governments for the installation of entry-blocking systems. These integrated systems consist of CCTV cameras, water-level gauges, automatic barriers, and public announcement systems at major underpasses announcement devices.

Figure 2.2.6 Underpasses and Entry-Blocking Facilities



Data Linkage via Local Government Control Centers

All data from entry-blocking facilities is linked to the respective local government control centers, enabling officials to monitor conditions in real-time via CCTV. When a risk to human life is detected, officials can remotely activate the blocking facilities. In cases where visibility is poor, the system is designed to enable automatic control based on data from water-level gauges.

Preparedness for System Failures

For major underpasses with a high risk of casualties, the government has strengthened accountability by designating four responsible persons (government officials, police officers and residents) to conduct regular inspections and management.
To prepare for potential electronic or mechanical failures during a crisis, a system has been established where assigned police officers are dispatched to the site to implement direct manual control of the underpass.

Key Achievements

Reduced Administrative Workload

The installation of underpass entry-blocking facilities has significantly reduced the workforce and time previously required for manual traffic control and guidance, while simultaneously enhancing monitoring accuracy. This shift has enabled public officials to allocate capacity to focus on areas that require more detailed human judgment and support, such as assisting the vulnerable with evacuation during disasters.

Establishment of an Underpass Casualty Prevention System in Response to Abnormal Climate Conditions

Urban underpasses face a high risk of casualties when factors such as heavy localized rainfall and traffic congestion combine. This is a common challenge not only in Korea but also in cities worldwide experiencing extreme rainfall exceeding 100㎜ per hour, illustrating climate risks that surpass existing meteorological observations and forecasting capabilities. The government is preemptively responding by addressing structural urban vulnerabilities through a policy package that includes improved safety standards, the establishment of flood monitoring systems and the expansion of entry-blocking installations. These measures are expected to function as sustainable urban safety strategies that ensure underpass safety against increasingly severe abnormal climate patterns in the future.

Future Directions

To prevent casualties in underpasses, the primary objective is to promptly alert drivers when flooding risks are detected, thereby blocking further vehicle entry. This necessitates the effective dissemination of risk information through various channels such as disaster text alerts and electronic signboards, alongside providing practical alternatives such as detour route guidance, and securing the voluntary cooperation of drivers.

Equally important is fostering a ‘citizen-participation safety culture’ where the public understands the government’s preventive efforts and can recognize and respond to risks appropriately. In collaboration with local governments, MOIS plans to strengthen safety education and public awareness campaigns continuously. These initiatives aim to ensure that the public fully understands flood prevention policies and that, when flood risks are detected, information is communicated swiftly to lead to immediate risk avoidance.

2.5 AI Detects Flood Risks First and Navigation Systems Notify Drivers

(AIoT-based Underpass Flood Prediction System)

Responsible Department | Ministry of Science and ICT, Digital Safety Infrastructure Division
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Background and Development

Extreme rainfall events can trigger catastrophic flooding within minutes, making rapid detection and proactive prevention the cornerstone of modern disaster management. Previously, flood monitoring relied heavily on human intervention and legacy systems, not only labor-intensive and costly but also struggled to provide the real-time precision required during a crisis. To overcome these structural limitations, the Ministry of Science and ICT (MSIT) integrated advanced AI and data-driven technologies into the national safety framework.

As a first step, MSIT established the "AIoT-based Underpass Flood Response System" in Busan Metropolitan City. This initiative leverages the Artificial Intelligence of Things (AIoT) to enhance localized prediction and prevention capabilities.

Furthermore, to ensure this critical information reaches the public directly, specifically while they are behind the wheel, the government spearheaded the integration of flood risk alerts into mobile navigation applications. Despite the absence of a dedicated budget, the government's persistent consultation and strategic partnership with the private sector successfully brought this vision to life. As of July 2024, real-time flood risk alerts are operational across major navigation apps, providing drivers with a life-saving layer of digital protection.

Key Features

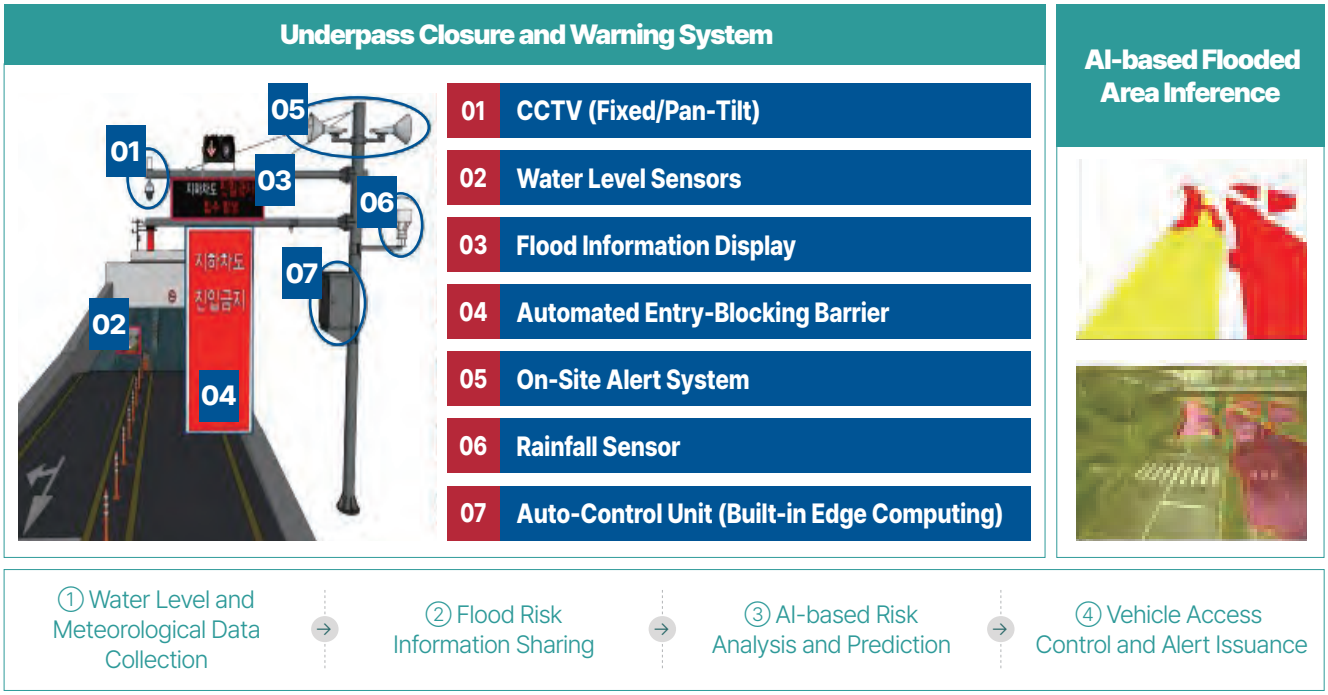
Deployment and Field Demonstration of the AIoT-based Underpass Flood Response System

The system utilizes IoT technology to provide real-time monitoring of underpass flood risks by aggregating data from water-level sensors-located both within the underpass and in surrounding areas (including nearby rivers)-alongside critical meteorological data such as rainfall and tide levels. Advanced AI algorithms then analyze this data to predict potential flooding before it occurs.

Upon detection of a flood risk, the system initiates a multi-layered response:

- **Driver Notification**
  Real-time alerts are displayed on electronic signboards to inform approaching drivers.
- **Entry Control**
  Physical barriers or banners are deployed to restrict vehicle access immediately.
- **Information Dissemination**
  Comprehensive real-time updates are channeled to the public via Busan's Integrated Urban Flood Information System.

Figure 2.2.7 AIoT-based Underpass Flood Response Process

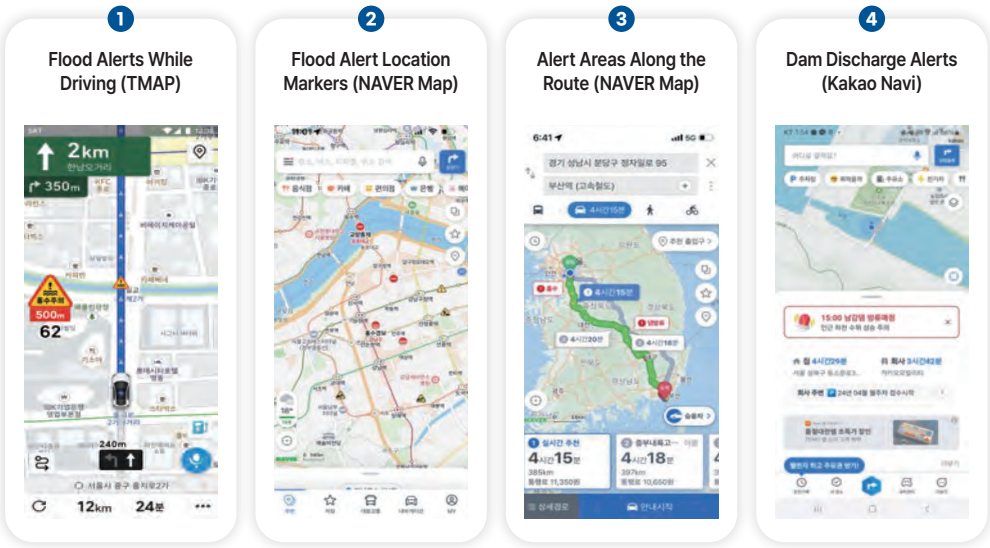


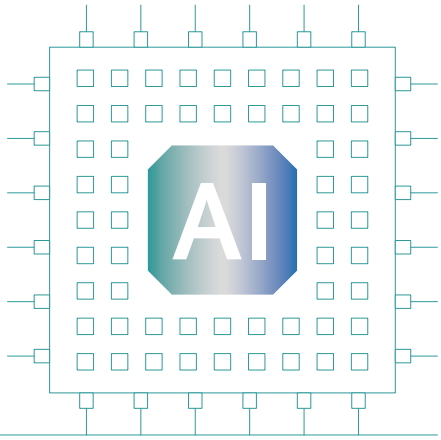
Road Flood Risk Alerts via Private Navigation Apps

To help drivers avoid flooded roads, the government established a cutting-edge early warning network. MSIT and the National Information Society Agency (NIA) transformed real-time flood data from the Ministry of Environment into a standardized API (Application Programming Interface). Private navigation providers integrated this API into their platforms, enabling the system to trigger high-priority alerts whenever a vehicle approaches within 1.5㎞ of a flood-prone zone.

In July 2024, a landmark Memorandum of Understanding (MOU) was signed between MSIT, the Ministry of Environment, the NIA, and six major industry leaders (Kakao Mobility, Tmap Mobility, Naver, Hyundai-Kia, Mappers, and iNavi Systems). This agreement solidified a robust public–private partnership. As a result, starting with the 2024 flood season, drivers approaching flood warning zones or dam discharge areas now receive seamless, real-time guidance through visual displays and they can receive real-time alerts via both on-screen alerts and voice guidance.

Figure 2.2.8 Real-Time Flood Risk Alerts via Navigation and Mapping Services





Key Achievements

Development and Implementation of AIoT-based Flood Response System

In 2024, the city of Busan successfully piloted the AIoT-based flood response system at the Centum City and Sinsundae underpasses. The initiative demonstrated the seamless integration of real-time warning alerts and automated vehicle entry control within the Integrated Urban Flood Information System.

Moving beyond conventional IoT-which is limited to data collection and transmission-AIoT (Artificial Intelligence of Things) enables autonomous real-time analysis, predictive modeling, and automated emergency response. This milestone proves the viability of transitioning to intelligent, tech-driven disaster management frameworks through advanced technological convergence.

Launch of Flood Risk Alerts via Public–Private Collaboration

A standout achievement of this project was the successful nationwide implementation of flood risk alerts without requiring additional government funding. This was made possible through a strategic collaboration with the private sector. By providing private companies with high-value, real-time government data, the state created a powerful incentive: allowing firms to enhance their service quality while fulfilling a critical public safety role.

During the 2024 flood season, this public-private partnership delivered timely, life-saving alerts to drivers across the country, covering a total of 41 flood warnings and 64 dam discharge notifications.

Future Directions

Preventing underpass flooding requires a high degree of system reliability and rapid information dissemination. To maintain this standard, the government will continuously monitor operational performance and implement functional enhancements based on direct feedback from citizens and private-sector partners. This iterative approach ensures that the digital safety infrastructure evolves alongside emerging technological capabilities and user needs.

The government also plans to provide information on complex disasters, such as landslides, through private navigation services. In regions that have experienced large-scale wildfires, the risk of landslides during the summer is expected to increase due to extensive forest damage and soil erosion. Accordingly, by linking landslide-prone area data and incident reports with navigation systems, the government aims to further strengthen the response framework for complex disasters during the flood season.

2.6 Future of Wildfire Response Transformed by Data and AI

(AI-based Wildfire Spread Prediction System)

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Background and Development

Driven by the escalating impacts of climate change, large-scale wildfires are becoming a frequent global phenomenon, and South Korea is no exception. According to analysis by the Korea Forest Service(KFS), the average number of wildfire incidents rose from 238 per year in the 1980s to 580 per year between 2020 and 2023. During the same period, the average area damaged by wildfires increased nearly eightfold, surging from 1,112 to 8,369 hectares. The massive wildfires that struck Gangneung, Uljin, and Ulju in 2022, Goseong and Sokcho in 2023, and Sancheong and Uiseong in 2025 were national disasters that caused severe displacement and property loss.

The existing wildfire spread prediction system, based on historical models, had limitations in fully capturing rapidly changing weather conditions and regional environmental variations driven by climate change. This underscored the urgent need for a fundamental innovation in wildfire response strategies, including the introduction of AI-based prediction systems and a transition toward early warning systems.

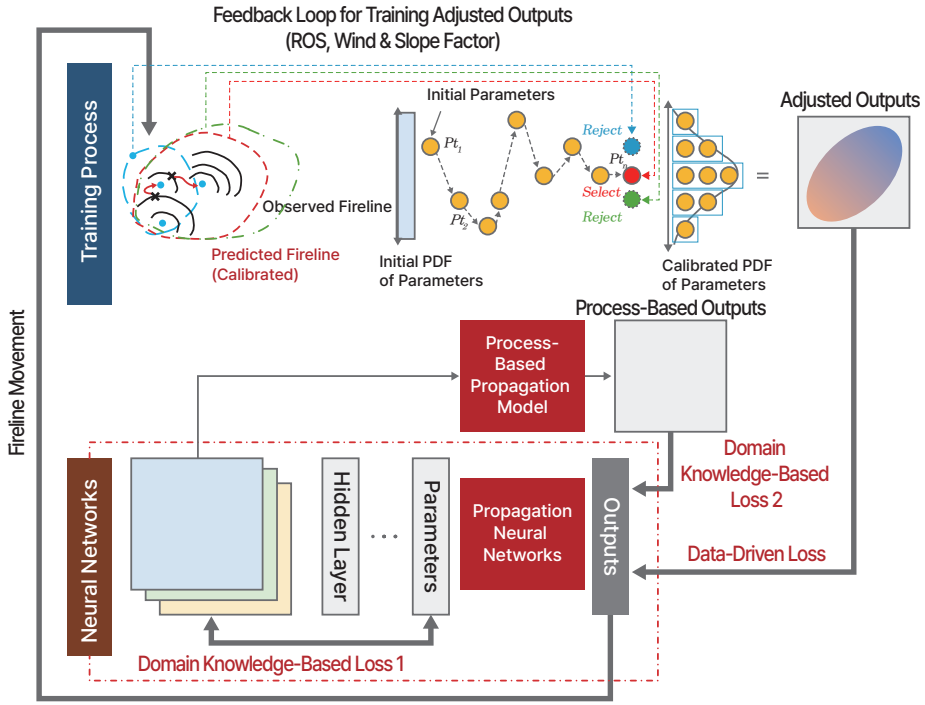
In response, the National Institute of Forest Science (NIFoS) designated the "Development of an AI-based Wildfire Spread Prediction System" as a priority research initiative. This project was actively developed and tested in conjunction with the Korea Forest Service's 2024 R&D program, specifically the R&D for Resolving Current Issues in Forest Disasters and Hazards. The current system continues to support firefighting operations and resident evacuation, thereby ensuring the reliability and effectiveness of AI-driven prediction models.

Key Functions

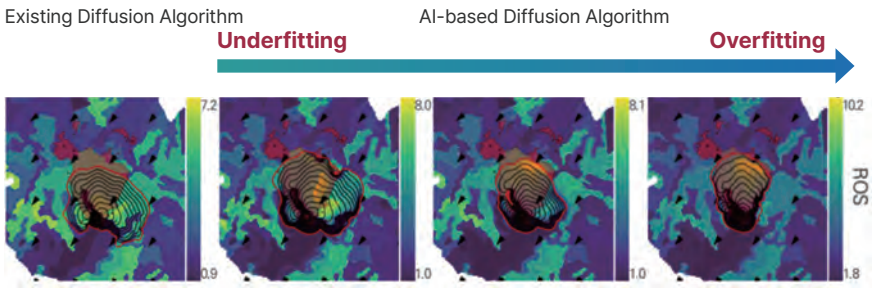
Development of an AI-based Wildfire Spread Prediction Model

The AI-based Wildfire Spread Prediction Model was developed as an advanced analytical tool for high-precision forecasting. It integrates Deep Learning techniques utilizing Artificial Neural Networks (ANN) with an enhanced fire-line propagation algorithm. By synthesizing real-time meteorological forecasts, topographical variables, and fuel load characteristics, the model delivers significantly more refined and reliable predictions of wildfire behavior.

Figure 2.2.9 Architecture of the AI-based Wildfire Spread Prediction Model



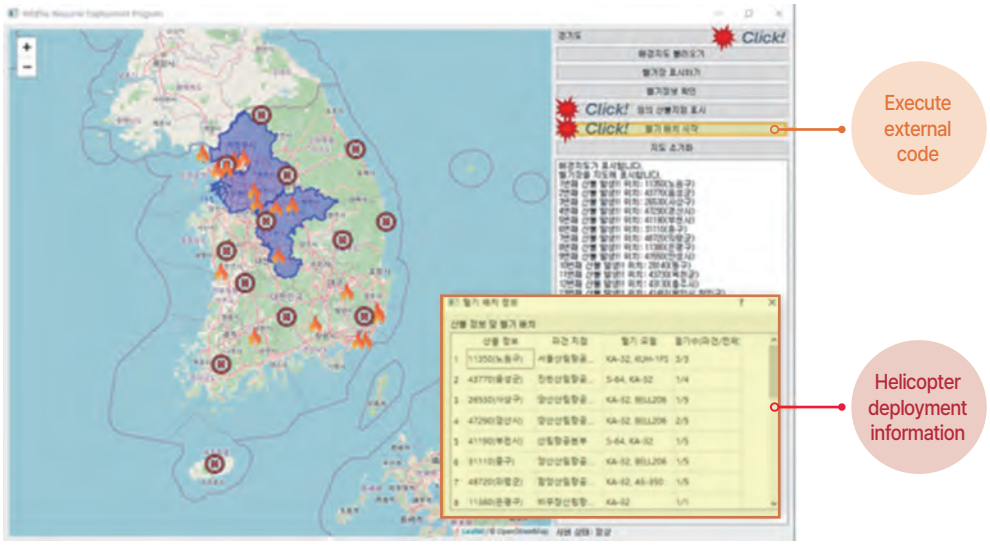
Schematic Diagram of the Optimized Process-based AI-Integrated Wildfire Spread Model
(Applying MCMC and Hierarchical Bayesian Methods)



Development of an Aerial Firefighting Resource Allocation Algorithm

An operational model was developed to assess wildfire spread difficulty and the potential for large-scale escalation, while factoring in required suppression times. Based on this model, an algorithm was established to determine optimal deployment routes for aerial firefighting resources including suppression helicopters.

