

Disaster Prevention Policy and Safety R&D in Korea

Chi Hun Lee* and Jae Hyun Shim

1. Introduction

There were multiple disasters and accidents that happened in the late years of 20th century, which caused a number of social problems in Korea such as the Mugunghwa-ho derailment and the sinking of the Seohae Ferry in 1993, the collapse of Seongsu Bridge and the gas explosion of Ahyeon-dong in 1994, the gas explosion of Daegu Subway, the collapse of Sampoong Department Store, and the crash of the Korean Air in Guam in 1995. Also, there were disasters and accidents that happened more recently, such as the typhoon Rusa in 2002, typhoon Maemi, and the arson in the Daegu Subway in 2003, the collapse of Gyeongju Mauna Resort gymnasium, and the sinking of the Sewol ferry boat in 2014.

When these disasters or accidents occurred, they aroused social criticism and debates whether the causes of their causes were human errors, acts of God, or government errors, and authorities announced that they would take measures to prevent disasters or accidents from occurring. One of the lessons we learned from years of research on safety management is the that safety should not be the temporary topic of discussion for a limited time whenever a disaster or an accident occurs but a

sustainable plan to fundamentally improve the safety management system of the society needs to be developed and practiced.

The scale and types of disaster damage have become diversified, expanded, and combined because of climate change. The predictability of the climate change is yet unsatisfactory in spite of the progress of science & technology on related fields. Also, as the standard of living has improved qualitatively and quantitatively, the public has become more concerned about having a comfortable and safe environment as the top priority. The natural disasters that happened domestically, such as typhoon, heavy rain, strong wind, heavy snow, etc., have caused deaths of 43 people and property damages of KRW 1.1556 trillion per year during the last ten-year period (2002–2012). In particular, a total of 22 natural disasters, such as the Typhoon Bolaven, the Typhoon Tembin, etc., in 2002 caused the death of 16 people and the property damage of KRW 1.0892 trillion. They account for 37% of the death and 94% of the property damage, comparing to 10 year average values stated above (National Emergency Management Agency, 2013).

Social or man-made disasters, such as emergence of new types of infectious diseases, environmental pollution, terrorism, riot, etc., are increasing globally.

National Disaster Management Institute, 136 Mapo-gu, Seoul, 121-719 Republic of Korea

* Corresponding Author: chihun@korea.kr

The types, frequency, scale of damages of domestic social or man-made disasters are also growing because of rapid industrialization and urbanization. The type of disasters are being diversified for the increase in risks, such as the leakage of toxic substance, forest fire, terrorism as well as safety accident in the living environment, safety accident against the socially disadvantaged, etc. An average of 279,924 human / social disasters have occurred, and they caused deaths of 375,725 people as well as property damages worth KRW 488.9 billion per

year during the last ten-year period (2001–2010) (National Disaster Management Institute, 2012).

The number of social issues regarding disaster and safety are increasing because of the atypical occurrence of natural disasters caused by the recent climate change and the increase in the social or man-made disasters caused by the industrialization and urbanization. With this to note, this review aims to analyze the current state of disaster prevention policy and R&D on disaster and safety in Korea and suggest the future promotion plans.

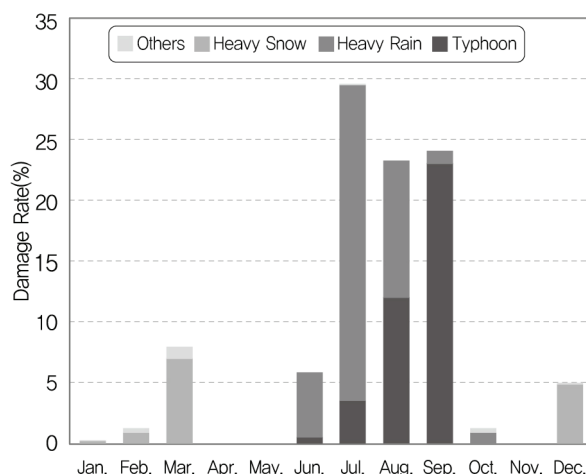


Figure 1. Damage rate during recent 10-year period by cause and month (National Emergency Management Agency, 2013)

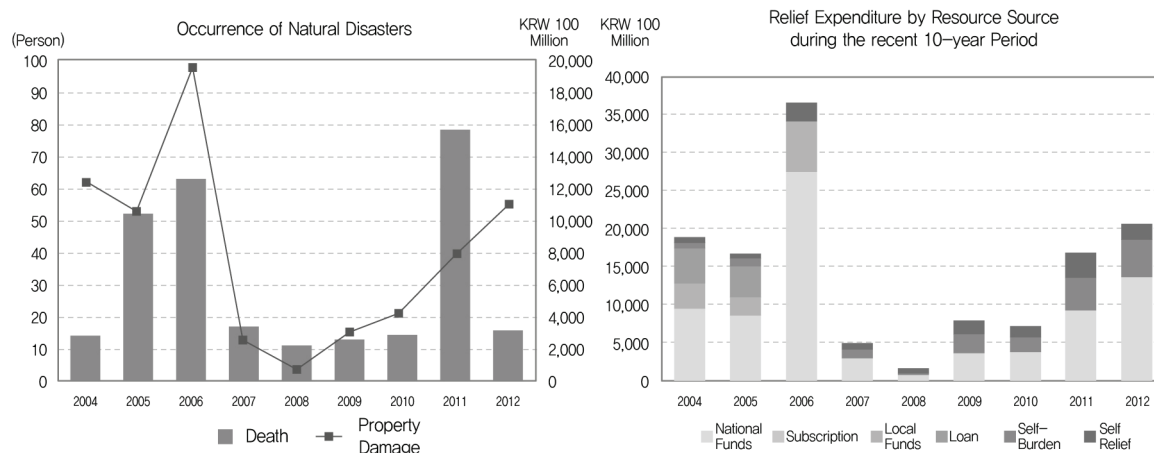


Figure 2. Scale of damage caused by natural disasters during the recent 10-year period

Source: e-Statistics Korea, www.index.go.kr

2. Analysis of Disaster Management and Safety R&D in Korea

2.1. *The 2nd Comprehensive Plan for the Development of Disaster and Safety Management Technology*

Korean government establishes the “Comprehensive Plan for the Development of Disaster and Safety Management Technology” every five years in accordance with Article 71-2 of the Enforcement Decree of the Framework Act on the Management of Disaster and Safety. Also the annual enforcement plan is established and implemented for developing disaster and safety management technology.