Figure 2.2.10 Optimal Routing for Aerial Firefighting Resources



Design of a Wildfire Response Strategy Support System

By analyzing existing response systems to identify gaps and areas for improvement, a decision support system was designed to facilitate wildfire response strategies. This system integrates geospatial data with unified algorithm linkages to visualize both prediction outcomes and resource allocation information.

Key Achievements

Enhanced Accuracy and Speed in Wildfire Spread Prediction

NIFoS established a comprehensive nationwide database by synthesizing meteorological, topographical and vegetation data with historical wildfire records. Based on this foundation, an AI-driven prediction model was developed using Artificial Neural Network (ANN) and Reinforcement Learning techniques. Compared to legacy models, this system delivers superior predictive accuracy by incorporating real-time weather fluctuations and regional environmental variables, thereby enabling more rapid and informed operational responses.

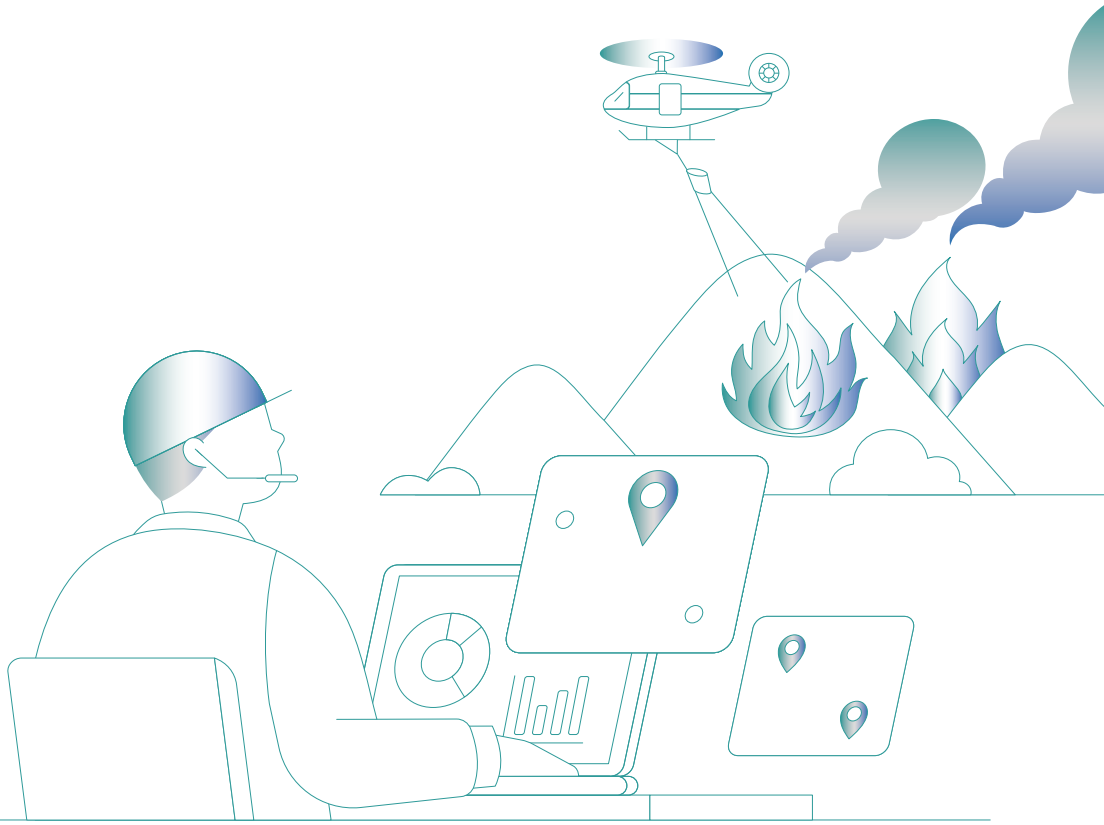
Real-time Response Framework and Strategic Resource Management

By integrating the prediction model and monitoring system into a unified software architecture, the government established a framework for real-time wildfire analysis and seamless information sharing with field responders. Furthermore, a strategic model was developed to optimize the deployment of firefighting assets, such as helicopters, by analyzing predicted fire size, spread velocity, and suppression difficulty. This enables precision deployment of resources at critical times and locations, facilitating effective early-stage intervention and significantly mitigating the risk of large-scale disaster impacts.

Future Directions

As the scale and frequency of wildfires escalate due to climate change, AI-powered real-time data analysis has emerged as a critical tool for proactive risk mitigation and damage reduction. Moving forward, the digital transformation of wildfire response frameworks will necessitate ensuring data integrity and timeliness, while establishing a robust foundation for the seamless integration of cutting-edge AI technologies.

Furthermore, to operationalize these innovations in real-world emergency settings, close multi-agency collaboration among KFS, the National Fire Agency, MOIS, local governments and local communities is essential. KFS remains committed to continuously refining the precision of its predictive technologies and strengthening institutional partnerships to enhance Korea's capacity to respond proactively to large-scale wildfire disasters.



2.7

Securing the Golden Hour with Cloud-Based Collaboration

(119 Emergency Medical Smart System)

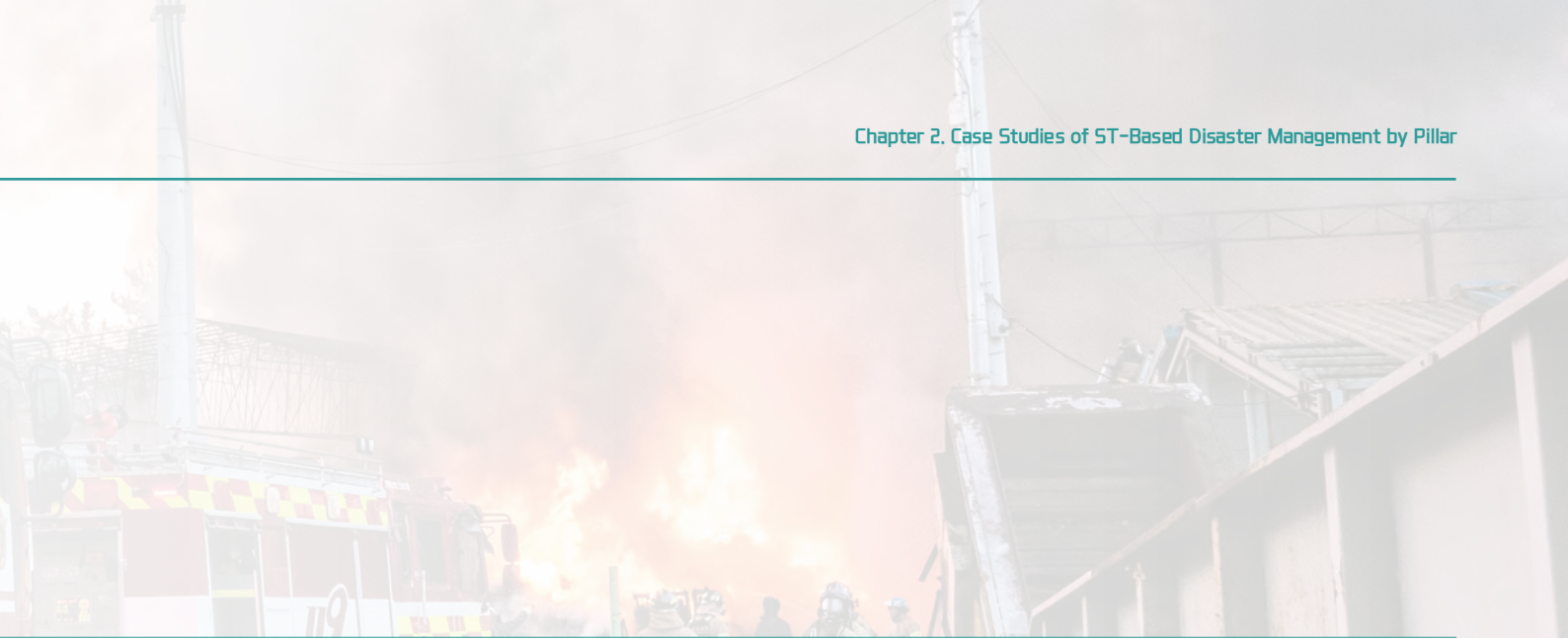
Responsible Department | National Fire Agency, 119 EMS Division
Contact (Email) | rladbswhd123@korea.kr

Background and Development

In large-scale disasters, rapid coordination among fire departments, medical facilities, and local governments is paramount to securing the "Golden Hour." During mass casualty events, the ability to perform swift triage and systematically manage transport and treatment is decisive in maximizing survival rates. The October 2022 Itaewon crowd crush underscored critical gaps in Korea's emergency medical response, particularly regarding real-time information sharing under extreme pressure.

To address these vulnerabilities, the National Fire Agency (NFA) launched a full-scale overhaul of its legacy emergency systems-originally developed between 2007 and 2014. Since 2022, the NFA has shifted toward a G-Cloud–based infrastructure, focusing on standardizing data linkages and establishing a seamless integrated network between central and provincial authorities. These upgrades eliminate data silos, providing field responders with a more agile and efficient framework at the disaster site.

A cornerstone of this modernization is the Pre-KTAS (Pre-hospital Korean Triage and Acuity Scale). By standardizing patient classification before hospital arrival and integrating a dedicated hospital selection function, the system ensures that patients are matched with the appropriate medical facility in real time. Following a successful pilot in Daegu, the new system was rolled out nationwide in February 2024.



Key Features

Integrated Platform via Unified Emergency Medical System

Previously, fragmented operations between central and provincial governments led to significant hurdles in data interlinkage. These silos, combined with aging software, often resulted in system failures that delayed critical public services, including emergency first aid, medical consultations, and hospital guidance.

To resolve these inefficiencies, the National Fire Agency (NFA) standardized both operational workflows and data protocols. By consolidating these disparate systems into a single integrated platform, the NFA has ensured seamless coordination across all levels of government, enabling a faster and more reliable response to public medical needs.

Enhanced Stability through G-Cloud Infrastructure

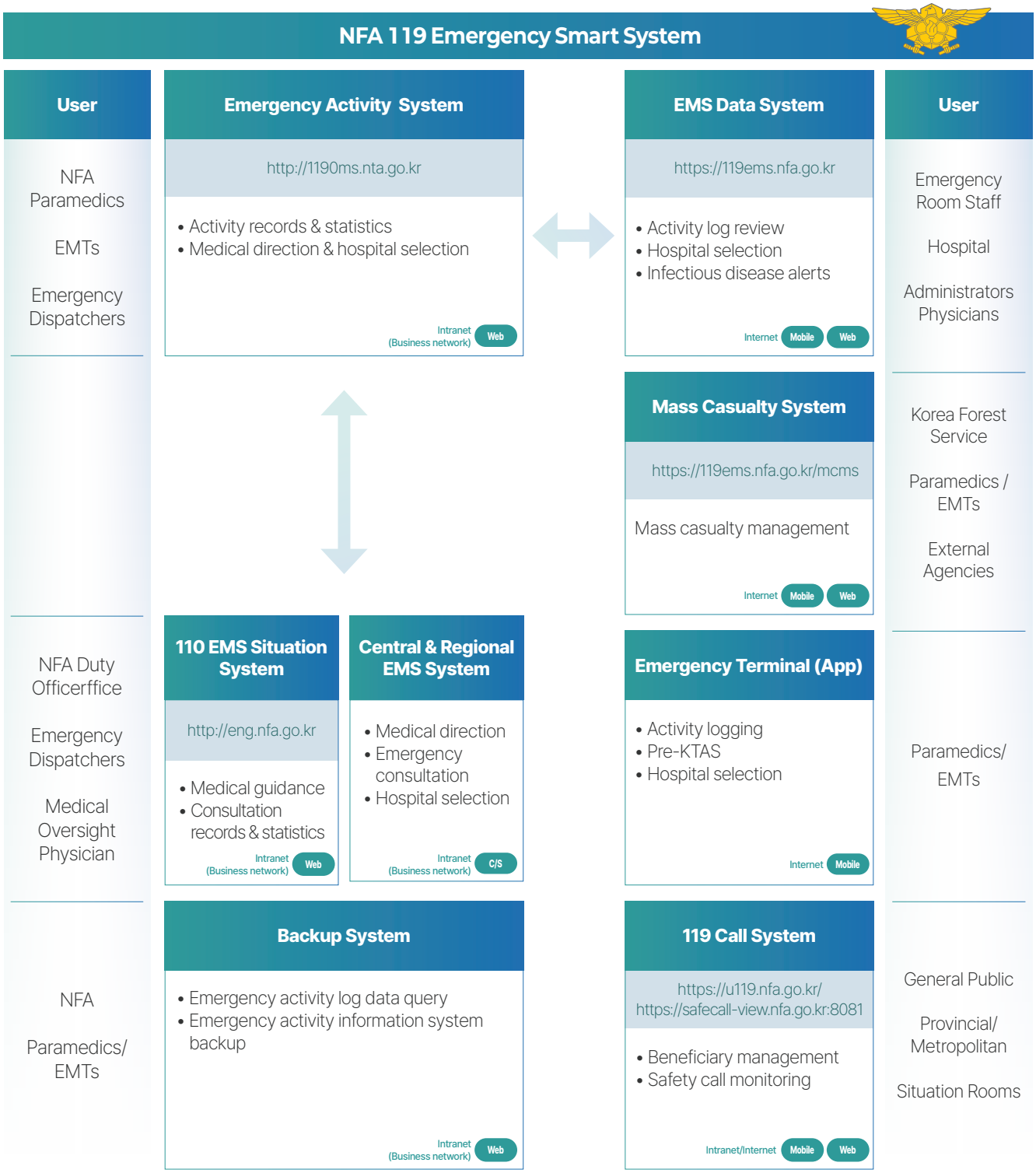
The legacy systems introduced between 2007 and 2014 had become increasingly prone to systemic risk due to technical obsolescence. To mitigate this, the NFA migrated these services to the G-Cloud infrastructure managed by the National Information Resources Service.

This transition allows for the centralized, cloud-based management of diverse systems, including:

- 119 Safe Call System (2007)
- Rescue and EMS Activity Information System (2009)
- 119 EMS Situation Management System (2012)
- National Emergency Patient Transport Information Network (2013)
- EMS Terminals (2013)

By unifying these tools under a cloud environment, the NFA has significantly improved operational efficiency and ensured the high-level stability required for life-saving emergency services.

Figure 2.2.11 Configuration of the 119 Emergency Medical Smart System



Key Achievements

Advanced Emergency Triage System

The National Fire Agency has integrated the Korean Triage and Acuity Scale (KTAS)-the same standard used by hospitals-directly into field emergency operations. By classifying the severity of a patient's condition using unified hospital-grade criteria prior to arrival, the system ensures consistency and accuracy throughout the transport and treatment process. This alignment between paramedics and medical facilities significantly enhances the probability of securing the "Golden Hour" for critical patients.

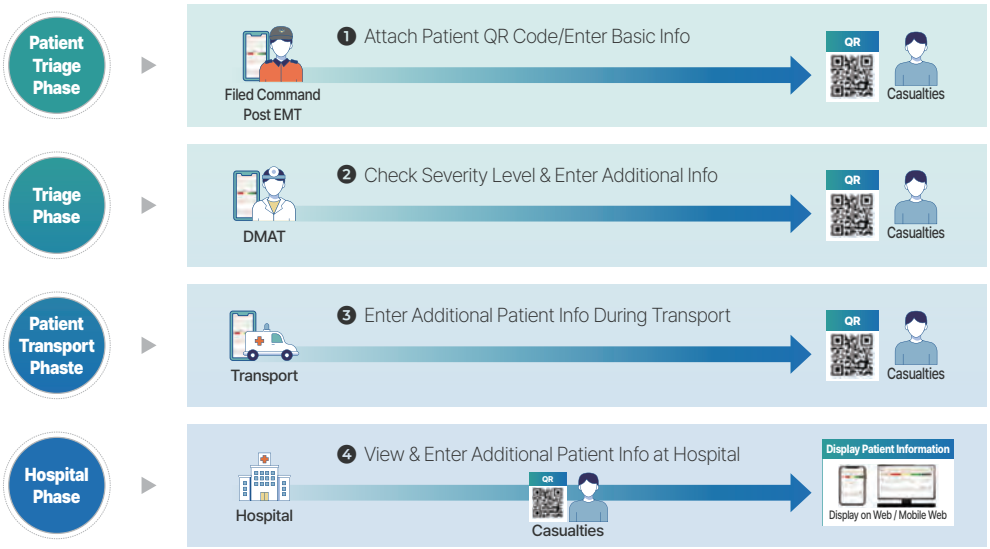
Figure 2.2.12 Pre-KTAS Feature in the 119 EMS Smart System



Established Mass-Casualty Management Framework

In the event of major disasters, EMS personnel can now attach QR codes to patients and track them in real time through terminals and smartphones. This innovation reduces on-site confusion and significantly enhances the efficiency of patient transport and emergency care.

Figure 2.2.13 Mass Casualty Management Function



Future Directions

Over the past four years, the NFA has successfully transitioned its legacy EMSs into a unified, cloud-based integrated platform, implementing innovative solutions to address long-standing challenges identified at disaster sites.

To ensure the new system—deployed nationwide in February 2024—becomes firmly established and continues to secure the Golden Hour for the public, the NFA remains committed to its evolution. The agency will conduct regular consultations with frontline paramedics, medical institutions, and other key stakeholders to gather feedback, ensuring that user insights are continuously integrated into future system enhancements and policy refinements.

2.8 Addressing Disaster Resource Shortages through Real-time Sharing

(Korea Disaster Resource Management System)

Responsible Department | MOIS, Disaster Resource Management Division
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Background and Development

The timely mobilization of disaster management resources, including heavy equipment, vehicles, and relief supplies, is critical for effective disaster response and swift recovery. However, individual local governments and agencies face practical challenges in securing adequate resources while also addressing daily needs related to the economy, welfare, and urban administration. Consequently, shortages during major disasters have, at times, exacerbated damage and delayed recovery efforts.

To address these issues, MOIS developed the Korea Disaster Resource Management System (KRMS) to incorporate the concept of the sharing economy into disaster resource management. It is designed to consolidate disaster resources owned or stockpiled across the country into a single platform, allowing users to search for and request the resources they need in disaster-affected areas. KRMS was developed over a three-year period, starting in September 2020, and was officially launched in January 2024 following a pilot.

Key Features

Systematic Registration and Stockpile Management

Under normal conditions (peacetime), disaster resource managers use the KRMS to register and maintain detailed data on stockpiled assets, including resource type, quantity, and performance specifications.
As of November 2025, the system's robust database includes:

- 21,955 registered resource managers
- 14,519 specialized storage facilities
- 80.05 million items categorized into 803 distinct types

This comprehensive inventory encompasses heavy machinery, specialized vehicles, medical supplies, and protective clothing essential for responding to floods, wildfires, and extreme snowfall. To ensure rapid mobilization, the platform provides AI and Big Data-driven search functions, enabling precise, efficient retrieval of resources during an active crisis.

Rapid Mobilization and Support during Disasters

In times of emergencies, KRMS enables responders to identify necessary resources and request them from nearby facilities and managers. Its GIS functions analyze resource and transport route locations, enabling the creation of optimal deployment plans. This significantly enhances the speed and efficiency of disaster response.

Key Achievements

Integration of Dispersed Resource Information

Figure 2.2.14 KRMS Integrated Control Dashboard



A hallmark achievement of the KRMS is the unification of disaster resource management, which was previously fragmented across multiple agencies and jurisdictions. By consolidating these disparate data streams into a single source of truth, the system ensures that limited resources can be rapidly secured and mobilized to the areas of greatest need, maximizing national response efficiency.

To achieve this, the KRMS incorporates advanced ICT-based logistics solutions, adapting private-sector innovations for public safety. These include:

- Supply Chain Management (SCM)
- Warehouse Management Systems (WMS)
- Transportation Management Systems (TMS)
- Integrated Logistics Systems

By integrating these technologies, it is now possible to track and manage supply chains, warehousing, and transport status in real time. This data-driven approach has transformed disaster resource operations from a manual, reactive process into a highly efficient, proactive management framework.

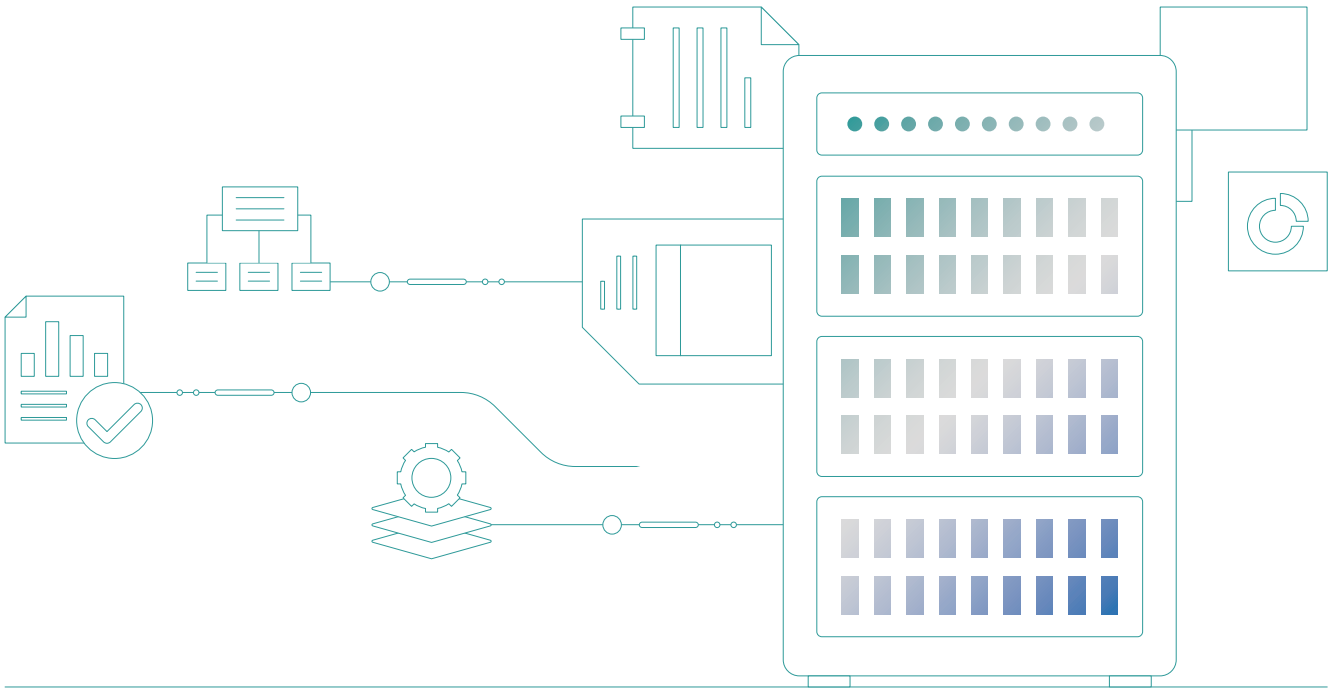
Rapid Resource Mobilization During Disasters

Beyond information management, the KRMS serves as a dynamic platform supporting rapid resource mobilization during actual disaster responses.
During an aircraft accident in Muan in December 2024, relief supplies, such as blankets, were quickly identified and delivered via the KRMS. Similarly, during the wildfires in the Gyeongbuk and Gyeongnam provinces in March 2025, the system was used to identify the real-time availability of radios and firefighting vehicles stockpiled by neighboring local governments. This enabled efficient mobilization requests by providing immediate access to resource status and contact information for the responsible personnel.

Future Directions

The effectiveness of KRMS depends on its active use by resource managers nationwide. Therefore, user feedback has been integrated since the development stage. The system's scope has expanded beyond physical goods to include human resources, formal agreements, assets, and information from private-sector suppliers.

To ensure the system functions effectively in the field during disasters, plans are in place to strengthen customized information capabilities through continuous user feedback. Additionally, user convenience will be improved through a reorganization of the mobile-friendly system. These efforts aim to establish KRMS as a practical tool for the field, further enhancing national disaster resource management capacity.



Chapter 2

Pillar 3

Building Safer Communities through Digital Participation

3.1 Protecting Community Safety through Citizen Digital Reporting
3.2 All Disaster Safety Information Integrated in One Place
3.3 Breaking Down Language Barriers in Emergency Calls
3.4 Curious about How Safe Your Community Is?

3.1 Protecting Community Safety through Citizen Digital Reporting

(Safety e-Report System)

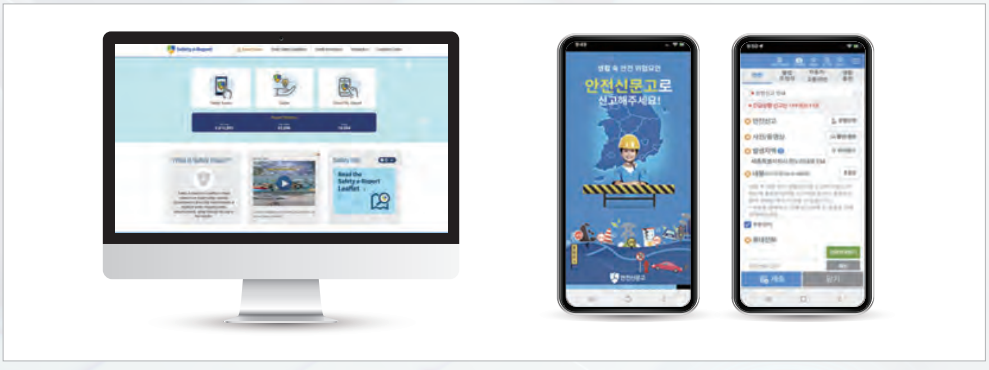
Responsible Department | MOIS, Safety Improvement Division
Contact (Email) | hoon25@korea.kr

Background and Development

Local governments make continuous efforts to identify and eliminate safety hazards to protect residents. However, due to limited manpower and administrative resources, it is difficult to preemptively identify every latent risk. The Safety e-Report is a digital citizen participation platform designed to strengthen community safety by helping local governments identify risk factors they might otherwise miss. It allows safety-conscious citizens to report everyday risks encountered in daily life such as commuting, going to school, shopping, and walking that could threaten their safety and that of their families.

Launched its service for PC and mobile in December 2014, it introduced a mobile app in February 2015. Since then, it has received positive evaluations as citizens' reports have contributed to strengthening community safety, and the number of reports and users has steadily increased. Over the past 10 years, the reporting fields and functions of the Safety e-Report System have been continuously improved. In 2024, the number of reports exceeded 12 million, growing into Korea's representative resident participation platform in the safety field.

Figure 2.3.1 Safety e-Report Portal and Mobile App



Key Features

Scope of Reporting

Residents can report a wide range of risk factors that threaten community safety or cause public inconvenience.

Table 2.3.1 Safety e-Report System: 4 Categories and 30 Types

Category	Reporting Targets
Safety	Damaged roads/facilities, hazards at construction/demolition sites, air/water pollution, non-emergency fire safety issues
Illegal Parking	Parking or standing subject to fines under the Road Traffic Act, Framework Act on Fire Services, Act on Convenience Promotion of Persons with Disabilities, and the Act on Promotion of Development and Distribution of Eco-Friendly Vehicles
Traffic Violations	Traffic violations, vehicle/motorcycle violations, overloading, license plate violations, illegal lighting, covered/damaged reflectors, illegal tuning
Public Nuisance	Illegal advertisements, abandoned bicycles, littering, and other inconveniences to daily life

Reporting and Processing Procedures

Reports received through the system are transferred to the responsible agencies. Most reports are addressed within seven days after which the results are notified to the reporter.

Table 2.3.2 Safety Report Submission and Processing Procedure

	Responsible Agency	Key Details
Safety Report Submission & Classification	Reporter (submission) → Safety Report Management Team	The report is received in the system and automatically classified to the responsible agency.
Safety Report Processing & Response	Responsible agency → Action and response by the processing department → Confirmation by the reporter	The General Civil Affairs Department designates the processing department. Within 7 days, the action taken is notified to the reporter through alerts ※ PUSH, KakaoTalk notifications, RCS (Rich Communication Services), LMS (Long Message Service), etc.

Key Achievements

Growth into Korea's Leading Safety Reporting Platform

While only 1,488 reports were received in 2014, its inaugural year, the Safety Report System has established itself as the government's representative platform for reporting safety hazards, with the annual number of reports surpassing 12 million in 2024. This growth was driven by high levels of citizen participation and the expansion of reporting categories.

Although it is difficult to quantify the extent of damage prevented by these reports, it is assessed that the detailed reports submitted by numerous citizens across various fields have substantially contributed to preventing local disasters and accidents and to protecting lives and property.

Table 2.3.3 Number of Safety Report Submissions by Year

(Unit: cases)

Year	2014	2015	2016	2017	2018	2019
Cases	1,488	74,173	152,768	226,919	236,002	1,018,717

Year	2020	2021	2022	2023	2024	2025 (As of July)
Cases	1,889,200	4,940,870	5,654,076	7,528,979	12,434,938	6,809,460

※ Source: MOIS, Statistical Yearbook of Interior and Safety (2018, p. 373; 2025, p.226 and MOIS internal data (2025)

Integration of Similar Reporting Systems

Previously, reporting systems with similar functions, such as Living Inconvenience Reports (developed by MOIS in 2012) and Smart Citizen Reports (developed by the National Police Agency in 2015), were operated redundantly. Living Inconvenience Reports was integrated into the Safety e-Report System in December 2020, and Smart Citizen Reports was integrated in April 2024. This allows citizens to report a wide range of safety and traffic-related hazards through a single platform while also improving administrative efficiency by reducing redundant costs associated with operating separate systems.

Continuous Expansion of Reporting Categories

The Safety e-Report System has steadily expanded its reporting scope to encompass various fields closely tied to citizens' daily lives. This expansion including illegal parking (April 2019), violations of COVID-19 quarantine rules (July 2020), hazards at demolition sites (August 2021), illegal parking in fire engine-only lanes and eco-friendly vehicle charging zones (2022), illegal lodging facilities (2023), and clogged storm drains (2023) has strengthened the foundation for actively capturing and resolving factors that could lead to actual risks.

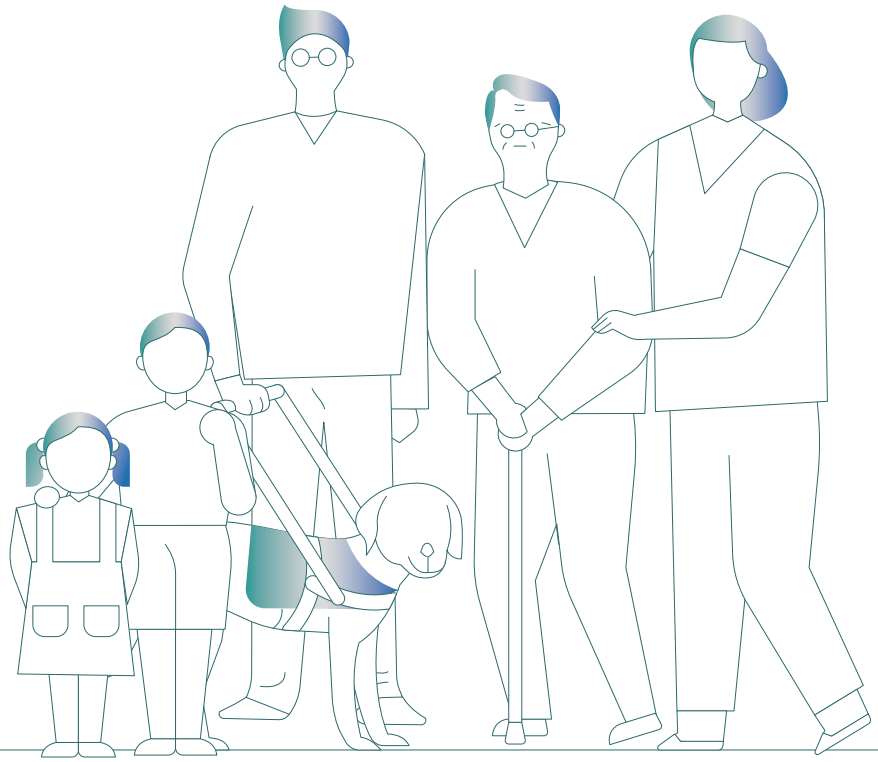
Strengthening Inclusive Functions for Vulnerable Groups

Customized functions for different groups have been continuously introduced to ensure that various demographics can report without inconvenience. These include the "Magnifying Glass Report" for seniors and persons with disabilities (November 2016), "English Reporting" for foreigners (December 2017), and the "Children's Safety Report System" for children (March 2025). In particular, the "Children's Safety e-Report System" allows elementary school students to directly report risk factors around schools; this is expected not only to secure children's safety but also to provide educational benefits by raising disaster safety awareness.

Future Directions

To encourage greater public participation, MOIS will continue initiatives such as the Seasonal Disaster Safety Focused Reporting System, which raises awareness of seasonal risk factors. Collaboration with volunteer groups, such as the Safety Monitoring Corps will also be strengthened to resolve safety blind spots through more detailed inspections and reports.

Furthermore, to handle the rapidly growing volume of reports more efficiently, MOIS plans to gradually introduce generative AI into the platform. This will improve user convenience, ensure faster and more accurate routing of reports, and enhance analysis of submitted cases—further advancing the effectiveness of the Safety e-Report.



3.2 All Disaster Safety Information Integrated in One Place

(National Disaster and Safety Portal)

Responsible Department | MOIS, Disaster Information and Communication Division
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Background and Progress

Citizens equipped with disaster safety knowledge and familiar with action guidelines can prevent disasters or at least minimize damage when they occur. Such "disaster knowledge" not only protects the lives and property of individuals and families but also enhances the overall disaster response capacity of communities and the nation, strengthening resilience. To meet this need, the government established the National Disaster and Safety Portal (www.safekorea.go.kr) in 2007 to provide comprehensive information, including citizen action guidelines, evacuation facility locations, and up-to-date disaster and safety updates.

Since its launch, the portal has continuously expanded its service scope and function. In August 2020, an English-language site (eng.safekorea.go.kr) was opened to improve accessibility for foreign residents. Efforts have also been made to strengthen system stability including creating emergency pages to handle traffic surges during large-scale disasters.

Main Features

One-Stop Disaster Safety Information

The National Disaster and Safety Portal provides citizens with a wide range of services in a single site: information for disaster prevention and preparedness, such as citizen action guidelines by disaster type and self-safety inspections: as well as civil defense, citizen safety insurance, disaster psychological counseling, and disaster status and statistics.

Table 2.3.4 Disaster and Safety Information Provided by the National Disaster and Safety Portal

Menu	Information Provided
Disaster prevention and preparedness	Action guidelines by disaster type, readiness checklists, self-inspections, playground facility checks, drills, and emergency contacts.
Civil defense	System overview, education and training, alerts, and guidance on emergency facilities.
Insurance and safety	Information on storm, flood, and earthquake insurance, claim procedures, case examples, safety resources, and citizen safety insurance.
Disaster psychological counseling	Support system information, multimedia resources, counseling centers, symptom and coping guides, and online applications.
Disaster status	Information on floods, red tides, wildfires, disaster text alerts, weather, traffic, firefighting, evacuation sites, risk areas, and statistics.
Participation and reporting	Property damage reports, recovery progress updates, and donation records.

Access to Disaster Text Alert Records

Citizens can search both past and current disaster text alerts issued by government agencies and local governments in one place. It is possible to search alerts by disaster type, region, time period, title, and content, making it easy to identify the history and current status of disaster occurrences across the country.

Online Reporting of Private Property Damage

When natural disasters cause property damage, citizens can submit reports online without visiting local offices. Submitted reports are used as the grounds for the payment of disaster relief funds, distribution of relief donations and indirect support.

Key Achievements

Increased Public Interest and Accessibility

The number of visitors to the National Disaster and Safety Portal has increased steadily since 2019, reaching about 5 million in 2024, with a monthly average of about 410,000. This growth establishes the platform as a representative portal in the disaster and safety field frequently used by the public.

Table 2.3.5 Annual Visitors to the Disaster and Safety Portal

(Unit: 1,000 persons)

Total	2016	2017	2018	2019	2020	2021	2022	2023	2024
30,467	4,476	3,969	4,826	2,063	2,352	2,181	2,324	3,263	5,013

Inclusive Information for Vulnerable Groups

In August 2020, an English-language site (eng.safekorea.go.kr) was opened for foreign residents in Korea to ensure that users of various languages can easily access disaster and safety information. The number of visitors to the English site grew significantly, from about 43,000 in 2021 to about 150,000 in 2024. To guarantee information accessibility for vulnerable groups, such as persons with disabilities and older adults, the portal also acquired web accessibility certification to ensure an inclusive environment where anyone can easily access the information.

Table 2.3.6 Annual Visitors to the Portal's English Website

(Unit: 1,000)

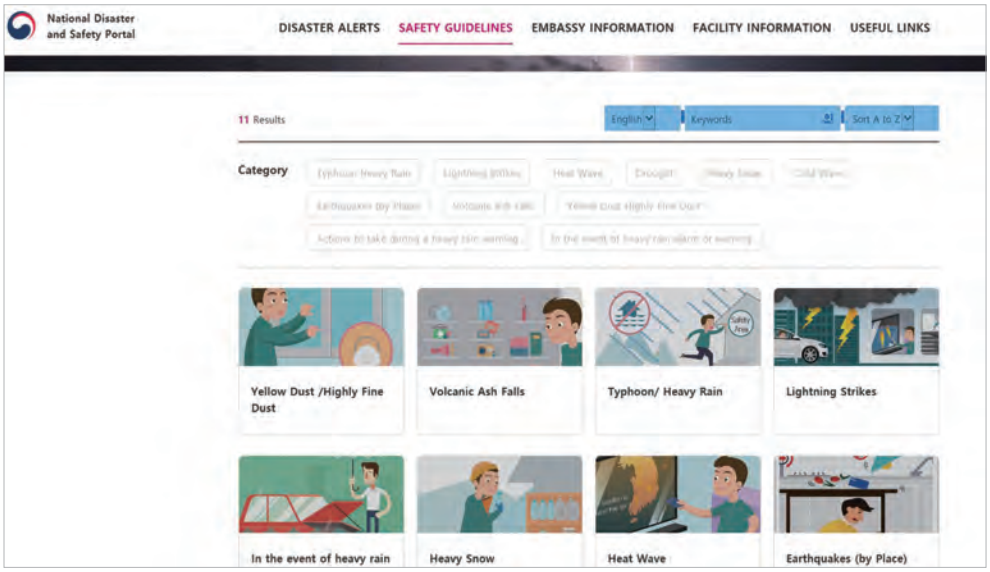
Year / Cases	Total	2021	2022	2023	2024
	229.7	4.3	10.2	69.2	146

Future Directions

As Korea's representative government portal for providing comprehensive disaster and safety information, the service will continue its efforts to enhance content quality and user convenience.

By utilizing the growing volume of disaster and safety data, the portal will provide information in a more user-friendly manner. This includes providing location-critical information, such as emergency medical facilities and evacuation shelters, through GIS-based maps. To improve accessibility for foreigners, an automatic translation function in 19 languages will be introduced on the English site, further enhancing access to information for visitors and residents in Korea.