The Comprehensive Plan is an inter-ministerial legal plan, which puts together disaster and safety management technologies of the related central administrative agencies in accordance with the Framework Act on the Management of Disasters and Safety. Since 2007, 14 related ministries have participated together in establishing the Comprehensive Plan, which aimed to improve the efficiency of R&D and create synergetic effect at a national level.

In the “2nd Comprehensive Plan for the Development of Disaster and Safety Management Technology (2013–2017),” the significance to develop the technology customized according to the disaster type and the regularly affected area was on the rise to reduce damages caused by repeatedly occurring disasters or calamities. As the risks of new types of disaster or calamity, such as volcano, infectious diseases, terror, etc., increased, the significance to develop preemptive technology was also on the rise in order to effectively respond to people’s anxiety and the increasing level of disasters and calamities based on their complications. Furthermore, as the people’s level of demand for safety and the number of social groups vulnerable to disasters increase, developing life-centered technologies that

can address people’s needs became more important.

The 2nd Comprehensive Plan shifted disaster and safety management R&D to create more value by leading creative technology development rather than passively following the technologies of advanced countries. It also led changes in understanding the significance of international cooperation to solve global problems. Furthermore, it valued the necessity to derive disaster and safety research areas that can contribute to the industry in order to overcome the issues such as lack of demand, small scale of business, and lack of connection with the field. The policies and projects corresponding to the 5 strategies and 14 major tasks according to this R&D initiative are shown in Table 1. The direction of the 2nd Comprehensive Plan was established on the basis of analyzing the demand for technology development, such as environmental analysis, current status and performance analysis of related upper plans that is, analyzing the occurrence of disaster and calamity, examples of foreign cases, technology standards and performance of the 1st Comprehensive Plan, etc. It was sought to change the main subject of policy-making from government ministries to the public citizens, and the direction of policy establishment from a stand-alone technology development system to a convergence system combining technology with policy, education, and industry. It led the changes of the direction of technology development from narrowing the technological gap with the advanced countries (‘catch-up’ type) to the leading type by aiming to develop creative technology such as the original, fundamental, and critical technology. And the purpose of technology development changed from solving a pending problem to creating a response system for future disaster and safety accidents. This led to the shift of disaster management, from a specific management to a comprehensive system that covers the full cycle.

Table 1. Technologies selected for priority investment for each strategy

Classification		Necessity
Strategy 1	To reduce the occurrence of major disasters and calamities through the development of customized technologies	<ul style="list-style-type: none"> - To anticipate major disasters and calamities by type - Technology to reduce damages caused by major disasters and calamities - To construct a system to manage major disasters and calamities
Strategy 2	To manage upcoming disasters and calamities through the development of preemptive technologies	<ul style="list-style-type: none"> - To develop an interdisciplinary convergence technology for creative technological development - To anticipate future disasters and calamities and develop a technology to respond such disasters and calamities - To anticipate combined disasters and calamities and develop a technology to respond such disasters and calamities
Strategy 3	To obtain national safety through the development of technologies close to everyday life	<ul style="list-style-type: none"> - To develop everyday technologies for the management of disasters and calamities - To develop a safety management technology for the socially disadvantaged - To improve the responsiveness during disasters and safety accidents on the basis of nationwide sympathy
Strategy 4	To strengthen the ability to develop technologies to efficiently manage disasters	<ul style="list-style-type: none"> - To construct infrastructures to manage disaster and safety - To sophisticate the disaster management level and safety by strengthening the capabilities of human resources - To strengthen the cooperation of international community in order to respond to cross-national disasters
Strategy 5	To construct a foundation for the diffusion of technology for disaster and safety	<ul style="list-style-type: none"> - To develop knowledge database in order to utilize the technologies for anti-disaster and safety - To construct a foundation for field application of the developed technology - To rear the disaster and safety industry and construct a support system

Source: Research on the Establishment of the 2nd Comprehensive Plan for the Development of Disaster and Safety Management Technology (National Emergency Management Agency, 2012)

2.2. Characteristics of National R&D on Disaster Prevention and Safety Management

As the risk of the occurrence of disasters and calamities, such as typhoon, heavy rain, foot-and-mouth disease (the scale of economic damages caused by national damages in 2010 – 2011 approached about KRW 3 trillion), etc., increased together with the occurrence of disaster and calamity and the damages thereof became complicated, thereby expanding the scale of damages, the national R&D on disaster and safety management technology has been prioritized.

Also, multi-ministerial projects such as R&D collaboration and cooperation among government departments through a comprehensive R&D adjustment system is being actively supported in order to overcome the fall of competitive power caused by the lack of concept and detailed definition for disaster and calamity as well as the sporadic R&D projects pushed by individual government departments.

For the R&D projects on the development of technologies to manage disaster and safety in 2013 in accordance with the 2nd Comprehensive Plan, the rates of investment with respect to the natural

disasters were high in preventive stage (46%) and basic research (48%). Meanwhile, the rates of investment with respect to the man-made or social disasters were high in the preventive stage (43%) and development research (41%).

With respect to the investment scale according to the type of disaster and calamity, the rates of R&D investment were high in infectious disease in domestic animals (24%); chemical, biological,

or radiological accidents (24%); and infectious diseases (20%). The priority investment fields include typhoon, heavy rain, flood, nuclear power plant safety, new or mutant infectious diseases, environmental pollution accidents, cyberterrorism, etc., and the necessity and technologies of the investment field were as follows (National Science & Technology Counsel, 2012).