Figure 2.3.2 Action Guidelines Provided by the English National Disaster and Safety Portal



3.3 Breaking Down Language Barriers in Emergency Calls

(Emergency Ready App)

Responsible Department | MOIS, Prevention and Safety Policy Division
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Background and Development

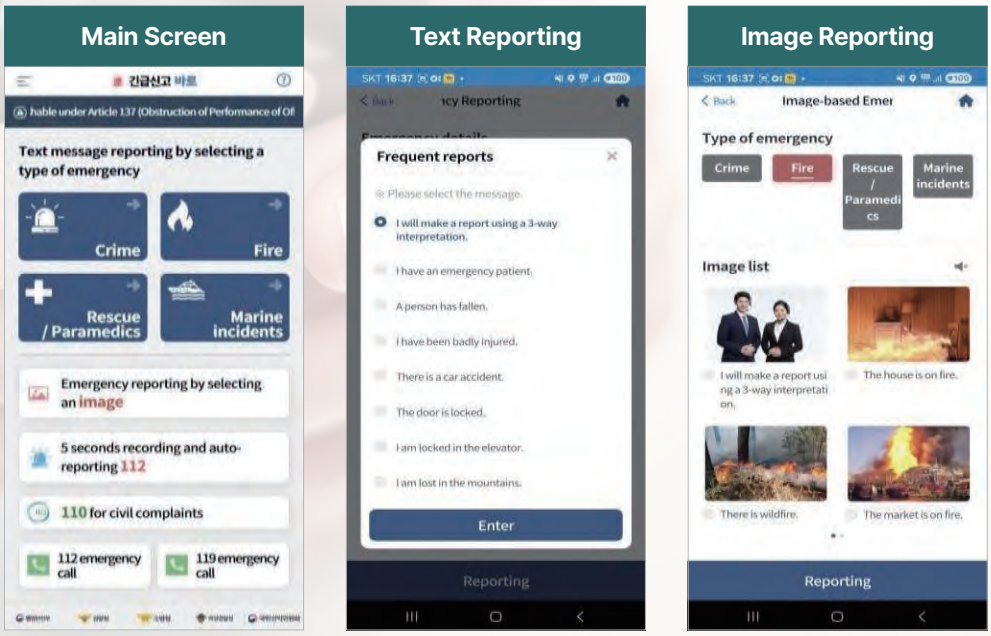
Foreign residents with limited Korean proficiency, multicultural families and persons with hearing impairments often face difficulties in reporting emergencies through hotlines such as 119 (firefighting and ambulance) or 112 (police). Although these groups are among the most vulnerable and in need of urgent assistance, they may be exposed to greater danger if they cannot report emergencies in time.

To address this challenge and support timely reporting by vulnerable groups, the Emergency Ready App was developed. Following a development phase from 2018 to 2022 and a pilot period ending in May 2023, the app has been officially launched as a public service available to all citizens.

Main Features

Easy Reporting through an Intuitive Interface

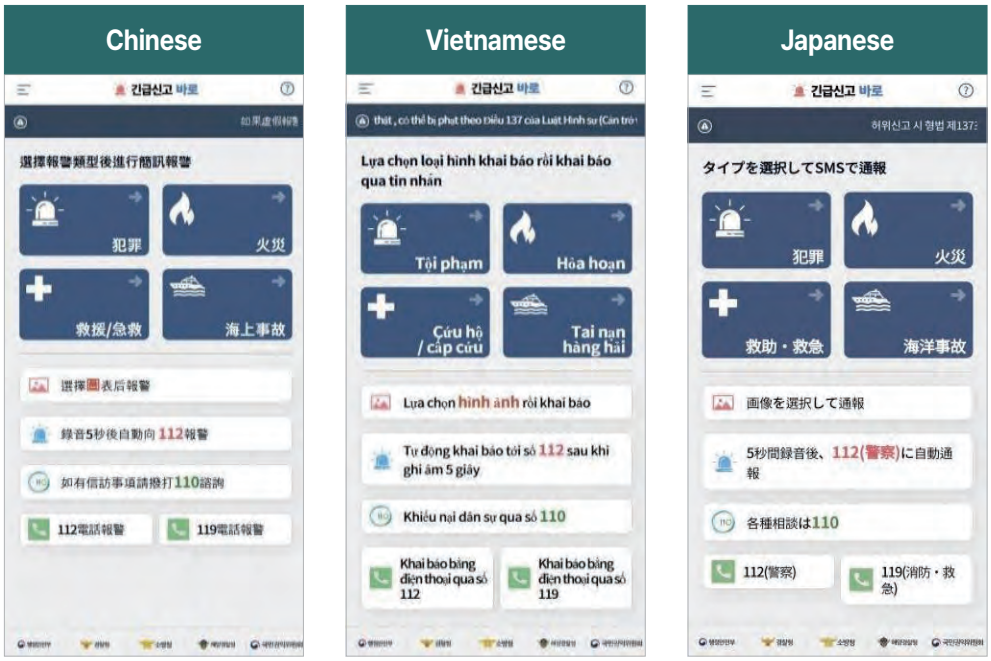
Figure 2.3.3 Various Reporting Methods via the Emergency Reporting App



The Emergency Ready App visualizes reporting categories, such as crime (police), fire/rescue/ambulance (fire service), and maritime accidents (coast guard), using icons or images that users can simply tap on their smartphones. In addition to voice calls, users can report emergencies through text, images, videos, and photos. The app automatically transmits GPS-based location data, enabling a rapid response.

Support for Emergency Reporting in Five Foreign Languages

Figure 2.3.4 Multilingual Emergency Reporting via the Emergency Reporting App



There are approximately 1.76 million foreign residents in Korea (comprising roughly 1.35 million registered foreigners and 410,000 members of multicultural families*). Within this population, speakers of English, Chinese, Japanese, Vietnamese and Filipino account for about 67% of the total. Reflecting these demographic characteristics, the app's reporting menus are provided in these five languages, enhancing accessibility by allowing foreign residents to report emergencies in their native tongues.

* Source: *Ministry of Justice, Statistics on Entry/Exit and Registered Foreign Residents (2023); Statistics Korea, 2023 Population and Housing Census*

Key Achievements

Improved Accessibility for Vulnerable Groups

Persons with disabilities, foreign residents and multicultural families who have difficulty making phone calls can now report emergencies in multiple formats—text, images, and video—creating an inclusive reporting environment.

Establishment of an Integrated Emergency Reporting System

A single application enables direct reporting to major response agencies, including the police (crime), fire service (fire, rescue, ambulance), and coast guard (maritime accidents). This integrated system provides a convenient one-stop emergency service from the citizen's perspective.

Growing Use in Real-World Situations

As of 2024, the Emergency Ready App has reached 281,326 downloads, with 6,019 cases actually used for emergency reporting. Since its transition from its pilot phase to an official service, the steady accumulation of real-world use cases demonstrates its potential to become an established digital emergency reporting platform.

Future Directions

Awareness of the app remains relatively low among foreign residents. To address this, promotion and training will be strengthened through key institutions, such as airports, foreign worker support centers and multicultural family support centers, where foreign residents frequently gather or seek assistance.

In addition, continuous user feedback will be collected to develop tailored training content that reflects diverse languages and user characteristics, thereby strengthening the emergency response capacity of vulnerable groups. Furthermore, analysis of the reporting data collected through the app will help systematically identify risk factors and inform more targeted safety policies in the future.

3.4 Curious About How Safe Your Community Is?

(Safe Map: Daily Safety Information Service)

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Background and Development

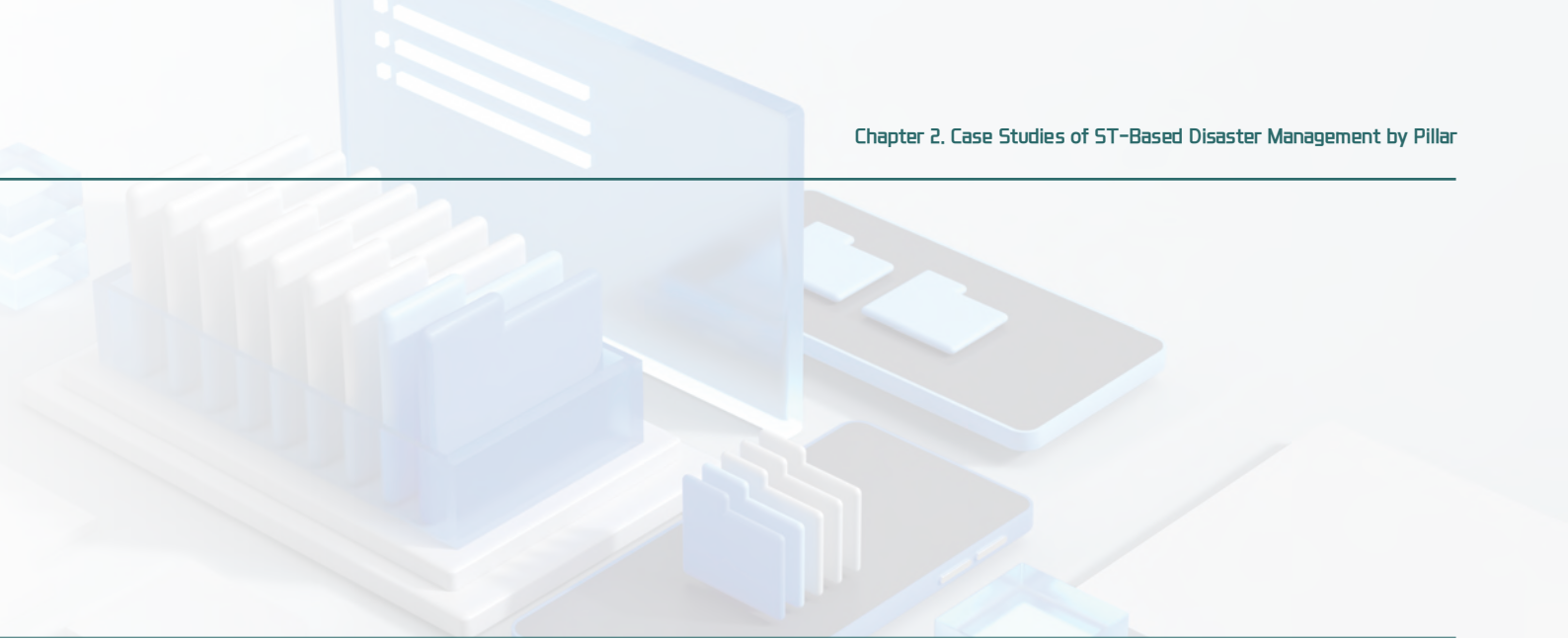
"How safe is my neighborhood?" is a question that many citizens ask. In the past, however, it was difficult for the public to directly access the disaster, crime, and safety information held by the government. To address this, the government established the Safe Map service (www.Safe Map.go.kr), enabling anyone to check the risk factors and safety conditions of their area of interest.

By integrating various types of public data, such as disaster and accident history, facility information and crime statistics, this service enhances the public's capacity for voluntary prevention. It also serves as essential foundational data for local governments when establishing disaster and safety policies.

Starting in 2013 with Business Process Reengineering (BPR) and Information Strategy Planning (ISP), the system moved through a pilot phase while its content and databases were steadily expanded. The successful completion of the main project in 2017 marked the beginning of the full-scale services for the entire nation.

Figure 2.3.5 Main Interface of the Safe Map Service





Main Features

The platform provides information through three main categories, “Safe Map,” “Regional Safety Grades,” and “Facility Safety Information,” accessible via both PC and mobile devices.

1) Safe Map

Safe Map visualizes various everyday risk factors through a map-based interface. It categorizes over 130 types of safety information, including flood traces, crime-prone areas and accident hotspots into six key categories: disaster, public safety, transportation, health, living environment, and facilities.

The service also provides the locations of critical safety facilities such as shelters, CCTV cameras, emergency call boxes and Automated External Defibrillators (AEDs). In addition, it includes essential response guidelines for disasters like fires and earthquakes. Through a built-in reporting function, users can report hazards they encounter in their surroundings directly.

Table 2.3.7 Information provided by the “Safe Map”

Domain	Service Content
Disaster	Real-time earthquake information, flood extent, flood risk maps, landslide history, etc.
Public Safety	Crime-prone areas (robbery, sexual violence, etc.), women’s nighttime safety, subway crime risk zones, etc.
Transportation	Real-time traffic information, accident-prone zones, icy road sections, bicycle paths, etc.
Health	Disease prediction, hospitals, emergency medical facilities, pharmacies, livestock epidemic data, etc.
Living Environment	Construction status, aging buildings, facility safety grades, mountain hiking safety maps, etc.
Facilities	Cooling shelters, emergency call boxes, smart safety booths, hazardous chemical facilities, etc.

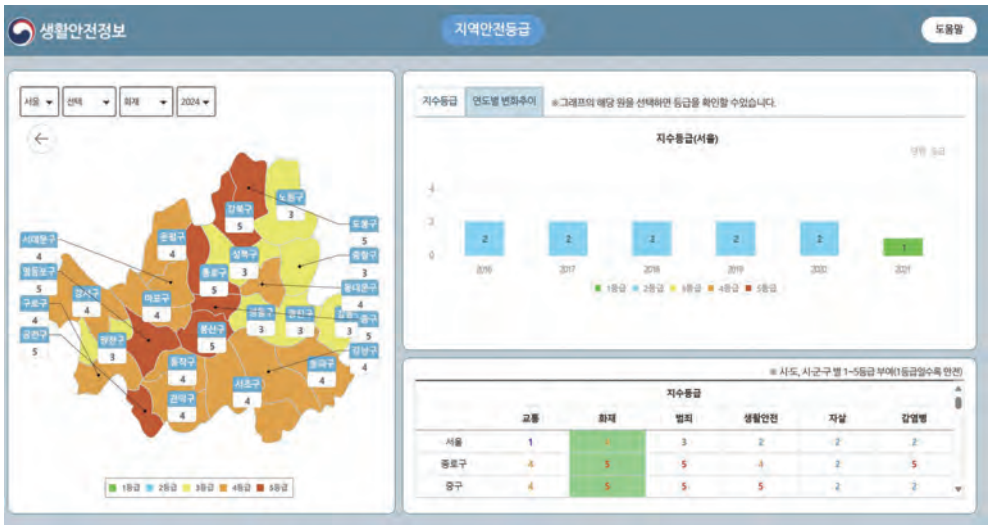
2) Regional Safety Grades

Regional Safety Grades provide a quantitative evaluation of local safety levels, helping citizens intuitively understand the relative risk of their areas of interest. The system analyzes data across six key domains-traffic, fire, crime, daily safety, suicide and infectious diseases-to assign each region a grade from Level 1 to Level 5.
Safety Grade Scale:

- **Level 1**
  - Highest safety level (top-performing region/sector)
- **Level 5**
  - Lowest safety level (vulnerable region/sector requiring urgent improvement)

Citizens can review historical grading records to track safety trends over time. Meanwhile, local governments utilize this data to identify vulnerabilities and formulate targeted policies to enhance regional safety.

Figure 2.3.6 Regional Safety Grade Search Interface (Seoul Fire Service)



3) Facility Safety Information

Facility Safety Information provides integrated data on the condition and safety of critical infrastructure including bridges, tunnels, and public buildings. In addition to basic specifications such as location, purpose and scale the platform discloses comprehensive details, including periodic inspection histories, maintenance records, past incident case studies and legal compliance status.

For selecting facilities, the system leverages advanced monitoring via IoT sensors and drones. This technology enables the early detection of risk indicators like cracks or ground subsidence, ensuring a proactive response. In the event of an accident, this data supports rapid recovery efforts and helps establish measures to prevent recurrence.

Figure 2.3.7 Facility Safety Information Search Interface

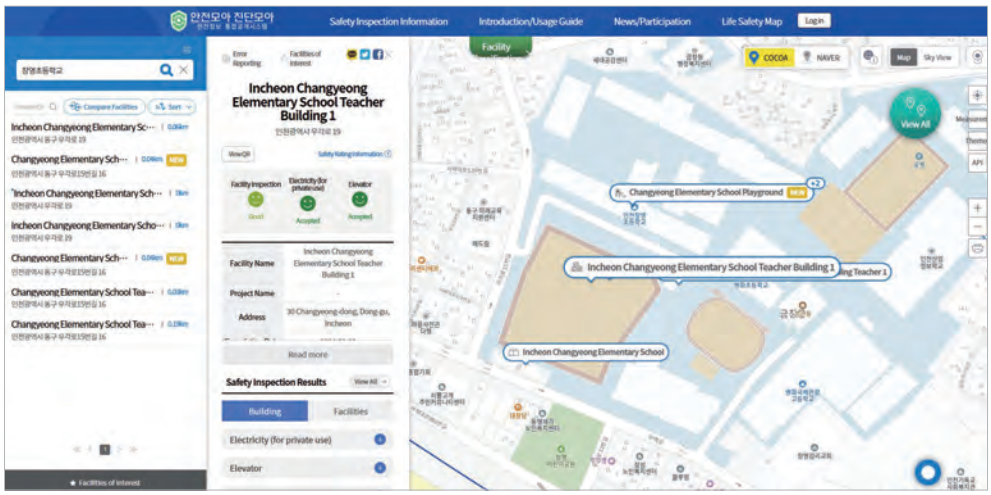
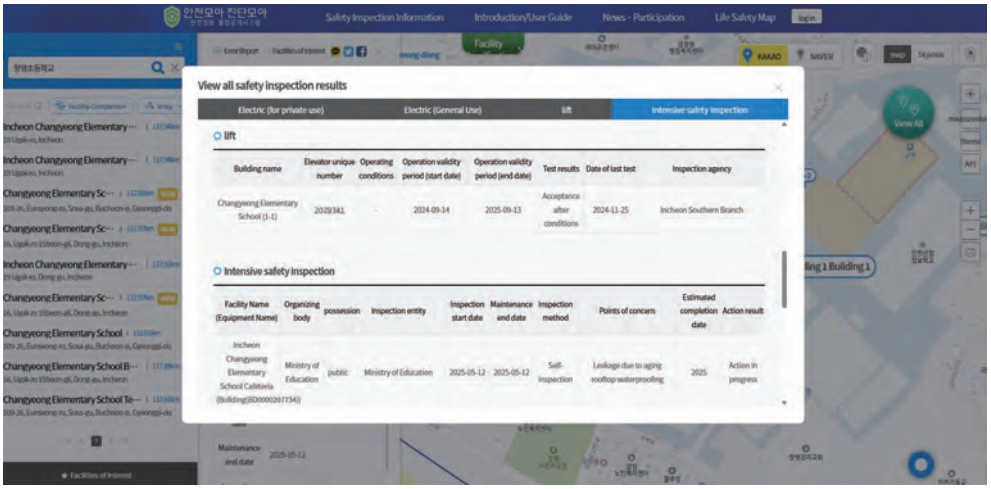


Figure 2.3.8 Safety Inspection Results Inquiry Interface



Key Achievements

The Safe Map service enables citizens to intuitively identify risk factors within their residential and activity areas through map-based visualization, while providing essential disaster-response information. This has significantly contributed to raising public risk awareness in everyday life.

By transparently and systematically disclosing safety inspection results and other data previously difficult for the public to access, the service has enhanced the accountability and accuracy of safety management activities conducted by both central and local governments. Notably, it provides objective diagnostics of a municipality's strengths and vulnerabilities, thereby supporting data-driven decision-making for local governments to establish the strategic direction of their disaster and safety policies.

Future Directions

In accordance with the Framework Act on the Management of Disasters and Safety, the Safe Map service regularly updates its databases and continues to strengthen quality management to ensure high levels of reliability and accuracy. Recently, the platform has integrated emerging public concerns, such as fine dust levels and climate-related risks, enhancing both timeliness and relevance to the daily lives of citizens.

Moving forward, the system's real-time warning and response capabilities will be further bolstered through the integration of AI-based predictive analytics and the advancement of user-tailored alert services. Furthermore, by analyzing diverse unstructured data including citizen reports, private-sector datasets and social media feeds, the platform aims to complement existing risk information. This evolution will transform Safe Map into a participatory safety management system in close collaboration with local communities.

Building a Safer Society
through Science and Technology

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A Compendium of Korea's Science and Technology-based Disaster Management

Chapter 2

Pillar 4

Systems and Global Expansion of ST-Based Disaster Management

4.1 Data Management: Foundation of ST-based Disaster Management
4.2 Developing Disaster Safety Technology and Industry as a National Priority
4.3 Proactive Disaster Management through Emerging Risk Analysis
4.4 Enhancing Flood EWS in Developing Countries

4.1 Data Management: Foundation of ST-based Disaster Management

(Disaster Safety Data Sharing Platform)

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Contact (Email) | jmi343@korea.kr

Background and Progress

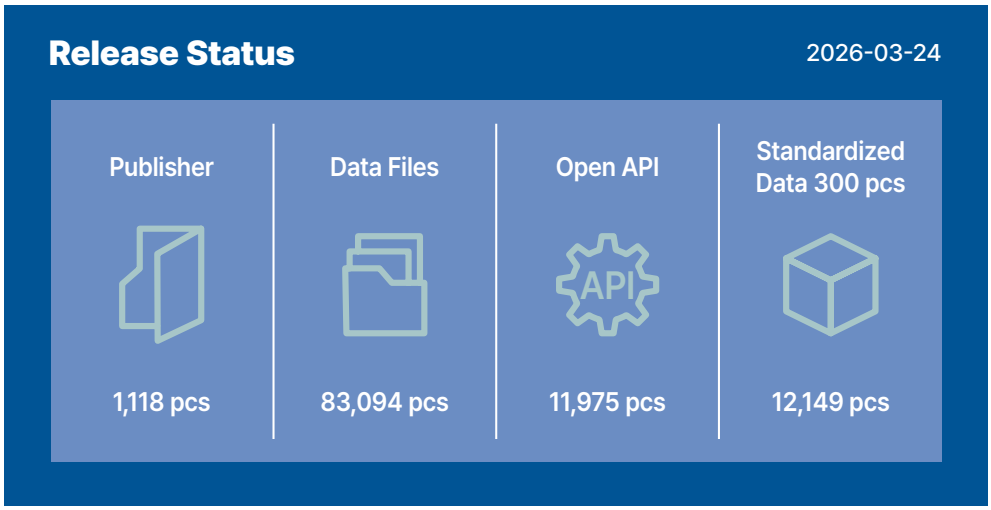
Since the 2010s, the Republic of Korea has actively promoted policies to expand data disclosure and utilization to advance digital innovation and foster the data economy. As a result, the government has established three major national data platforms: the Public Data Portal (data.go.kr, launched in 2013), the Big Data Platform (launched in 2018), and the AI Hub[2)] (launched in 2020) (Eom et al., 2025).

Among these, the Public Data Portal provides open datasets held and managed by public institutions in accordance with the Act on Promotion of the Provision and Use of Public Data. These datasets are made available in various formats including file data, Open APIs and visualizations. As of October 2025, the portal hosted approximately 100,000 datasets.

In the field of disaster safety, the growing importance of data-driven decision-making across all stages including prediction, preparedness and response, has highlighted the need for a data platform capable of integrated and systematic management. Accordingly, the Ministry of the Interior and Safety (MOIS) developed the "Disaster Safety Data Sharing Platform" to manage disaster safety data in an integrated manner. Following three years of development and pilot operation (2022–2024), the platform officially launched its full-scale service in January 2025.

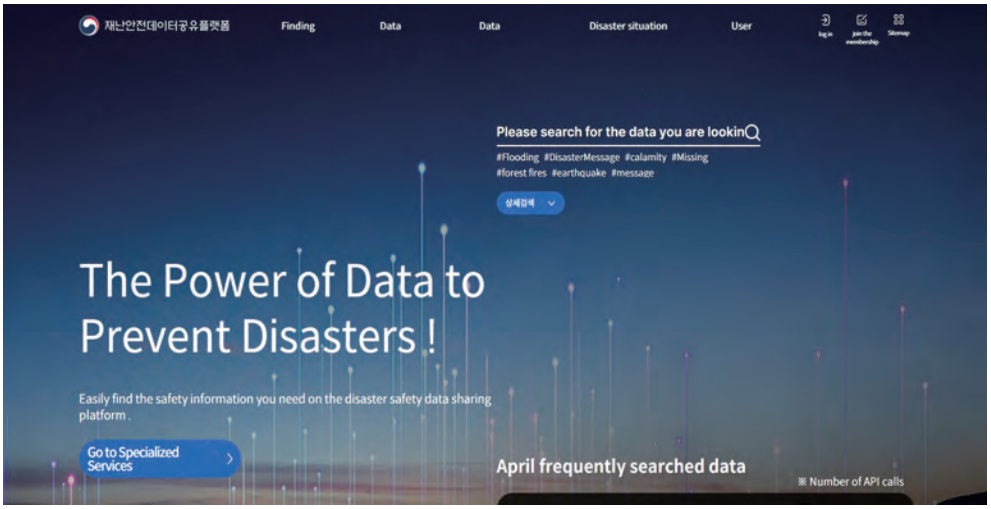
2) The Big Data Platform promotes data transactions and supports private-sector innovation by enabling industry-tailored data distribution and integrated data services. As of March 2024, it comprises sector-specific platforms across 21 fields including telecommunications, finance and social welfare, operated through approximately 230 centers. AI Hub is an integrated platform that provides data, computing resources and AI solutions to support AI research and industry development. As of April 2025, it offers 847 AI training datasets across 14 thematic areas downloadable files, open APIs, and data visualizations.

Figure 2.4.1 Status of Data Disclosure on the Public Data Portal



(www.data.go.kr)

Figure 2.4.2 Disaster and Safety Data Sharing Platform



(www.safetydata.go.kr)

Key Features

Platform Development and Legal/Institutional Framework

In the past, each agency operated separate systems for its own purposes, leading to issues such as data duplication, lack of standardization and low accessibility and usability. In particular, the tendency to avoid disclosing sensitive information acted as a barrier to data sharing.

To resolve these challenges, MOIS revised the Framework Act on the Management of Disasters and Safety and its Enforcement Decree. This established a legal basis for the Minister of the Interior and Safety to request and link necessary data from disaster management agencies through the Disaster Safety Information Sharing Council.

System Integration and Data Provision

The Disaster Safety Data Sharing Platform automatically collects and stores data by connecting to 57 systems across 59 institutions. It provides approximately 1,800 disaster and safety datasets under 62 categories including natural disasters (13), societal disasters (29), major response situations (16), and safety types (4).

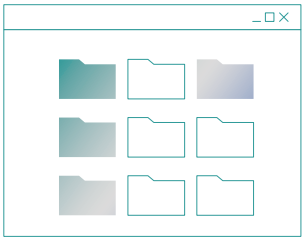
Services are provided in three categories based on access authorization:
For the general public, for disaster management agencies and for authorized source institutions. Among these, 172 datasets from 20 systems are provided via real-time APIs, significantly enhancing data usability.

Users can preview up to 100 entries and download them as a file. Those wishing to use an API can access it freely after a separate application and approval process. The “Use Cases” menu showcases how others have used data, facilitating idea sharing.

Specialized Services

The platform also offers specialized services by providing data packages actually used in the field such as wildfire prevention and underground utility information (communication lines, gas pipes, etc.) or by intermediating high-demand data for private companies.





Key Achievements

Establishment of a Data Management System for ST-based Disaster Management

With the establishment of the platform, data users no longer need to visit individual agencies or separately request materials; instead, they can access all necessary disaster and safety data in a single, one-stop location. Importantly, data that were previously used only internally within institutions in a limited capacity are now shared with other agencies and externally, greatly strengthening data-driven decision-making capabilities for disaster prevention, response and recovery in the public sector.

Improved Public Services through Public–Private Collaboration

As disaster and safety data are opened to the private sector, practical services utilizing this data are being developed across various industries. Representative examples include:

- Providing wildfire data to gas companies to prevent secondary damage; and
- Providing evacuation shelter information by integrating it into the map services of major internet platforms (Naver, Daum).

Such public-private collaboration strengthens the linkages within the disaster response system and delivers tangible safety services that citizens can benefit from.

Future Directions

With a disaster and safety data management system now established, the priority is to foster a data ecosystem for practical utilization. The more the private sector, academia and research institutions produce useful analyses and citizen-centered services based on this data, the more the government can expand data openness.

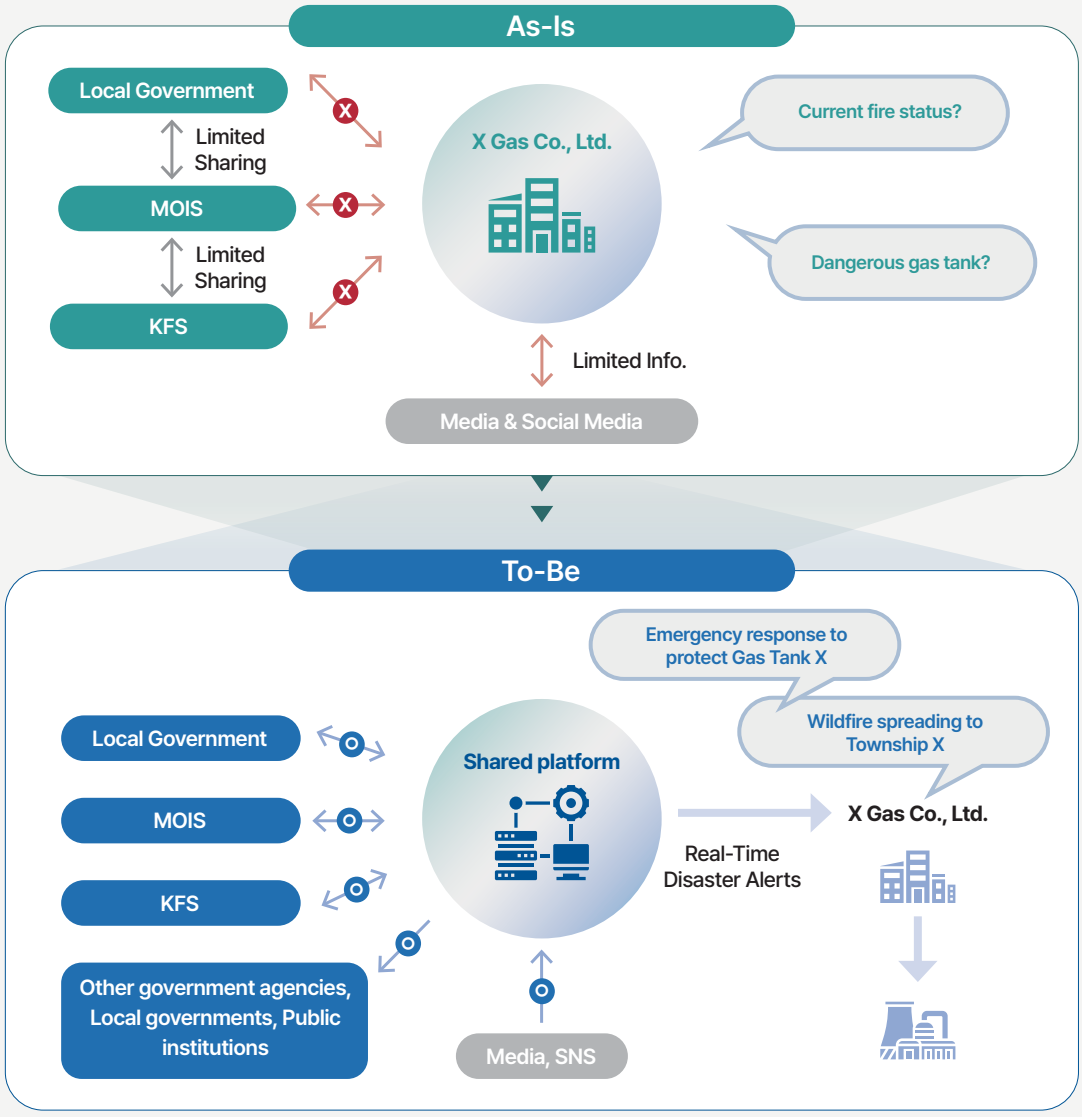
The private sector, in particular, can flexibly apply advanced technologies such as Artificial Intelligence (AI), Machine Learning (ML), and Large Language Models (LLMs), thereby opening up new possibilities for data use. To ensure an ecosystem encompassing both the government and the private sector is formed based on disaster and safety data, MOIS plans to actively support private utilization through initiatives including: startup support, competitions and challenges, corporate consulting and participation in industry exhibitions.

Disaster and Safety Data Utilization Services

Case 1 SK Gas Support for Prevention of Secondary Damage from Wildfire

During the Gangneung wildfire (April 2023), data on wildfire occurrence reporting status information and weather information were shared with SK Gas.
This enabled rapid safety measures to be implemented for 1,574 gas filling stations and facilities located within a 10㎞ radius of the wildfire ignition point, effectively preventing secondary damage.

Figure 2.4.3 Wildfire Damage Prevention Using Disaster and Safety Data



Case 2

Integration of Shelter Information and Linking with Private-Sector Map Applications

Information on four types of shelters-heatwave shelters, cold wave shelters, earthquake outdoor shelters and tsunami evacuation shelters-previously provided separately, was integrated, deduplicated, and released via open APIs for immediate use.

As a result, citizens can now conveniently access shelter locations through map applications operated by major private platforms including Naver, Kakao, and T-map.

Figure 2.4.4
Cold Wave Shelter Guidance of the Naver Portal

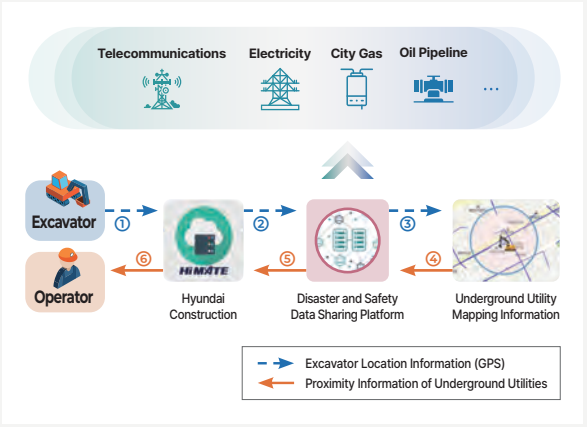


Case 3

Establishment of an Information-Sharing System for Preventing Underground Facility Damage

To prevent accidents during excavation, information on the location of underground facilities including communication cables, oil pipelines and gas pipelines, was shared with HD Hyundai Site Solutions. As a result, the system helps minimize excavation-related damage, and furthermore, it is being expanded to include additional institutions for more systematic management of underground facility data.
In addition, real-time location data from excavators is shared with underground facility owners to prevent accidents during excavation work.

Figure 2.4.5
Opening Urban Underground Infrastructure Information to the Private Sector



4.2 Developing Disaster and Safety Technology and Industry as a National Priority

(Disaster Safety Industry Promotion Framework)

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Background and Progress

As climate change intensifies the scale and complexity of disasters, social and economic losses are increasing. Against this backdrop, the disaster and safety industry has emerged as a core sector that goes beyond providing technologies and infrastructure for emergency response. It now plays a critical role in ensuring public safety across the entire disaster management cycle including prevention, preparedness, response, and recovery.

The global natural disaster management market is projected to expand from approximately USD 63.8 billion in 2024 to USD 199.9 billion by 2034, recording a high compound annual growth rate (CAGR) of 12.1% from 2025 to 2034. The increasing disaster risks from climate change and the urbanization of vulnerable areas are driving demand for disaster management systems. Furthermore, the proliferation of AI, IoT, and satellite-based early warning and risk analysis technologies is fueling market growth, driving rapid investment in disaster management solutions and resilient infrastructure across both public and private sectors (Polaris Market Research, 2025).

The domestic disaster and safety industry in Korea has also grown rapidly, with the market size expanding by KRW 20 trillion (approx. 55%) from KRW 36.5 trillion in 2015- when official government surveys began-to KRW 56.5 trillion in 2022, showing a CAGR of approximately 6.4%. However, the industrial structure remains characterized by small-scale enterprises and a weak R&D base. Companies with annual revenues between KRW 100 million and KRW 500 million account for the largest share at 35.2%, and only 2.4% of companies possess research and development records related to disaster safety (MOIS, 2016; 2023c).

In response, MOIS has been advancing a comprehensive policy agenda to foster the disaster and safety industry, which holds high industrial value and is vital for protecting lives including promoting the development and dissemination of advanced technologies, supporting domestic and international market access and accelerating enterprise growth.

Key Features

Promoting Dissemination of Advanced Technologies and Products

MOIS operates the Designation System for Disaster Safety New Technologies and the Certification System for Disaster and Safety Products to promote the adoption of outstanding technologies and products. Incentives such as eligibility for negotiated contracts and preferential procurement are provided to facilitate their use in disaster response and safety management.

In addition, MOIS, in cooperation with local governments, is establishing specialized promotion centers by disaster type including floods, fires, and earthquakes, which provide integrated assistance for disaster safety companies, ranging from R&D and performance testing to market entry. The government is also implementing initiatives to facilitate the commercialization of disaster safety technologies and support the market entry of proven core technologies.

Supporting Enterprise Growth Acceleration

To foster the growth of disaster and safety enterprises with high potential but facing financial difficulties, the government plans to establish a dedicated investment fund (the National Safety Industry Fund) in 2026. Operating with KRW 20 billion, the fund comprises KRW 10 billion in government contributions through the Korea Fund of Funds (KFoF), and an additional KRW 10 billion in matching investments from the private sector and local governments.

The investment will be concentrated on early-stage disaster and safety companies with outstanding technologies, including those focused on advanced technologies seeking to expand into international markets. By leveraging the expertise of professional venture capital (VC) managers, the initiative aims to serve as a catalyst for technological upgrading and market development.

In parallel, MOIS offers preferential benefits to disaster and safety enterprises with limited collateral capacity including reductions in credit and technology guarantee fees to alleviate financial burdens. The government also implements capacity-building consulting programs for domestic and international certification acquisition and marketing to strengthen the commercialization capabilities of promising firms.

Supporting Domestic and International Market Access

Since its inception in 2015, the Korea Safety Expo has grown into the nation's largest exhibition dedicated to the disaster and safety sector. The Expo showcases advanced technologies and products while hosting concurrent events including export and procurement consultations, global business forums and disaster safety conferences in order to facilitate technology promotion and market expansion.

MOIS also organizes integrated Korea Pavilions at renowned international disaster and safety exhibitions in collaboration with local governments. These initiatives feature the technologies and products of promising Korean firms, provide business matchmaking opportunities, and offer customized market entry briefings for host countries, thereby expanding overseas market opportunities and strengthening global networking.

Key Achievements

Establishment of an Institutional and Policy Framework

Previously, disaster and safety industry promotion policies were fragmented, lacking systematic coordination and a sufficient legal grounding. In response, MOIS secured a formal legal basis for industry promotion by enacting the Disaster and Safety Industry Promotion Act in 2022. As a follow-up, the government formulated the First Basic Plan for Disaster and Safety Industry Promotion (2024–2028) in 2023, marking the nation's first mid- to long-term national roadmap for the sector.

This integrated policy framework, linking "Legislation-Basis Plan-Implementation Plan," facilitates a comprehensive and strategic promotion system tailored to the entire lifecycle of disaster and safety enterprises.

Promotion of Advanced Technology Development and Dissemination

With the policy foundations strengthened, the implementation of technology-focused support systems has accelerated. Through the certification and designation systems, 230 products and 330 technologies have been certified or designated, facilitating their adoption in public procurement and disaster management operations.