Table 2. Technologies selected as priority investment for each classification

Classification	Necessity	Technologies
Typhoon, Heavy Rain, Flood	Loss of lives and property damages caused by typhoon, heavy rain, or flood take the largest types of damages and calamity.	Technology to secure water resources and reduce disaster and calamity through the development of a sound water cycle city
Safety of Nuclear Power Plant	Possibility of accidents caused by problems in facility itself as well as disaster and calamity, such as earthquake, terrorism, etc.	Technology to prevent serious accidents and power failure
New or Mutant Infectious Diseases	Increased possibility of new or mutant infectious diseases and spread of damages, such as highly pathogenic communicable diseases between men and beasts.	Technology to cure intractable tuberculosis
Environmental Pollution	The scale of damages caused by the exposure of pollutants, such as Taean oil spill accident, etc., tends to expand and its effects on human and ecosystem tends to be prolonged.	Technology to swiftly detect and respond to the hazards in health by utilizing a method to assess risks based on the exposure to harmful substances
Cyberterrorism	The scale of economic or social damages caused by cyberterrorism is large. In particular, the cyberterrorism against infrastructure, such as nuclear power plant, will cause substantial damages.	Cyber security technology of nuclear power plant

Source: Strategies for R&D Investment on Disaster and Calamity in 2013 (Draft) (National Science & Technology Council, 2012)

2.3. Implication of Disaster Prevention and Safety Management Technology in Korea

Advanced countries, such as the U.S., the EU, OECD, etc., have established strategies to take precautionary measures to prepare for future disasters and performed related researches on disaster management and safety at a national level. They

have made attempts to make a safe future society through preemptive responses, and solve problems regarding future issues.

Advanced countries have established the policy direction for food, population, information communication, as well as disaster and safety as issues for future response and prepared alternatives to respond thereto. In particular, in the disaster and safety field, future

responses in consideration of social developments, such as disasters caused by climate change, internet response of information and communication technology, and bombing or terrorism, etc. has been emphasized in order to make a sound society.

The biggest keyword in the field of technological change is “smart.” Artificial intelligence in a variety of IT devices and terminals has been advanced by being smart, and various IT devices and terminals have evolved to communicate with humans. It is anticipated that such an evolvement will lead the development of related industries, such as an augmented reality. Besides, it is anticipated that eco-friendly technology and environment management technology will be continuously developed and diffused, and such technology will be synchronized with artificial intelligence and the increased popularity of automated smart devices.

The said advancement of the cutting-edge IT improved the artificial intelligence of smart devices, making it possible to introduce a human-centered

product, device, or service and expand the technology to prevent, prepare, and respond to the disasters, which grafted smart phone-based sensor, touch, and location. The technology to maximize the reality through virtual / augmented reality-based new interface will be important means for citizens to actively participate in disaster preparation and response on the basis of virtual disaster experience.

It will be necessary to establish comprehensive and systematic strategies at a national level in order to efficiently respond to the globalization, combination and the increased prevalence of disasters. Also, it is necessary to prioritize the development of technologies to preemptively and systematically respond to new future disasters, calamities, and safety accidents. Furthermore, it is important that the technology development and investment strategies are carried out in a systematic manner. The major areas and necessity for disaster and safety technology in Korea are as follows.

Table 3. Development of technologies for responding to disasters and safety accidents

R&D Areas	Necessity for Technology Development
The need to develop statistics-based technologies	It is necessary to develop technology that utilizes statistical information in order to anticipate super disasters.
The need to develop convergence technologies	It is anticipated that the development of convergence technology with livestock, construction, urban planning, health care, agriculture, etc., will be more effective.
The need to develop technologies to prevent new types of safety accidents	It is necessary to develop technology to prevent safety accidents damaging cultural properties.
The need to develop responsive technologies based on combined disasters	The damages became more serious as the technological disasters are combined with natural disasters. It is necessary to classify the types of combined disasters that can occur in Korea and develop a technology that is centered on the preparation for such disasters.
The need to develop technologies based on spatial data on urban disaster preparation	The natural disasters in urban area are occurring increasingly such as landslide, flood, etc., caused by localized heavy rain because of the recent climate change. It is necessary to develop a technology based on spatial data on natural disasters in urban areas.
The need to develop a field-centered and citizen participating technologies	Disaster prevention strategies which are field-centered and citizen participatory shall be urgently introduced even for the reduction of prevention costs. It is effective to develop such technology by linking it with cutting-edge devices, such as smart phones and it is important to include training programs.

The need to develop technologies based on intelligent disaster prevention	It is necessary to develop a technology in connection with the analysis of smart technology from other countries to prevent disasters. Thus, it is necessary to cooperate and develop partnerships with advanced countries in relevant technological fields.
The need to develop technologies based on small and medium-sized businesses and export vitalization	It is necessary to develop a database for technology development in order to vitalize the participation of businesses in the area of disaster, calamity, and safety accident. It is necessary to expand the market as well as to commercialize and develop a technology for responding to safety accidents that is becoming more prevalent.
Key area for technology development	It is necessary to develop an intelligent meteorological technology for disaster prevention. It is necessary to develop a technology for the alarm system as well as the provision, recovery, and restoration of information

Source: 1) Plan to Strengthen Korea's Ability to Research Disaster and Safety (Ahn, Hyo Dae, 2011)

2) Basic Plan for R&D on Disaster Prevention (Central Disaster Prevention Council of Japan, 1993)

Table 4. Establishment of policies for responding to disasters and safety accidents