Specialized promotion centers categorized by disaster type have been established nationwide, beginning with Gunsan (floods) in 2023, followed by Yangsan (earthquakes), and Hongseong (fires) in 2024, and Saha-gu, Busan (landslides) in 2025. In 2026, an additional center focused on climate change-related disasters such as heatwaves and droughts, is scheduled for establishment.

Expansion of Market Access for Disaster and Safety Enterprises

At the 2025 Korea Safety Industry Expo (17-19 September 2025), advanced technology-based solutions including AI and drones from 380 companies were showcased across 1,000 booths. The event attracted approximately 40,000 visitors and 95 overseas buyers from 23 countries, serving as a platform for sharing global industry trends through forums and conferences.

Export consultation sessions yielded 1,168 business consultations, resulting in KRW 363 billion in potential contracts and providing concrete market opportunities for Korean companies.

In addition, integrated Korea Pavilions were operated at major overseas exhibitions in 2025, including RISCON Tokyo (Japan) and Secutech Viet Nam (Viet Nam). A total of 50 Korean disaster and safety companies participated, achieving 998 consultations, KRW 98.9 billion in projected contracts, and 12 MOUs thereby strengthening the foundation for international expansion.

Future Directions

To fulfill its role as a catalyst for the development of the disaster and safety industry, MOIS will continue reinforcing institutional foundations for technology development, dissemination, market expansion and enterprise growth.

The government is also pursuing the establishment of a Disaster and Safety Industry Promotion Agency to address limitations arising from fragmented policy implementation and short-term support programs. As a dedicated entity, the Agency will provide integrated, end-to-end support across the entire enterprise growth cycle including commercialization-oriented R&D, investment facilitation and market access.

Through these efforts, the government aims to elevate national disaster management competitiveness, enhance the global branding of "K-Safety," and position Korea as a leading nation in disaster and safety innovation.

Figure 2.4.6 Korea Safety Expo 2025



4.3 Proactive Disaster Management through Emerging Risk Analysis

(Center for Emerging Risk Analysis)

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Background and Development

Globally, disaster environments are changing rapidly due to climate change, technological advances and shifts in social structures, leading many countries to experience large-scale disasters that were previously unforeseen. As a result, the need for national-level management of "emerging risks" has become increasingly paramount.

Emerging risks encompass several categories: new types of risks not previously experienced; risks where existing hazards manifest differently due to environmental changes; compound risks arising from two or more hazards occurring simultaneously or sequentially, potentially leading to complex disasters; and risks characterized by high uncertainty or information gaps that make assessment difficult.

In the Republic of Korea, the Itaewon crowd crush (29 October 2022) underscored the urgency of anticipating and preparing for new forms of risk in advance, elevating the issue of emerging risks to a key national policy priority. Accordingly, the government incorporated the management of emerging disaster risks into the Comprehensive Countermeasures for Reforming the National Safety System (27 January 2023).

To implement this agenda, the Center for Emerging Risk Analysis was established within the National Disaster Management Research Institute (NDMI) in February 2023. This was followed by the Emerging Disaster Risk Assessment and Selection Committee in March 2023, composed of experts from diverse fields. The Center and the Committee now jointly analyze and select emerging risk factors through biannual meetings.

Key Features

The Center for Emerging Risk Analysis operates a biannual cycle that encompasses a series of procedures, from risk identification and evaluation to in-depth analysis and report publication and concludes with policy recommendations and implementation monitoring.

Identification of Emerging Risk Factors

The Center identifies shifts in the disaster and safety landscape and analyzes the underlying causes of emerging risks through macro-environmental analysis, big data analytics, domestic and international case studies and surveys.

Expanding beyond purely quantitative data, the Center leverages big-data analysis of media reports, conducts surveys targeting experts and frontline responders (such as firefighters and police officers), and examines international reports on disaster trends.

Furthermore, active collaboration with public corporations, local governments, and central ministries strengthens field-oriented identification, ensuring that practical insights from the front lines are integrated into the analysis.

Evaluation and Selection of Emerging Risk Factors

Identified risk factors are evaluated by the Emerging Disaster Risk Assessment and Selection Committee, which assesses them based on criteria such as potential impact and likelihood of occurrence. Risks requiring prioritized national-level management are selected.

The Committee consists of 24 members including 20 experts representing diverse disaster and safety sectors and division directors from relevant agencies. These agencies include MOIS, the National Police Agency, the National Fire Agency, and the Korea Coast Guard.

Publication of Biannual Emerging Risk Analysis Reports and Implementation Monitoring

Risk factors selected by the Committee undergo in-depth analysis and are published biannually in the National Emerging Risk Report. Each report provides comprehensive assessments of likelihood, potential impacts and recommended improvement measures.

To date, 15 reports have been published, proposing approximately 28 improvement measures. These proposals include reforms to legislations, institutional frameworks, and operational manuals; strengthened research and development (R&D); enhanced education and training; and improved information sharing and system development. MOIS conducts biannual monitoring to track the progress of these implementations across relevant agencies.

Table 2.4.1 List of Identified Emerging Disaster Risk Factors

Issuance	Report Title	Relevant Ministries/ Agencies[3)]
1st (Oct 2023)	Risks of Large-Scale Fires and Structural Collapse Following the Emergence of Electric Vehicles	MOTIE, MOLIT, MOF, NFA, KCG
	Threat of Vibrio Septicemia Resulting from Rising Sea Temperatures	MOIS, MOHW, MOF, MFDS, KDCA
	Inland Tornado Damages Caused by Climate Change	MOIS, KMA
2nd (Feb 2024)	Fire Risks of Personal Mobility Devices in Public Transport and Multiuse Facilities	MOLIT, KATS, KORAIL, SR
	Summer Wildfires Triggered by Flash Droughts	MOIS, KFS, NFA
3rd (Jul 2024)	Hazardous Material (HazMat) Spills from Freight Train Accidents	MOIS, MOLIT, MOE, NFA, KORAIL
	Structural Collapse of Coastal infrastructure Due to Sea-Level Rise	MOIS, MOLIT, MOF, MOE
	Increased Risk of Marine Leisure Vessel Accidents Following the Rise in Ocean Tourism	MOIS, MOF, KCG
4th (Jan 2025)	Aging Underground Pipelines in Industrial Complexes and Potential Rupture Risks	MOTIE, MOE, MOEL, MOLIT, NFA
	Fire and Explosion Hazards at EV and Two-Wheeler Charging Stations	MOIS, MOTIE, MOE, MOLIT, NFA
	Fire and Leakage Risks in Oil Refineries and Petrochemical Facilities	MOTIE, MOE, MOEL, MOLIT, NFA
	Collapse of Abandoned Houses on Slopes in Urban Areas and Resulting Debris Impact	MOIS, MOLIT, MOEF
5th (Sep 2025)	Structural Collapse Risks of Inadequate Construction Supervision Systems	MOLIT
	Potential for Digital Blackouts Resulting from the Increasing Complexity of Information Services	MSIT, MOIS
	Risks Associated with Extended-Length and Deep Underground Roads	MOIS, MOTIE, MOE, MOLIT, NFA

3) **Abbreviations of Ministries and Agencies**
MOIS: Ministry of the Interior and Safety
MOTIE: Ministry of Trade, Industry and Energy
MOLIT: Ministry of Land, Infrastructure and Transport
MOF: Ministry of Oceans and Fisheries
MOE: Ministry of Environment
MOEL: Ministry of Employment and Labor
MOHW: Ministry of Health and Welfare
MOEF: Ministry of Economy and Finance
MFDS: Ministry of Food and Drug Safety
KDCA: Korea Disease Control and Prevention Agency
KMA: Korea Meteorological Administration
KFS: Korea Forest Service
NFA: National Fire Agency
KCG: Korea Coast Guard
KATS: Korean Agency for Technology and Standards
KORAIL: Korea Railroad Corporation
SR: SR Corporation

Key Achievements

Integration of Emerging Risks into Disaster Management Systems

Identified emerging disaster risks have been incorporated into the annual implementation guidelines for central ministries and local governments, as mandated by the National Basic Disaster Management Plan. The National Emerging Risk Report has served as a catalyst for legal and institutional reforms, with relevant agencies translating its findings into substantive improvement measures. Notable examples of this impact include:

- **EV Fire Safety (August 2024):** In direct response to the report's findings, the Ministry of Environment and MOIS jointly established a comprehensive suite of fire safety protocols for electric vehicles in underground spaces.
- **Marine Safety (May 2025):** A multi-agency Institutional Improvement Plan for the Prevention of Leisure Boat Accidents was finalized, addressing the surging risks in maritime tourism.

Furthermore, nationwide disaster preparedness exercises-such as the "Ready Korea" drills-now incorporate specialized training scenarios based on these identified emerging risks, ensuring that theoretical analysis leads to enhanced field-level response capabilities.

International Cooperation and Knowledge Sharing

Korea's achievements in emerging risk management have been widely shared with the international community through high-level platforms including the Typhoon Committee Expert Seminar (September 2024), the Korea-Japan Disaster Management Meeting (December 2024), the OECD High-Level Risk Forum (December 2024) and the APEC Senior Disaster Management Officials' Forum (July 2025). Building on these exchanges, Korea is actively spearheading the establishment of international cooperation frameworks dedicated to emerging disaster risk management.

A significant milestone was reached in 2025 when the OECD featured Korea as a leading case study-alongside the United States, Ireland, and Israel-in its flagship publication, Managing Emerging Critical Risks: Case Studies and Cross-Country Synthesis Report. The OECD evaluated Korea's emerging disaster risk management system as a representative best practice, highlighting its systematic approach to identification and policy integration.

To further facilitate international collaboration, the NDMI began publishing English editions of the National Emerging Risk Report on its official website in June 2025. This initiative aims to expand knowledge exchange and strengthen partnerships with key international organizations including the UN, OECD and APEC.

Future Directions

As the global disaster landscape grows increasingly complex and defined by cascading, compound, and emerging risks, the proactive identification of these hazards has become a shared international priority. To navigate this evolving environment, the Center for Emerging Risk Analysis at NDMI is committed to fortifying its analytical capacity, deepening policy integration, and spearheading international cooperation. Key efforts will include:

- Institutionalizing the regular operation of the Committee
- Advancing risk analysis methodologies; and
- Refining implementation monitoring systems across relevant ministries.

These measures aim to increase policy uptake and improve the predictability of responses to diverse compound and emerging risks. Furthermore, Korea will expand the global sharing of identified risks and deepen cooperation with international organizations. Using the English editions of the National Emerging Risk Report, Korea will broaden knowledge exchange with the UN, OECD, and APEC, while promoting joint research and policy consultations through international expert networks.



4.4 Enhancing Flood EWS in Developing Countries

(ODA Projects for Disaster Risk Reduction)

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Background and Development

Developing countries with limited technology and infrastructure for disaster preparedness tend to suffer disproportionately greater human and economic losses from large-scale natural disasters compared to developed nations. In particular, the Asia–Pacific region is one of the most disaster-prone areas in the world, accounting for around 40% of global natural disaster events, approximately 45% of global economic losses, and nearly 80% of the world's disaster-affected population (UNEP, n.d.).

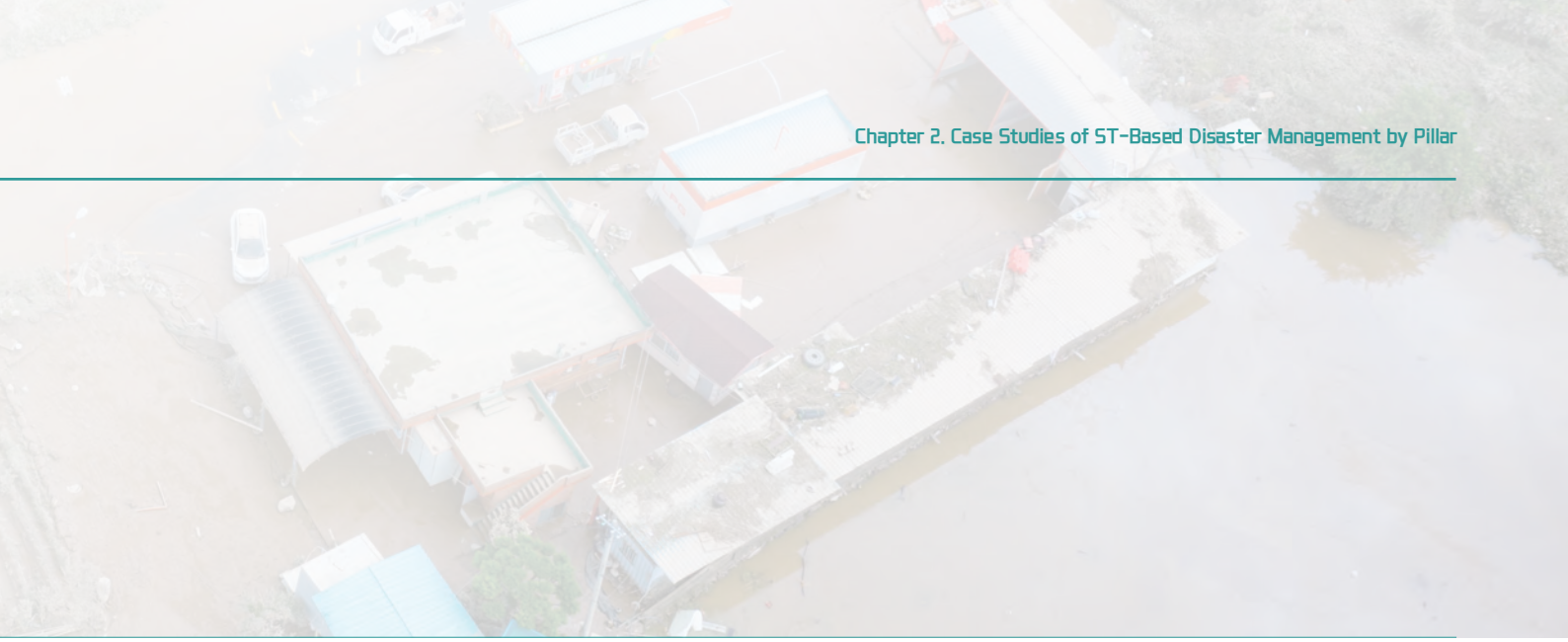
The Sendai Framework for Disaster Risk Reduction (2015–2030), a global roadmap for reducing disaster risk, emphasizes strengthening disaster risk analysis enabling evidence-based policymaking and supporting infrastructure in countries with limited access to technology. In alignment with this, the United Nations and the World Meteorological Organization (WMO) launched the Early Warnings for All (EW4ALL) initiative in 2022, aiming to ensure that everyone worldwide benefits from early warning systems by 2027.

Responding to this initiative and the needs of Asian developing countries, Korea has actively promoted projects to establish flood early warning systems in the Philippines, Laos, Fiji and other partner countries.

2005 — Korea began serving as Chair of the Typhoon Committee's Disaster Prevention and Preparedness Working Group under UNESCAP/WMO (Chair: NDMI President).

2012 — At the 44th Typhoon Committee Session, a request was made to investigate the damage caused by Typhoon Washi (December 2011) in Mindanao, Philippines.

2013~ Present — Has Initiated and expanded the construction of a flood early warning system in Cagayan de Oro, Philippines, and expanded projects to Vietnam, Laos, and Fiji. (Budget allocated: KRW 7.528 billion, 2021–2025).



Key Features

This project goes beyond simple technology transfer to partner countries. Its primary goal is to strengthen practical, field-based disaster response capacity by providing integrated support across the entire process from observation and analysis to warning issuance and evacuation to minimize damage during flood events.

Observation System Development

Rain gauges and water-level sensors have been installed in flood-prone areas to measure rainfall and river levels in real time. The locations for equipment installation are determined based on climate and topographic characteristics, as well as historical flood data.

Collected data is automatically transmitted and visualized through a web-based platform, enabling officials to quickly assess rainfall patterns and rising water levels. These real-time observations play a crucial role in the early recognition of flood risks and in preparing follow-up actions.

Warning System Installation

Based on hydrological and hydraulic analysis, region-specific “flood warning thresholds” are established and warning stations (e.g., sirens) are installed in residential areas and public spaces with vulnerable zones. Warnings are activated automatically or manually when heavy rainfall or flooding is expected, alerting residents via audible and visual signals. Notably, thresholds are tailored to local conditions by integrating both meteorological forecasts and real-time hydrological data. This scientific approach ensures that residents can trust the warning signal and evacuate promptly.

Operation of the Early Warning System

Local governments and disaster officials monitor the situation in real time through observation equipment and issue warnings when necessary. The system automatically analyzes hydrological data and triggers an immediate warning when thresholds are exceeded, enabling officials to take rapid response measures. To ensure the system is actionable, simulation drills and community education are conducted alongside technical training, ensuring that residents respond effectively during actual emergencies.

Figure 2.4.7 Real-time Flood Monitoring System



Key Achievements

Strengthened Disaster Risk Reduction Capacity in Vulnerable Countries

The NDMI has significantly contributed to enhancing disaster response capacity in vulnerable countries by transferring flood early warning systems (EWS). By replacing manual data management or and addressing the lack of observation equipment with automated digital monitoring systems, NDMI has enabled real-time tracking of flood risks.

This technological transition has led to shorter response times and secured critical evacuation windows for residents through timely early warnings. Furthermore, the project supports systematic decision-making based on scientific data analysis and established thresholds. Combined with simulation-based evacuation drills and training, these efforts continue to build and sustain local disaster response capacities.

Systematic Performance Evaluation

Beyond technology transfer, NDMI evaluates ODA project performance based on the six evaluation criteria of the OECD Development Assistance Committee (DAC): relevance, coherence, efficiency, effectiveness, impact and sustainability. To ensure the highest level of evaluation reliability, NDMI utilizes a multi-faceted approach that incorporates surveys, quantitative indicator analysis, stakeholder interviews, and expert consultations. These evaluation results are integrated into the system to improve ongoing projects and serve as a foundation for designing future programs.

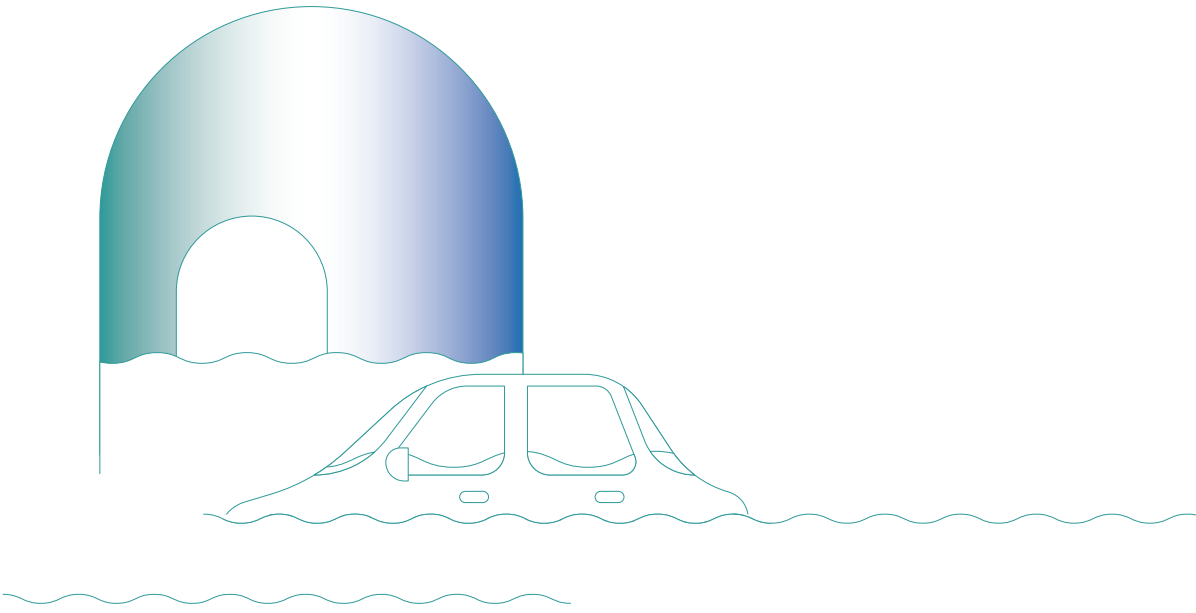
Local Capacity Building and Sustainable Operations

To ensure ODA projects move beyond one-off support, training is provided for local officials and residents and operation manuals are developed to enable autonomous system management. This approach not only improves immediate response capacity but also establishes a foundation for long-term, sustainable disaster management systems within the partner countries.

Future Directions

To maximize the effectiveness and sustainability of flood early warning systems deployed in developing countries, it is essential to strengthen post-project management capacities. This involves establishing systematic support for spare parts supply, operator training, maintenance services, and follow-up monitoring.

Additionally, enabling Korean companies to participate directly in overseas system management can provide partner countries with timely services while facilitating the transfer of both technology and operational expertise. Such efforts would also help expand Korea's exports of disaster management technologies and equipment, making it necessary to actively pursue policy support in this area when implementing ODA projects.



Building a Safer Society through Science and Technology

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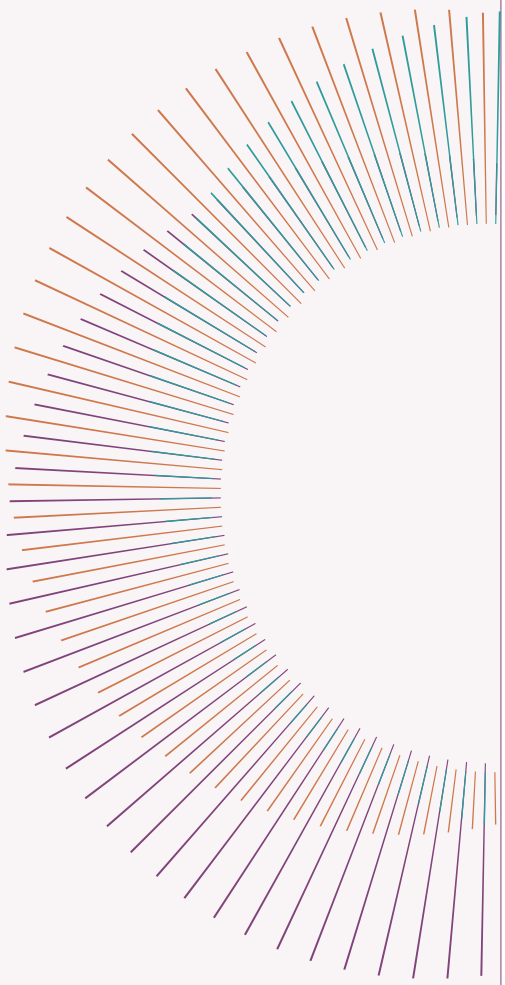
A Compendium of Korea's Science and Technology-based Disaster Management

Chapter 3

Synthesis and Future Tasks

7

Key Drivers of Korea's ST-based Disaster Management



1. Trends Identified through Case Studies

This compendium presents 24 cases of ST-based disaster management. Each case is organized by their implementation background, key achievements, and future development directions. The compendium serves as a reference for disaster management practitioners, researchers, and countries seeking to benchmark Korea's experience. Cases are authored by the officials responsible for each policy and project, providing an authentic account of the rationale for each initiative, its operational mechanisms, and the strengths and limitations identified.

Analysis of 24 cases indicates that ST-based disaster management is now a fundamental component of Korea's national disaster management policy. These cases illustrate Korea's progress toward a proactive, cooperative, inclusive and data-driven system, and they demonstrate the effective implementation of these policy orientations.

First, the adoption of digital technologies including artificial intelligence (AI), sensors, and big data has facilitated faster and more accurate risk detection. Automated alert systems now provide real-time monitoring and rapid notifications. These advancements have shifted disaster management from a reactive to a proactive model.

Second, the expansion of digital communication networks and integrated platforms has reduced information gaps among institutions, strengthened data-driven collaboration, and supported predictive decision-making. These developments have established the foundation for cooperative disaster management.

Third, mobile reporting tools and disaster information applications have enabled citizens to contribute risk information and participate actively in disaster response. These interactive platforms have significantly enhanced inclusive and digitally enabled disaster management.

Fourth, the establishment of data-sharing systems, the advancement of the disaster safety industry, and the introduction of digital tools for emerging risk analysis have strengthened the foundations for data-driven disaster management in Korea, while international cooperation-particularly through ODA-driven technology transfer and policy sharing-has facilitated the diffusion of these approaches to other countries, supporting their sustainability and long-term development.

Table 3.1.1 Comparison of Conventional and ST-based Disaster Management

Category	AS-IS (Traditional Disaster Management)	TO-BE (ST-based Disaster Management)
1 Real-time Risk Monitoring and Rapid Dissemination	• Observation and report based processes cause delays	• Real-time risk detection using AI, big data, and sensors
	• One-way, manual warning systems	• Automated and tailored alert systems
	• Limited accuracy and slow initial response	• Strengthened early prediction and proactive response through data analytics
2 Smart Technology–based Collaborative Disaster Management	• Fragmented systems hinder information-sharing	• Integrated digital networks and unified platforms for interagency collaboration
	• Phone-based single-channel communication lowers field efficiency	• Faster mobilization through shared data and analytics
	• Experience-driven decisions lack consistency and reliability	• Predictive and collaborative decision-making structures established
3 Inclusive Disaster Management through Digital Participation	• One-way, government-centered information delivery	• Two-way citizen participation platforms enabling co-production of risk information
	• Limited access for foreigners and persons with disabilities	• Multilingual and accessible disaster communication services
	• Weak community-level prevention and engagement systems	• Enhanced community-led prevention and response capacity
4 Enabling Environment for ST-based Disaster Management	• Fragmented and siloed data management	• Integrated data-sharing and open-data governance
	• Weak linkage between R&D and safety industry development	• Institutionalized support for technology and safety industry development
	• Project-based, fragmented international cooperation	• Expanded cooperation focused on technology transfer and policy sharing

2. Factors Behind the Advancement of Korea's ST-based Disaster Management

Korea has made significant progress in ST-based disaster management within a relatively short time. This achievement is not solely due to new technologies; it also stems from strong government commitment and high public acceptance and participation, which have fostered innovation. The policy trajectory began in the 1990s with e-government, progressed to digital government and evolved into an AI-driven government. This has established a solid foundation for continuous advancement alongside technological development. This path has also prepared the way for the active application of science and technology in disaster management.

The high level of digital literacy among the public and their strong willingness to participate have been critical factors enabling ST-based disaster management systems to operate effectively on the ground. Based on a synthesis of domestic and international literature, analyses of relevant policies and case studies, the key factors that have enabled the development of ST-based disaster management in Korea can be summarized as follows.

Table 3.1.2 Key Success Factors of Korea's ST-based Disaster Management Model

Theme	Policy / System	Implementation / Outcome
Legacy of Successful National Informatization Policies	• Long-standing national commitment to informatization and e-Government since the 1980s	• Development of world-class digital infrastructure and data platforms • High levels of public digital literacy and strong adaptability to digital services
Strategic and Systematic Advancement of Science-based Disaster Management	• Long-term policy direction and sustained budgeting for ST-based disaster management	• Digital transformation of national crisis-management systems and advancement of data-driven reforms • Expansion of disaster-safety R&D and strengthening of implementation capacity
Expansion of Public Participation through Digital Tools	• Nationwide adoption of the Safety Report app and other mobile participation tools	• Strong culture of civic engagement supported by world-leading digital platforms • Increased use of digital safety information in daily life (e.g., Safe Map)
Strong Technological Capacity and Public-Private Collaboration	• Advanced ICT and AI capabilities in the private sector supporting disaster management	• Expansion of key services, including AI-based CCTV and infrastructure monitoring through industry cooperation • Institutional mechanisms enabling sustained public-private partnerships

(1) Experience and Legacy of Successful National Informatization Policies

Strong National Commitment to Informatization Aligned with Technological Advancement

Since the 1980s, Korea has consistently pursued national informatization and e-government initiatives as essential mid to long-term policies. This occurred despite frequent changes in government and shifts in the policy environment. A government-wide implementation framework, supported and prioritized by the President, has ensured continuity and consistency in these policies.

This framework remains a significant competitive advantage for digital administration today. The national informatization initiative, which took off in the late 1980s, has become essential across all areas of administration, education, and industry. This initiative reinforced the belief that "informatization is the backbone of national competitiveness." Even during the challenging financial crisis of the late 1990s, the pursuit of national informatization policies was unwavering. These policies were viewed as both a strategy for administrative innovation and a catalyst for economic growth. Embracing the vision "Though we were late in industrialization, we can lead in informatization," Korea focused intensely on expanding information and communications networks, updating laws and regulations, and digitizing public services.

In the 2000s, core e-government services, including one-stop public service delivery and electronic approval systems, were established. Moving into the 2010s, the government shifted toward open data and data-driven governance. As mobile administrative services became widely adopted and the government transitioned to a digital platform, it developed a system that could proactively respond to technological change and public needs.

Since 2020, the government has upgraded data governance and utilization systems across the public and private sectors through the Digital New Deal[4]. It has also demonstrated the effectiveness of digital technologies in national crisis response, such as infectious disease response. The data foundations created during this period became critical groundwork for accelerating discussions on AI-enabled public administration (Eom et al., 2025).

The advancement of e-Government, which has taken place over decades of institutional and environmental changes, represents a transformative national process. It has reshaped the administrative and economic landscape, established information-sharing systems between central and local governments, standardized administrative procedures, and implemented data-driven policymaking. The evolution also fostered a culture of collaboration and enhanced digital capacities within the public sector. These experiences have provided essential administrative and institutional foundations for advancing a scientific approach to disaster management.

4) The Digital New Deal, implemented by the Moon Jae-in administration (2018-2022), was a significant policy initiative with a budget of approximately KRW 30 trillion allocated for the period between 2020 and 2022. Its primary goals were to support economic recovery following the COVID-19 pandemic and to accelerate digital transformation. Key components of the initiative included strengthening the ecosystem for data, networks and AI, promoting non-face-to-face industries, and advancing the digitalization of social overhead capital (SOC). Notably, major projects aimed to expand data-driven infrastructure, such as the establishment of a "data dam" and the development of big data platforms. The policy is considered effective in reinforcing the foundations of the digital economy by promoting the opening, linking and utilization of both public and private data.

Figure 3.1.1 Launch of the Government-wide AI Common Platform Service (Nov. 2025)



World-Class Digital Infrastructure and High Public Acceptance

Over decades of national informatization, Korea has built a world-class digital infrastructure. This is supported by strong public acceptance of digital technologies, enabling rapid digital transformation in disaster management. National ICT infrastructure was strengthened through the National Backbone Computer Network Project (1987–1996) and the High-Speed National Information and Communications Network Project (1995–2003) (Eom Seok-Jin et al., 2025). Since then, about 17,000 administrative information systems have been established across central ministries, local governments, and public institutions (MOIS, 2025, p.82).

Additionally, three major national data platforms, the Public Data Portal (2013), the Big Data Platforms (2018) and the AI Hub (2020) have created an environment where the government and private sector can jointly produce, share and utilize data. These technological and data infrastructures form the core foundation for digital transformation in both disaster management and the broader public sector.

Korea's digital infrastructure is highly regarded globally. According to the ITU ICT Development Index (2024), Korea scored 94.4, surpassing the high-income country average (91.7) and the Asia-Pacific average (77.3). Korea scored 100 in categories such as internet usage rate, household internet access, and mobile broadband affordability (ITU, 2024). These high levels of digital capability and acceptance enabled ST-based disaster management to take root quickly and substantially in daily life. This greatly enhanced the efficiency and effectiveness of crisis response.

Table 3.1.3 ICT Development Index (2024)

Category	KOREA	High-income Avg.	Asia-Pacific Avg.
ICT Development Index	94.4	91.7	77.3
Universal Connectivity	93.4	89.9	73.4
Internet users	100	95.3	76.2
Households with Internet	100	96.6	79.3
Mobile broadband penetration	80.1	77.7	64.8
Meaningful connectivity	95.5	93.5	81.2
Mobile broadband coverage	99.9	98.8	90.4
Mobile broadband traffic	82.6	78.1	66.4
Fixed broadband traffic	90.4	88.3	78.0
Mobile broadband affordability	100	98.7	85.8
Mobile phone owners	100	98.3	84.8

※ Source: Author's compilation based on ITU data (2024).

(2) Government Commitment and Systematic Promotion of Science-based Disaster Management

Establishment of Strategies, Institutions, and Budgets for ST-based Disaster Management

Strong policy commitment and continuous policy efforts significantly contributed to the establishment and development of Korea's scientific disaster management. Before the 2000s, projects applying digital technologies to disaster management were mainly implemented as part of e-government initiatives. However, in the 2000s, scientific disaster management emerged as an independent policy direction and priority area, leading to the launch of the 1st Comprehensive Disaster and Safety Management Technology Development Plan (2008–2012) (MOIS, 2008).

Since the 2010s, the government has actively integrated the policy direction of "science-based disaster management" into mid to long-term strategies including the Basic Plan for National Safety Management.

In this plan, which serves as the top-level policy in the field of disaster and safety, the initiative to strengthen science-based disaster management was established as a key task beginning with the Third Plan (2015–2019). This policy direction has been further reinforced in the Fourth Plan (2020–2024) and Fifth Plan (2025–2029) (MOIS, 2015, 2020, 2024a).

The most notable shift occurred after the Itaewon crowd crush which led to the adoption of the Comprehensive National Safety System Reform Plan (2023–2027) in January 2023. Recognizing the need for predictive and rapid-response systems enabled by digital technology, the government presented "digital-platform-based science-based disaster management" as a core strategic area (17 tasks), with approximately 40% of all 97 tasks involving science and technology applications (MOIS, 2023a).

A significant example of the policy shift toward scientific disaster management is the Comprehensive National Safety System Reform Plan (2023–2027), announced in January 2023 in response to the Itaewon crowd crush that occurred on 29 October 2022. Following this unprecedented large-scale crowd incident, the government recognized the urgent need to utilize science and technology to predict potential disasters and to ensure a rapid and coordinated response on-site. The plan outlines five major strategies and includes 97 tasks. Notably, "Strategy 3" focuses on "science-based disaster Management based on digital platforms" as a key implementation strategy, comprising 17 specific tasks. This highlights the policy direction towards the "digital transformation of disaster management." Approximately 40% of the 97 tasks pertain to disaster management through the application of science and technology (MOIS, 2023a).

Government investment in disaster-safety R&D has also expanded continuously. While the annual average during the 1st Plan (2008–2012) was around KRW 136.5 billion, this increased to KRW 547.2 billion in the 2nd Plan (2013–2017) and KRW 1.4637 trillion in the 3rd Plan (2018–2022). By 2023, related budgets reached KRW 2.24 trillion, accounting for about 7.3% of the total government R&D budget (MOIS, 2023b).

In 2021, the Disaster and Safety Industry Promotion Act established the institutional basis for fostering the disaster-safety industry as a strategic national industry. The First Basic Plan for Promoting the Disaster and Safety Industry (2024–2028) aims to shift from short-term technology-driven responses to activating private-sector participation and creating a sustainable ecosystem (MOIS, 2024b).

These policy and institutional efforts can be viewed as a turning point that expanded ST-based disaster management from an administrative and technical policy domain into the realm of industry and the innovation ecosystem. In this way, the government's sustained commitment and systematic policy implementation have been key to ensuring the sustainability of Korea's ST-based disaster management system.

Rapid Adoption of Digital Disaster Management based on e-Government Achievements

Digital transformation in Korea's disaster-safety sector took root rapidly thanks to the systems, institutions and administrative culture accumulated during the implementation of e-government and digital government initiatives. Many of the key systems and platforms in the disaster management sector were developed from existing e-government services or reorganized and expanded to suit the specific characteristics of the disaster safety field. Key systems, such as the National Disaster Management System (NDMS) from 2005 and the e-People platform from 2008 were built on existing e-government services to enhance disaster management. In 2014, the Safety e-Report System was introduced, enabling citizens to report disaster risks and fostering public participation in monitoring. These advancements have improved administrative efficiency and established a strong policy foundation for a ST-based disaster management system.

Standardized system structures and inter-agency cooperation fostered through e-government significantly enhanced interoperability among disaster information systems and strengthened collaboration between central and local governments and the private sector. This enabled the rapid establishment of whole-of-government disaster response systems and integrated decision-making.

High public acceptance of digital technologies driven by the broad use of digital government services, also accelerated the societal adoption of digital disaster management. According to the 2025 Administrative Statistics Yearbook (MOIS, 2025), the proportion of civil petition documents issued online increased from 48.4% in 2015 to 83.7% in 2024, with online usage reaching nearly four times that of offline services. Citizens actively check mobile disaster alerts, submit hazard reports via the Safety e-Report app and obtain evacuation and response information through the National Disaster Safety Portal.

The accumulated continuity of policy and public acceptance created through e-government has thus been a critical enabler of Korea's rapid transition toward digital disaster management, strengthening the effectiveness and credibility of ST-based approaches.

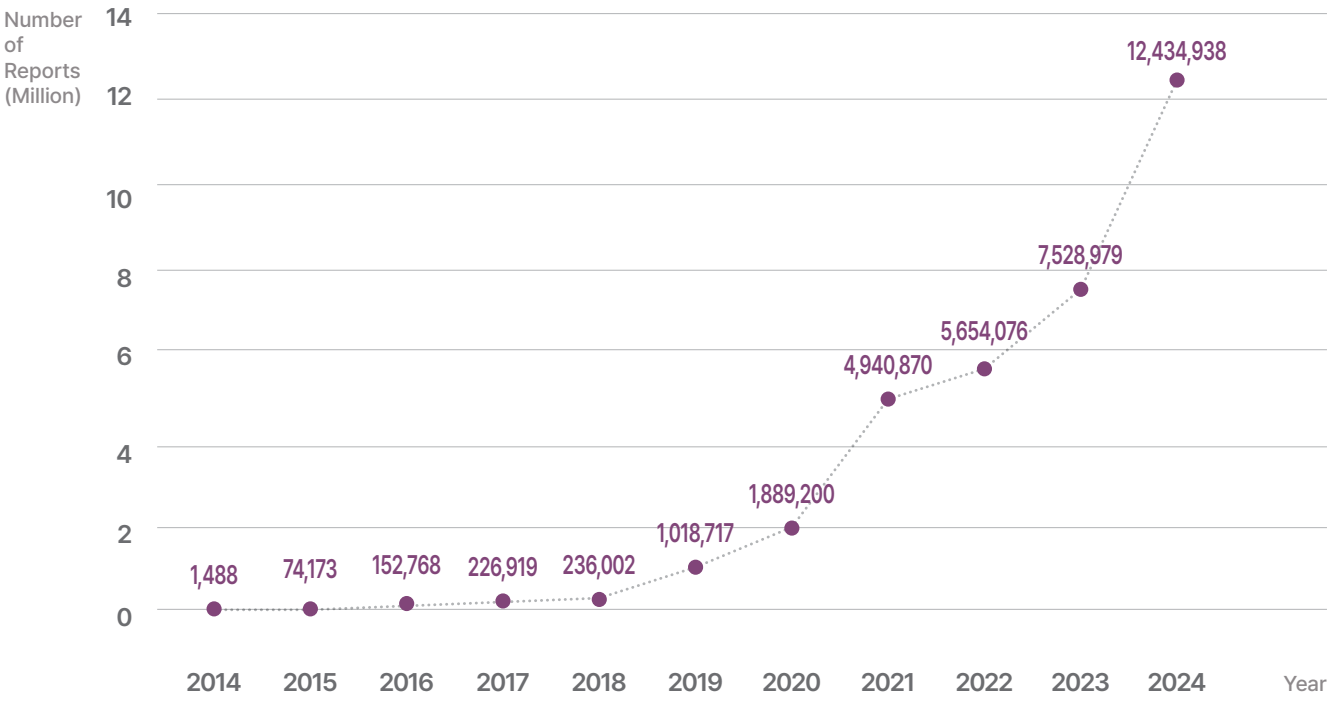
(3) Digital Public Participation and Virtuous Cycle of Engagement

Korea ranked first in the UN E-Participation Index (2022), demonstrating internationally recognized institutional capacity and active public engagement through feedback, policy suggestions and opinion sharing in digital administrative services (United Nations, 2022).