R&D Areas	Necessity for Technology Development
The need to develop technologies related to the establishment of autonomous industrial foundation	It is necessary to establish an autonomous industrial foundation by strengthening the investment in the advanced management of disasters, calamities, and safety accidents
Construction of network for industry–university–institute cooperation and Establish commercialization strategies	The network for industry–university–institute cooperation and the establishing commercialization strategies are necessary in rearing the industry related to the management of disasters, calamities, and safety accidents
The need to develop technologies based on meteorology, demography, and psychology	It is necessary to relate the researches to recent climate change and consider topics to social changes such as increase in working couples, ageing, expansion of five-day work week and home working, and accidents related to school violence, suicide, etc., based on psychological circumstances and changes.
The need to develop a national statistics portal for disaster response	It is anticipated that these problems will be solved through the development of a national statistics portal for disaster, calamity, and safety accident.
Establishment of legal and institutional plan related to cyberterrorism	It is necessary to develop a technology to analyze foreign laws and system for damage prevention. Demand for the establishment of legal and institutional plans related to the cyberterrorism
The need for training programs	It is effective to develop a training program related to disasters, calamities, and safety accidents by linking with cutting-edge devices, such as smart phone, etc.
Technology development based on systematic analysis of foreign disasters	It is necessary to urgently develop a technology based on the systematic analysis of disasters, calamities, and safety accidents that occurred overseas. In particular, cyberterrorism and combined disaster, etc.

Construction of a social safety net for multi-cultural societies	It is necessary to develop a technology to manage man-made and social disaster related to resident foreigners in Korea based on the advent of multicultural societies. For example, construction of social safety net for foreigner crimes
The need to develop technologies based on psychology and demographics	It is required to develop a technology to prevent safety accidents that may occur from everyday lives, e.g., technology for prevention of adolescence suicide, safety measures for a child of a working couple, etc.
Construction of safety net for the aging society	As the aging population increases rapidly, the number of one-person household is also sharply increasing and additional programs may be necessary. It is necessary to conduct R&D on the safety of elderly and utilize the results thereof for practical use.
Strategic partnership with an advanced country in line with disasters, calamities, and safety accidents as well as checks on China	It is necessary to develop a technology by establishing global partnerships with a country that is advanced in the relevant field. Also it is necessary to develop a technology by establishing various global partnerships among governments, businesses, institutes, and universities from an advanced country.
Construction of governance and resident partnership among local autonomous entities	It is necessary to exchange human resources and functions by establishing a governance system in order to secure the continuity of the functions of the local government in case of the occurrence of disasters. To construct a network for an administrative agency and residents to link with the local society

Source: 1) Plan to Strengthen Korea's Ability to Research Disaster and Safety (Ahn, 2011)

2) Basic Plan for R&D on Disaster Prevention (Central Disaster Prevention Council of Japan, 1998)

3. Current State of Investment in Technology for Disaster and Safety Management in Korea

Korea's R&D on disaster safety is led mainly by government agencies and not by a private sector. The major agencies are thirteen governmental departments in addition to the Ministry of Security and Public Administration: National Emergency Management Agency; Ministry of Land, Infrastructure and Transport; Nuclear Safety and Security Commission; Ministry of Science, ICT and Future Planning; Ministry of Agriculture, Food and Rural Affairs; Ministry of Trade, Industry, and Emergency; Ministry of Health and Welfare, Ministry of Environment; Ministry of Maritime Affairs and Fisheries; Ministry of Food and Drug Safety; Rural Development Administration; Korea Forest Service; and Korea Meteorological Administration.

3.1. Investment in R&D on Disaster and Safety

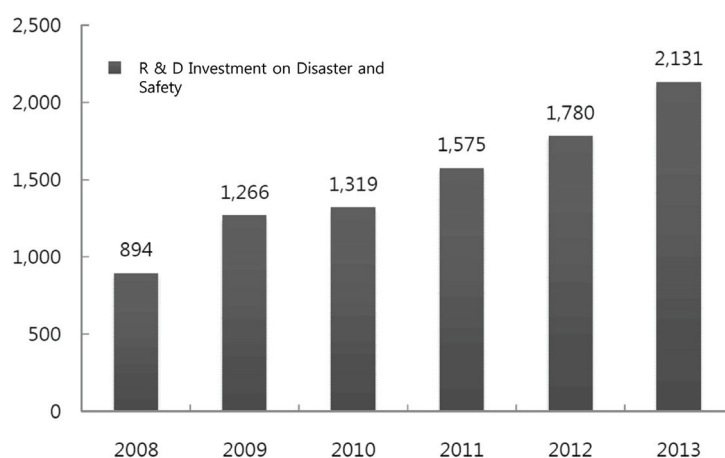
Korea's budget for disaster and safety R&D in 2012 is KRW 178 billion, which has increased by 13.0% (KRW 20.5 billion) compared with that in 2011. In addition, the R&D budget in the disaster and safety field in 2013 has increased by 19.7% compared with that in 2012. However, these only accounted for 1.11% and 1.26% of the whole national R&D budget, respectively.

The R&D endeavors in 2013 have mainly focused on the technologies such as the development of eye-level technology for future types of disaster and safety accidents, the expansion of systematic foundation for disaster and safety convergence and R&D result creation, and the provision of tangible safety services, etc.

Table 5. Changes in the scale of R&D investment in disaster and safety (2010~2012)

Classification	National R&D Budget (B)	R&D Budget on Disaster and Safety (B)	Proportion of R&D on Disaster and Safety (B/A)	Rate of Increase in R&D on Disaster and Safety Compared with the Previous Year (%)
2010	KRW 13.6824 Trillion	KRW 131.9 Billion	0.96%	-
2011	KRW 14.8902 Trillion	KRW 157.5 Billion	1.06%	19.4%
2012	KRW 16.0244 Trillion	KRW 178.0 Billion	1.11%	13.0%
2013	KRW 16.8777 Trillion	KRW 213.1 Billion	1.26%	19.7%

Source: Enforcement Plan for the Development of Technology to Manage Disaster and Safety in 2012 (National Science & Technology Council, 2012)

**Figure 3.** Changes in the budget for Disaster and Safety R&D (KRW 100 Million)

Source: Enforcement Plan for the Development of Technology to Manage Disaster and Safety in 2013 (National Science & Technology Council, 2013)

The disaster and safety R&D conducted by the Ministry of Land, Infrastructure and Transport accounted for KRW 36.1 billion (16.9%) of the R&D investment on disaster and safety by department in 2013, which was the largest. Meanwhile, the Korea Meteorological Administration accounted for KRW 29.8 billion; the National Emergency Management Agency accounted for KRW 25.2 billion; the Ministry of Health and Welfare accounted for KRW 23.4 billion; the Ministry of Maritime Affairs and Fisheries accounted for KRW 20.6 billion; and the Ministry of Food, Agriculture, Forestry and Fisheries accounted for KRW 20.0 billion.

The investment proportions of the top three

departments in 2013 were 42.7%. This was substantially reduced from 51.7% in 2012, and it appeared that the investment proportions by department were relatively dispersed within a fixed budget (the concentration of investment by small number of departments has declined: 85.8% in 2009, 81% in 2010, and 61.8% in 2011).

This phenomenon leads to the improvement of research capacity by each department on disaster and security according to the implementation of multi-ministerial R&D. Technological and policy efforts to reinforce the R&D network among the departments, to reduce similar or concentrated investment and to improve joint cooperation projects

among departments shall be continuously expanded. Most of all, R&D investment on disaster and safety shall be continuously expanded in order to reduce the technological gap with advanced countries and improve the quality and safety of life.

3.1.1. Analysis of Investment Proportion of R&D on Disaster and Safety by Disaster Type

The natural disaster accounted for 45% (KRW 80.7 billion) of the government R&D investment in disaster and safety in 2012; the social disaster accounted for 38% (KRW 68.1 billion); and the human resource disaster (including firefighting) accounted for 13% (KRW 22.6 billion). On the other hand, the natural disaster accounted for 38% (KRW 81 billion) of the government R&D investment in disaster and safety in 2013. Human resource and social disaster, including the field of firefighting, accounted for 54% (KRW 115.1 billion), and life safety accounted for 13% (KRW 43.6 billion). Others accounted for 6%. Thus, the investment proportion of the natural disaster was decreased by 7% and that of the human resource and social disaster was increased by 3% in 2013. Also, as the investment proportion of the life safety is additionally increased to 2%, it is estimated that the investment in safety

accidents will be continuously expanded.

The amount of investment in the natural disaster in 2013 was increased by 44% compared with that in 2012 in order to respond to the acceleration and combination of natural disasters, such as deluge, landslide, drought, etc., caused by the climate change. The amount of investment in the human resources and social disaster in 2013 showed an increase by 32% compared with those in 2012 according to an increase in occurrence of new types of disasters, such as infectious diseases like foot and mouth disease, and cyberterrorism due to industrialization, urbanization, and the progress of science & technology (National Science and Technology Council, 2013).

The necessity for the increase in investment in connection with multi-cultural society in which the proportion of the government investment has been relatively small in the past is on the rise. The amount of investment to secure everyday life safety in 2013 was increased by 81% compared with that in 2012 in order to prevent various safety accidents caused by the rapid changes in economy, society, and culture. In case of safety accidents, it is necessary for the investment to continuously increase in relation to adolescence suicide or elderly safety based on the ageing society.

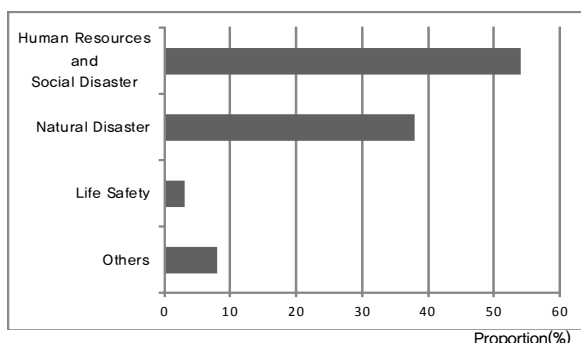


Figure 4. Proportion of R&D Investment in Disaster and Safety by Disaster Type (2013)

Source: Enforcement Plan for the Development of Technology to Manage Disaster and Calamity in 2013 (National S&T Council, 2013)

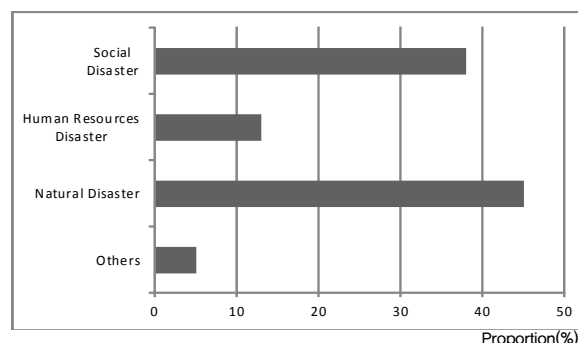


Figure 5. Proportion of R&D Investment in Disaster and Safety by Disaster Type (2012)

Source: The 4th Special Committee on Science and Technology Support for Disaster and Calamity (National S&T Council, 2012)

3.1.2. Analysis of Investment Prospect in the Development of Technology for Disaster and Safety

It was shown that a total of KRW 1.93 trillion would be invested for the expansion of the existing projects and new projects during a planned period for R&D investment in disaster and safety accidents (2014 ~2017).

The Ministry of Land, Infrastructure and Transport / The Ministry of Oceans and Fisheries will account for 25.8% of the R&D investment in disaster and safety accident until 2017, which is the largest. The Ministry of Health and Welfare will account for 19.1% of the R&D investment in disaster and safety

accident until 2017, and the National Emergency Management Agency will account for 11.1% thereof. The Korea Meteorological Administration will account for 10.0% of the R&D investment in disaster and safety accident until 2017, and the Ministry of Security and Public Administration will account for 9.3% thereof. Because there is a discrepancy with the current state of investment in 2013, and the investment proportions for the Ministry of Agriculture, Food and Rural Affairs as well as the Ministry of Health and Welfare are relatively small, rational coordination will be necessary prior to the establishment of actual plans in future.