As digital government matured and digital literacy increased, digital participation expanded across society. Platforms such as e-People (2008), Safety e-Report (2014), and National Petition Service (2017–2022) spread rapidly, providing digital channels that integrated citizens' insights into policymaking. These platforms not only served as channels for civil complaints but also acted as essential conduits for reflecting the collective intelligence of citizens in the policy-making process within a digital environment, thus promoting active digital participation in the disaster safety sector.

Local governments' fast and effective responses to citizen reports played a key role in creating a virtuous cycle in disaster-safety participation. When public reports led to visible improvements, people gained a sense of participation efficacy, encouraging further engagement. Consequently, Safety e-Report submissions surged from 1,488 in 2014 to about 74,000 in 2015 and exceeded 12 million in 2024 (MOIS, 2025, p.226).

Figure 3.1.2 Total Reports Submitted via the Safety e-Report System



※ Source: Ministry of the Interior and Safety (MOIS), Statistical Yearbook of Public Administration and Safety (2018, p.373; 2025, p.226)

The government has also made parallel efforts to enhance public knowledge of disaster safety. The National Disaster Safety Portal (2007~) provides safety guidelines and shelter information for each type of disaster, while the Daily Safety Information Service (2013~) visualizes historical risks and safety grades to support local prevention and policymaking. Mandatory safety education for children, school-level safety curricula, digital learning content, safety-experience centers and NGO campaigns further strengthen disaster awareness across age groups.

Ultimately, the spread of public digital participation, combined with responsive government systems, high public digital literacy and a participatory social culture, has become a key driver enhancing both the operational effectiveness and societal legitimacy of Korea's ST-based disaster management.

Figure 3.1.3 On-Site Inspection of Children's Safety on the Way to and from School



(4) Strong Private Sector Capabilities and Public-Private Collaboration Ecosystem

Korea's private sector is globally recognized for its advanced digital technological capabilities. According to the IMD World Digital Competitiveness Ranking (2024), Korea ranks third worldwide, excelling in areas such as "technology infrastructure" and "agility of companies" (IMD, 2024). The OECD's Digital Economy Outlook (2024) notes that the Information and Communication Technology (ICT) sector contributes approximately 10.3% of Korea's GDP, double the OECD average of 5.4%, highlighting the crucial role that digital sectors play in the country's economic growth (OECD, 2024). Additionally, Korea ranks 5th in WIPO's Global Innovation Index (2024), demonstrating strong ICT infrastructure and robust private-sector research and development capacity (WIPO, 2024).

Through collaboration with the public sector, the private sector's technological advancements and innovative capabilities are producing various results in disaster and safety. During the COVID-19 pandemic, private apps utilizing public APIs for self-diagnosis, mask inventory tracking, and vaccine reservations served as excellent examples of this collaboration. Telecom companies partnered with the government to develop the national Public Safety LTE Network and enhance location-based emergency alert services. More recently, domestic firms have actively contributed to the deployment of AI-CCTV, AI-based crowd management systems and hazard prediction systems, while portal and navigation companies provide flood-risk information and other disaster alerts.

Figure 3.1.4 Startup Competition Utilizing Public Data (December 2025)



Case Study: Development of Unmanned Firefighting Robots through Public-Private Partnerships

Collaboration between the government and private companies is growing, not only in data analysis and utilization of technologies but also in physical AI and robotics. Hyundai Motor Group, which has recently increased its investment in robotics technology, has developed unmanned firefighting robots in collaboration with the National Fire Agency.

On February 24, 2026, Hyundai Motor Group donated four unmanned firefighting robots to the National Fire Agency. These robots are designed to extinguish fires and assess situations in high-temperature and high-risk environments that are difficult for firefighters to access. They were deployed during the fire at the Eumseong factory in North Chungcheong Province on January 30 and have been utilized at numerous disaster sites, including a forest fire in Miryang, South Gyeongsang Province, on February 23.

Equipped with a spray-cooling system capable of operating in high-temperature environments of 500–800°C, AI-based vision-enhancement cameras, and a 6x6 in-wheel motor electric drive system, these unmanned firefighting robots can move stably and respond to fires even amidst thick smoke and flames. In the future, approximately 36 of these robots are planned for deployment within the next four years, with long-term plans to distribute them to disaster sites across the country. This initiative is recognized as a case study in strengthening disaster response capabilities through advanced robotics technology, demonstrating the potential for increased utilization of physical AI and robots in various disaster safety fields.

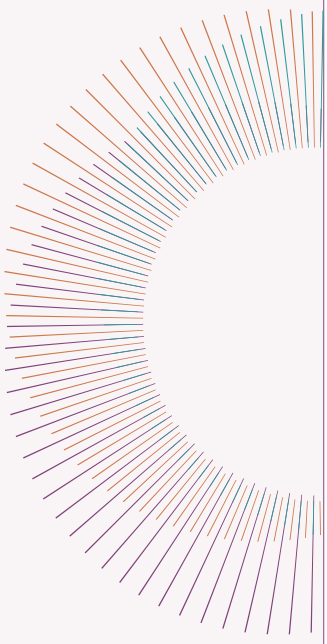
Figure 3.1.5 Unmanned Firefighting Robots and Firefighters Deployed at the Scene



2

Future Challenges for ST-Based Disaster Management

To enhance disaster management through science and technology and translate technological advancements into effective risk reduction, it is essential to continuously discuss and tackle various challenges. These challenges are not exclusive to Korea; they are common considerations for all countries implementing ST-based approaches to disaster management.



1. Enhancing the Reliability of Disaster Information

In the field of disaster and safety management, data reliability is directly related to the overall effectiveness of disaster management systems. During data collection, several issues can arise, including sensor malfunctions, system errors and omissions or manual data entry errors. Additionally, sampling bias, such as the under- or overrepresentation of specific regions or population groups, along with poorly designed models, can compromise the accuracy of risk assessments. The UNDRR has warned that these data quality issues can lead to misperceptions of risk, delays in response and misallocation of resources, ultimately resulting in greater disaster impacts (UNDRR, 2025b).

Since the early 21st century, social media has significantly changed how disaster-related information is produced and shared. Individuals can now share photos, videos, and location-based information about disasters in real time. Social media platforms have also become effective channels for swiftly disseminating official messages from disaster management authorities to the public, which supports disaster response efforts.

However, these platforms can also contribute to the rapid spread of misinformation and disinformation, while algorithm-driven exposure to sensational content can increase fear, erode trust in warning systems and worsen social tensions, ultimately undermining the consistency of disaster response (Tran et al., 2020; UNDRR, 2025b).

Korea has made continuous policy and technological efforts over a long period to enhance data reliability. In particular, the central government has launched administrative informatization initiatives by developing and distributing core administrative information systems such as resident registration, local taxation and vehicle registration systems, to local governments. This approach enabled the early establishment of a standardized foundation for data production, unlike many countries where local governments initially operated separate systems and only later pursued integration and interoperability.

In the 2010s, as Korea fully implemented open data policies, efforts intensified to improve the quality of public data through systematic quality diagnostics, automated error checks and metadata standardization. This focus on data has been crucial for the evolution of e-government and digital government, providing a strong foundation for disaster management. Key administrative datasets, covering areas such as resident registration, social welfare, income, and health, have created conditions for diverse disaster management applications, including the identification of vulnerable populations, the delivery of disaster relief payments, and the management of high-risk areas.

At present, disaster and safety-related data are integrated and managed through a dedicated disaster safety data platform. During actual disaster situations, the National Disaster Management System (NDMS) serves as the central hub, automatically connecting real-time data from various agencies, including meteorological, water resources, wildfire, and infectious disease authorities, to enhance both the reliability and timeliness of information provided.

Ensuring the reliability of the disaster information ecosystem requires verification across the entire data lifecycle-from collection and analysis to utilization-alongside transparent information disclosure by public institutions, responsible fact-checking by the media, the enhancement of public digital literacy, and the establishment of collaborative governance with platform companies In particular, a data-friendly system design, along with the process of opening up data and collaboratively discovering and correcting errors with users, is an effective way to enhance the quality of public data. Conversely, when data are neither opened nor actively used, errors are more likely to remain undetected.

Given that a substantial share of disaster-related information today is disseminated through social media, there is a growing need to establish dedicated forms of collaborative governance with platform companies. In Korea, media organizations have made voluntary efforts since 2014 by adopting the Disaster Reporting Guidelines, which aim to ensure accurate information provision, prevent the spread of harm, and protect the rights of disaster victims. However, in the social media sector, which is steadily gaining influence, there are complex issues, such as individual freedom of expression and the challenges of applying domestic norms to global platforms, making effective regulation difficult. Accordingly, further discussion at the international level and the development of reasonable, shared standards will be necessary going forward.

2. Leveraging Artificial Intelligence based on Trust

In recent years, AI has become a crucial instrument for improving the efficiency of disaster management and reducing disaster losses. AI, along with machine learning (ML) and generative AI (GAI), enables faster and more sophisticated analyses than traditional methods by identifying patterns in large datasets. These technologies support various functions, including predicting the likelihood of disaster occurrence, real-time monitoring, and decision support. As a result, they create new opportunities for innovation throughout the entire disaster management cycle including risk analysis, early warning systems, scenario-based preparedness and optimizing resource allocation.

The increasing potential of advanced technologies brings with it several technical and ethical challenges. The lack of transparency in "black box" models makes it difficult to understand their decision-making processes. Bias arising from imbalanced training data and the risks of generating inaccurate information with AI can pose serious threats in disaster and safety contexts (UNDRR, 2025b). As the use of personal data becomes more widespread, concerns about privacy violations and data ethics become more salient, potentially eroding public trust (Kwon, 2025).

Accordingly, when introducing AI into disaster management, ensuring accountability and transparency is as essential as addressing technical considerations. The adoption of explainable AI (XAI), systematic management of data bias, clear attribution of responsibility in the event of errors or failures, and the establishment of human-in-the-loop decision-making structures for critical judgments constitute fundamental prerequisites for the responsible use of AI in disaster management (UNDRR, 2025b).

In Korea, AI is mainly used for risk detection and prediction such as AI-based CCTV systems and flood or landslide prediction models. However, in line with the current government's policy agenda to become the "world's

leading AI-driven democratic government" (National Policy Agenda No. 24), its applications are expected to expand into public safety services, including the "AI Safety Reporting System."

As of now, no country has fully integrated AI to support key judgment and decision-making during the actual disaster response phase. To achieve this level of integration, it is important to do more than just add technology to existing processes; we need to establish new policies and operational frameworks specifically designed for AI.

Achieving this objective requires continuous learning and validation of AI systems through real-world disaster scenarios. AI deployment strategies should be driven by actual operational needs. These initiatives must include comprehensive reviews of technical and ethical risk mitigation measures, as well as enhancements to legal and institutional frameworks to promote the responsible use of AI.

It is also crucial to build response capacities for the mid to long-term, which involves strengthening specialized research institutions in the disaster and safety sectors and establishing effective collaboration mechanisms among public, private and academic entities. Given the rapid advancement of AI, these efforts are vital. By accumulating such efforts, we can foster social trust in AI and create a "trustworthy, AI-enabled science-based disaster management system." This will facilitate the effective use of AI throughout all phases of disaster management while minimizing technical and ethical risks.

3. Advancing Digitalization of Inclusive Disaster Management

As the digitalization of disaster management accelerates, there is a growing risk that older persons, low-income groups, persons with disabilities, foreigners and women may be left behind in accessing and using digital services. Differences in smartphone literacy, device and data costs, language barriers, and disparities in communication infrastructure across regions can create a situation in which the "digital divide translates into a safety divide."

To address these gaps, the Korean government and local governments have taken parallel approaches. They aim to enhance the user-friendliness of digital disaster and safety services while continuing to offer traditional, non-digital forms of disaster communication and support. These initiatives include providing digital literacy training for older adults and low-income groups, offering public Wi-Fi and data support, implementing multilingual disaster alert services, and improving warning systems for individuals with visual and hearing impairments.

In rural and coastal local governments, where many residents are less familiar with digital devices, traditional warning-dissemination mechanisms, such as village broadcasting systems, electronic display boards, telephone alerts, and in-person notifications by local community leaders, continue to play an important role. In addition, approximately 4,500 individuals in flood-prone vulnerable groups, including older persons living alone and persons with disabilities, have been identified and paired one-to-one with evacuation assistants. These arrangements are linked to the "119 Safety Call" service to enable rapid rescue and evacuation support during disasters.

UNDRR also emphasizes that disaster risk reduction should not rely solely on advanced digital technologies, but should continue to incorporate low-cost, low-technology warning tools such as village broadcasting systems, sirens and radio. In particular, for older persons, migrants, and other vulnerable groups with limited digital access such low-tech, highly accessible solutions may be more effective in delivering warnings. Accordingly, UNDRR recommends that countries establish hybrid early warning systems that combine high-tech and low-tech approaches (UNDRR, 2025b).

Ultimately, the true success of digital transformation lies not in the speed of technological innovation, but in the establishment of inclusive systems that ensure all citizens can access safety information and respond on an equal basis. Such foundations help reduce the exposure of vulnerable groups to risk and, in turn, lower overall societal losses. Korea's Digital Inclusion Act, scheduled to take effect in 2026, is expected to provide an important institutional basis for advancing this direction. Building on this momentum, ST-based disaster management services should incorporate universal design principles from the earliest stages of system planning and design, ensuring a user experience (UX) that is easily accessible to all-regardless of age, gender, language or disability status.

4. Strengthening Public Disaster Knowledge and Safety Awareness

Advancements in science and technology have enabled citizens to better understand risks and respond more proactively. However, effective participatory disaster management requires improvements in public knowledge of disasters and risk awareness.

Disasters are no longer challenges faced only by specific regions or groups; they are risks encountered by everyone in everyday life. Public awareness of disaster risks, combined with accurate knowledge and the ability to take appropriate action, is essential for disaster prevention and minimizing losses. The dissemination of disaster knowledge and the promotion of a safety culture form a critical foundation not only for individual survival but also for strengthening societal resilience.

In Korea, large-scale accidents in the early 1990s prompted the development of a national safety culture. This initiative was further solidified by the establishment of the Framework Act on the Management of Disasters and Safety (2004) and the Framework Act on the Promotion of Safety Education for Citizens (2015). Despite these efforts, industrial accident rates and everyday safety incidents in Korea remain higher than the OECD average. This indicates ongoing challenges within the social and organizational culture, which tends to prioritize speed and efficiency while treating safety as a secondary concern.

At the international level, the sharing of disaster knowledge is widely recognized as the starting point for disaster risk reduction. The Sendai Framework for Disaster Risk Reduction (2015–2030) identifies "Understanding Disaster Risk" as a top priority, clearly establishing the importance of accumulating knowledge and information as the foundation of all risk reduction efforts (UNDRR, 2015). Similarly, the Early Warnings for All (EW4All) initiative places Disaster Risk Knowledge (Pillar 1) at its core, emphasizing the need for people to understand the risks they face (UNDRR, 2023).

The key instruments of disseminating disaster knowledge are education, information dissemination, and institutional design. First, we must strengthen prevention-oriented thinking across all generations through school, workplace, and lifelong education programs that reflect the latest disaster risk information. Second, the government, media, and local communities must convey reliable information quickly and clearly, while eliminating information gaps caused by differences in language, age, geographic location and digital accessibility. Third, this must be supported by institutional frameworks that recognize safety not as a cost but as the foundation of sustainable development. Ultimately, safety is the foundation that underpins the sustainability of society as a whole; only when this understanding takes root can a culture of safety be established in daily life and the public's active participation be expanded.

5. Reassessing and Redesigning Processes beyond Technology

Rapid environmental changes driven by technological advancement, urbanization, demographic shifts, and ecological transformation are undermining the risk assumptions on which traditional disaster management systems were built. In many regions, previously unforeseen "surprise hazards" have emerged, while existing hazards are occurring more frequently and with greater intensity. These trends highlight the structural limitations of disaster management frameworks that depend solely on existing technologies and institutions, making effective response increasingly difficult.

Climate change, in particular, is accelerating the frequency of extreme events. According to UNDRR (2025a), the lifetime probability of experiencing what is termed a "100-year flood" has increased from 63% for individuals born in 1990 to 86% for those born in 2025. Moreover, if countries' Nationally Determined Contributions (NDCs) under the Paris Agreement remain unchanged, global average temperatures are projected to rise by approximately 2.6–3.0°C by 2100. Under this temperature scenario, events historically classified as "100-year floods" are expected to occur about 2.5 times as frequently by the middle of this century as in the past (UNDRR, 2025a).

Preparing for such significant changes cannot be achieved solely by introducing new technologies. A comprehensive redesign of disaster management processes is essential. This includes clearly defining responsibilities for risk identification and management, improving collaboration between agencies, and streamlining decision-making

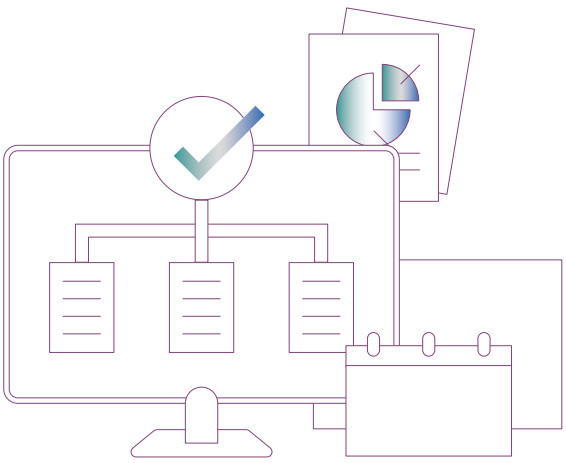
procedures. As illustrated by Korea's establishment of an emerging risk identification and management system following the Itaewon crowd crush (Case 4.3), there is a growing need to identify social risks in advance and determine who is responsible for preparedness and response.

Investment in infrastructure that adapts to an evolving risk environment is crucial. Even the most advanced disaster prediction and response technologies cannot fundamentally reduce losses from extreme weather if urban and social infrastructure remain vulnerable. Reducing disaster risk and vulnerability requires implementing structural measures concurrently such as expanding dams, reservoirs, and drainage facilities; zoning based on flood history and risk; and designing infrastructure and buildings to withstand return periods. The UNDRR's GAR 2025 emphasizes that proactive investment in such strategies is the most cost-effective approach to disaster risk reduction, yielding benefits that range from 2 to 10 times the initial investment in disaster preparedness (UNDRR, 2025a).

The redesign of disaster management processes must prioritize the needs of both field personnel and users. Adopting new technologies should be based on practical experience and specific requirements. During major disasters, it's essential to implement fundamental process improvements to prevent similar incidents in the future, using a thorough analysis of the root cause.

Furthermore, after introducing new technology, it is crucial to ensure end-to-end improvements throughout the entire process. This includes enhancing capacity-building for operational personnel, providing user training, establishing testing and feedback systems, and improving interoperability across systems.

By implementing process innovation alongside new technologies, we can ensure these technologies function effectively in real-world environments and gain the trust they deserve. This proactive approach will enable the disaster management system to adapt seamlessly to changing risk environments, evolving into a robust system that continuously learns and improves.



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