Table 6. Plan for the Investment in Technology for Disaster and Safety Management by Department

(Unit: Hundred Million Won, %)

Department	Investment by Year				Total	Proportion (%)
	2014	2015	2016	2017		
Nuclear Safety and Security Commission	60.0	55.0	50.0	40.0	205.0	1.1
Ministry of Science, ICT and Future Planning	69.0	54.0	34.0	34.0	191.0	1.0
Ministry of Education	82.0	51.0	46.0	15.0	194.0	1.0
Ministry of Security and Public Administration	225.5	349.1	514.5	703.7	1792.8	9.3
Ministry of Agriculture, Food and Rural Affairs	192.6	205.0	214.8	227.0	839.4	4.3
Ministry of Trade, Industry and Energy	298.8	318.8	233.8	233.8	1085.2	5.6
Ministry of Health and Welfare	678.5	761.3	814.2	1432.6	3686.6	19.1
Ministry of Environment	71.5	330.0	326.0	318.0	1045.5	5.4
Ministry of Land, Infrastructure and Transport Ministry of Oceans and Fisheries	1052.3	1246.3	1291.3	1401.8	4991.7	25.8
National Emergency Management Agency	370.5	477.0	594.0	698.1	2139.6	11.1
Rural Development Administration	195.0	170.0	180.0	142.0	687.0	3.6
Korea Forest Service	80.7	77.7	71.2	61.7	291.3	1.5
Ministry of Food and Drug Safety	90.3	75.6	75.4	12.0	253.3	1.3
Korea Meteorological Administration	456.4	478.2	494.5	500.0	1929.1	10.0
Total	3923.1	4649.0	4939.7	5819.7	19331.5	100.0

Note: The estimate by department will be round off in million won

Source: Data posterior to 2014 in Research on the Establishment of the 2nd Comprehensive Plan for the Development of Disaster and Safety Management Technology (National Emergency Management Agency, 2012)

(1) Investment Plan by Disaster and Safety Type

With respect to the investment plan by disaster and safety type, KRW 944.8 billion would be for natural disaster and KRW 888.3 billion is planned to be invested for man-made and social disasters. In addition, KRW 154.3 billion is planned to be invested for safety accidents, and KRW 114.3 billion is planned to be invested for the combined type.¹ For other purposes, KRW 50.4 billion is planned to be invested.²

With respect to the natural disasters, KRW 236.9 billion is planned to be invested for the combined type (typhoon, flood, heavy rain, landslide, collapse of steep slope land, earthquake, tsunami, etc.), and KRW 145.5 billion is planned to be invested for landslides and the collapse of any steep-slope land. In addition to this, KRW 107.8 billion is planned to be invested for earthquakes, and KRW 103.3 billion would be invested for typhoons. Lastly, KRW 81.1 billion is planned to be invested for floods. Thus, the proportion of R&D in connection with the combined

type would account for 25%, which was the largest.

With respect to the man-made/social disaster, KRW 459.0 billion is planned to be invested for infectious diseases, and KRW 102.8 billion is planned to be invested for environmental pollution. Also, KRW 80.2 billion is planned to be invested for infectious disease in domestic animals, and KRW 72.6 billion is planned to be invested for fire incidents. Lastly, KRW 63.2 billion is planned to be invested in transportation accident and traffic infrastructure, and KRW 52.3 billion is planned to be invested in chemical, biological, and radiological accidents. Thus, the proportion of R&D in connection with the infectious disease would account for 52%, which was the largest.

With respect to the safety accident disasters, KRW 122.5 billion is planned to be invested for disaster safety, and KRW 8.4 billion is planned to be invested for public place safety. KRW 7.7 billion is planned to be invested for traffic safety, and KRW 4.9 billion is planned to be invested for a safety-conscious culture. Lastly, KRW 1.9 billion is planned to be invested in gas accidents. Thus, the proportion of R&D in connection with the disaster safety would account for 80%, which was the largest.

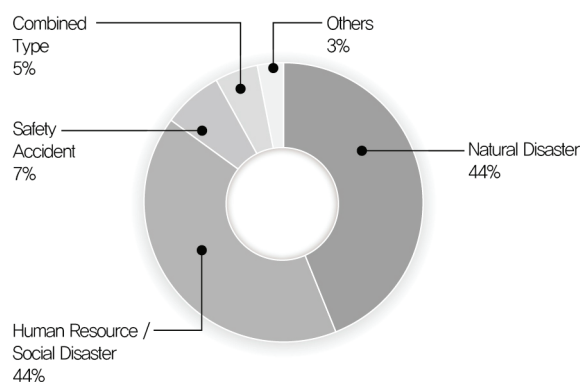


Figure 6. Investment Plan by Type of Disasters
(2013 - 2017)

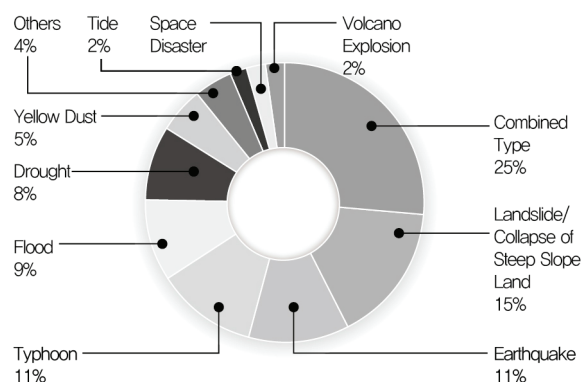


Figure 7. Investment Plan by Type of Natural Disasters (2013 - 2017)

- 1 Combined Type: because the occurrence patterns of disasters, calamities, and safety accidents are similar, more than two patterns, which may comprehensively respond to disaster, calamity, and safety accident, are overlapped.
- 2 Others: Disasters, calamities, and safety accidents, which may not be fit into the existing classification or which is difficult to be classified (Government Continuity Plan, Model to Manage Disaster Conflict, etc.)

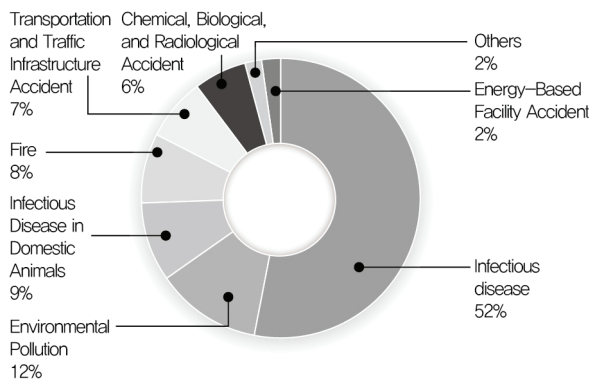


Figure 8. Investment Plan by Type of Human Resource / Social Disaster (2013 - 2017)

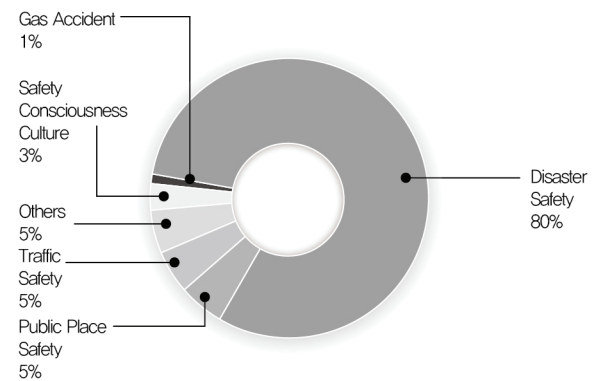


Figure 9. Investment Plan by Type of Safety Accident (2013 - 2017)

(2) Investment Plan by Management Phase

With respect to the investment plan by disaster management phase, KRW 926.7 billion is planned to be invested in prevention, and KRW 818.2 billion

is planned to be invested in its preparation. KRW 383.3 billion is planned to be invested for response, and KRW 23.9 billion is planned to be invested for restoration. Thus, the proportion of the prevention phase would account for 43%, which was the largest

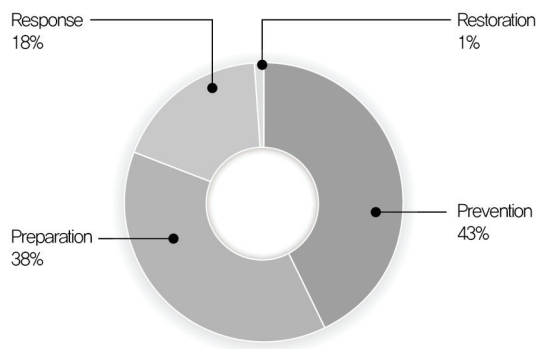
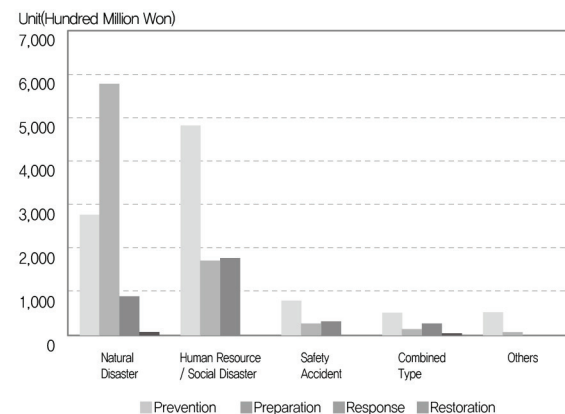


Figure 10. Investment Plan by Disaster and Calamity Management Phase (2013 - 2017)

(3) Investment Plan by R&D Research Phase

With respect to the investment plan by R&D research phase, KRW 1.0558 trillion is planned to be invested for the application phase, and KRW

567.3 billion is planned to be invested for the development phase. Lastly, KRW 529 billion is planned to be invested in the foundation phase. Thus, the proportion of the application phase would account for 49%, which was the largest.



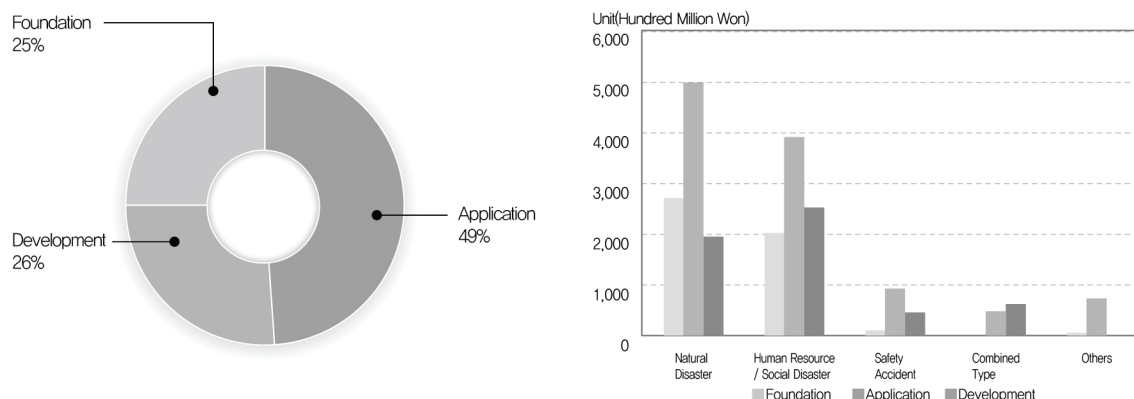


Figure 11. Investment Plan by R&D Research Phase (2013 – 2017)

3.2. Implications of the Current State and Prospect of R&D Investment in Disaster and Safety

It is very important to expand the R&D budget for disaster and safety in order to meet the social demands, such as construction of a national disaster and safety management platform for climate change and new types of disasters, expansion of foundation for convergence and outcome creation system, national interest in the disasters, etc.

It is somewhat difficult to expect that the current disaster and safety R&D, which 14 departments are implementing according to their own demands, will cause a technical breakthrough due to overlapped investment by multiple departments, a lack of investment in the required technology, etc. Also, although each ministry supports disaster-related prevention and response system, since most of such supports are basic research and focused on specific fields, a comprehensive management or links among projects at national level are lacking.

Most of the existing researches have focused on a microscopic approach that prioritize projects in a specific technological field or suggest the priority of research projects. Macroscopic research such as establishing R&D investment priority is relatively very scarce. Also, even though the significance of development of disaster and safety management

technology for prevention rather than restoration activity posterior to the disaster occurrence is increasing, the related budgets are still very insufficiently appropriated. Thus, R&D budgets shall be urgently increased.

According to the progress of cutting-edge technology, such as IT, NT, etc., the budgets shall be appropriated for system construction and development of scientific disaster management technology, which is focused on the prevention of disaster, and grafted with the said cutting-edge technology. It is urgent to construct an analysis framework for economic feasibility and ripple effect of the disaster prevention field in order to vitalize the disaster prevention industry that has sufficient potentials to be developed as a cutting-edge industry or field.

The role that the disaster prevention industry contributes to the national economy is not properly evaluated because of its distinct characteristics. Also, the training of human resources for the existing disaster management focuses on parts of natural disasters, such as firefighting and water resources, while it is insufficient to effectively manage various types of disasters, such as man-made disaster, social disaster, etc. Most of all, it is important to resolve similar overlapped researches among departments and to induce the vitalization of convergence researches by forming and operating the tentatively

named “Council for Joint Promotion of Development of Disaster and Safety Management Technology” in order to secure a cooperative system among ministries to improve investment efficiency.

4. Conclusions

As the modern industrial society becomes highly developed, it accelerated the urban structure to the sky and to the underground. Because the means of production have been expanded and concentrated, the number of dangerous facilities has increased. As the society has been concerned with development and pursuit of profits, the security is thought lightly of. Also, the “security ignorance” was greatly intensified by insufficient investments because of the rapid economic development focused on efficiency and speed as well as by insufficient safety management consciousness (Choi, 2006). This means that Korea, which has unprecedentedly and compressively developed its economy, should fundamentally understand the safety issues that Korea has regarded as incidental. This also means that we should begin with the changes in recognizing the safety management system in terms of policy, regulation, and cultural level that is different from the previous system. This is because the introduction of paradigm, which is the operation of the societal system that is reconstituted from moral and scientific reasonableness, is necessary in 21st century where the future is unpredictable because of the climate change, enlargement and diversification of social risk factors, etc.

As the standard of living is quantitatively and qualitatively improving, the safety demand of the public is rapidly increasing. This is because people may obtain information on disasters that occurred in various areas in the world through real-time global information sharing system. Also, the international community has empathized with the fact that various

demands regarding disasters and the necessity for technological supports were the main driving forces for social and economic development by selecting national interests in responses to disasters as the main agendas in G20 Summit in 2012 and APEC Ministers of Finance Meeting in 2012. As the citizen’s interest in disaster and safety increase, this may be a crisis and an opportunity at the same time to risk managers or researchers in disaster management.

From this perspective, the establishment of the strategic roadmap for national key science & technology that the government carries forward is an attempt in line with the new concept to remove the partition among departments and to use the available information for the central government / the local government as well as the private sector. The future R&D on disaster and safety in accordance with the strategic roadmap for national key science & technology establishes the following as its main strategic direction: to secure foundation of basic studies and converging studies through fundamental and comprehensive R&D on disaster and safety; commercialization of developed technology and utilization thereof for contribution to the public; construction of infrastructure to monitor, anticipate, alarm, and respond to disasters in advance; enactment and amendment of laws and regulations for disaster and safety; system maintenance; support for continuous and stable R&D in order to sophisticate the related technology and system, etc.

This review has covered the current state and future plans for R&D on disaster and safety in Korea. It is necessary to recognize the necessity for the establishment of strategies that are comprehensive and systematic in order to effectively respond to globalization, as well as the combination and increased prevalence of disaster and risks. It is also necessary to prioritize technology development in order to preemptively and systematically respond to the new types of future disasters and safety accidents.

References

Ahn, H.D (2011). Plan to strengthen Korea's ability to research disaster and safety

Central Disaster Prevention Council of Japan (1993), Basic Plan for R&D on Disaster Prevention

Central Disaster Prevention Council of Japan (1998), Basic Plan for R&D on Disaster Prevention

Choi, B.H. (2006). Problems and tasks for disaster and calamity management system of Korea. *Public Administration Research*, 7, 1, 101 – 24.

Fischhoff, B., Slovic, P., Lichtenstein S., Read, S., Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits, *Policy Science* 9, 127–52.

Lee, Y.A. (2013) Risk perception of Korean, NaNam Publishing House.

Ministry of Science, ICT and Future Planning (2013). The 3rd Basic Plan for Science & Technology (Draft)

National Science and Technology Council (2011). Results of Technology Level Evaluation in 2010 (Draft)

National Science and Technology Council (2012). Enforcement Plan for the Development of Technology to Manage Disaster and Safety in 2012

National Science and Technology Council (2012). The 4th Practice Committee on Science & Technology Support for Disaster and Calamity

National Science and Technology Council (2012), Strategies for R & D Investment on Disaster and Calamity in 2013 (Draft)

National Science and Technology Council (2013), Enforcement Plan for the Development of Technology to Manage Disaster and Safety in 2013 (Draft)

National Science and Technology Council (2013), Comprehensive Plan for the Development of Disaster and Safety Management Technology in 2013

National Science and Technology Council (2014). Strategic Roadmap for National Key Science & Technology (Draft)

National Emergency Management Agency (2013). Disasters Annual Report in 2012

Song, W (2008). Assignments of Innovation Policy which Aims Social Objectives, Science and Technology Policy Institute