Keidanren
Policy & Action

Promoting Further Use and Development of Technologies to Prevent and Mitigate Damage from Natural Disasters

Keidanren
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Contents

I. Introduction

We have witnessed and experienced a great number of devastating natural disasters here in Japan. Japanese corporations have used these experiences to accumulate a diverse range of technologies to prevent and mitigate damage from natural disasters, as well as find numerous seeds for new technological developments. In terms of disaster management as well, corporations and governments in Japan are also working hard to prepare, and improve the effectiveness of Business Continuity Plans(BCP). They will help prevent and mitigate the impact of natural disasters.

There are, however, predictions for major natural disasters, including earthquakes to occur with epicenters directly under Tokyo ("Metropolitan Earthquake") and in the Nankai Trough off the Pacific coast of Japan ("Nankai Trough Earthquake"). For this reason, it is critical that corporations and governments incorporate the existing disaster prevention and mitigation technologies in their countermeasures, as well as drive forward further development and use of these technologies.

On a global level as well, there is an increase in the natural disasters caused by climate change and related factors. For the last 30 years (1983–2013), natural disasters have caused on average around 80,000 deaths per year, with the cost of the damage averaging 7.9 billion dollars per year.[1] Enhancing measures to prevent and mitigate damage from natural disasters requires the training and securing of personnel, as well as a wide range of costs. In developing and emerging countries, therefore, disaster prevention and mitigation measures lag behind those in developed countries, which leads to huge human suffering and property damage caused by natural disasters, and is a significant barrier to sustainable development.

Making societies as a whole more resilient to natural disasters is a common challenge throughout the world. As part of Japan's contribution to the international community, we need to disseminate to other countries the disaster prevention and mitigation technologies we have developed to help them confront this common challenge. The Third United Nations World Conference on Disaster Risk Reduction will be held in Japan in March 2015, where it is expected that global guidelines for disaster prevention and mitigation to succeed the Hyogo Framework of Action will be formulated. Using technologies and systems to improve natural disaster response is being discussed as part of this.

In January 2015, Keidanren released our new vision entitled "Toward the Creation of a More Affluent and Vibrant Japan,"[2] in which we outlined the kind of country we believe Japan should strive to become. Some of the attributes we identified in our vision for Japan for 2030 are, "a solid foundation enabling the economy to grow strongly," and, "contributing to the prosperity of the world by providing solutions to global problems." Measures to prevent and mitigate damage from natural disasters, and policies to make Japan a stronger and more resilient country, are critical steps in achieving this vision, and our vision also proposes that Japan's technologies and expertise related to disaster prevention and mitigation measures should be utilized internationally to make the world overall more resilient to natural disasters.

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[1] Keidanren Secretariat calculation based on Cabinet Office, *White Paper on Disaster Management 2014*.

[2] Keidanren, *Toward the Creation of a More Affluent and Vibrant Japan—Innovation & Globalization* (January 2015). https://www.keidanren.or.jp/en/policy/2015/vision.html

Based on these points, this document first outlines the current status of disaster prevention and mitigation technologies, and then proposes corporate actions, collaborative actions between various entities, and actions required of government, with a view to promote the further development and use of these technologies.

II. Current Status of Japanese Corporations' Disaster Prevention and Mitigation Technologies

Keidanren conducted a questionnaire survey on the disaster prevention and mitigation technologies of its member companies.[3] In this chapter, we look to see what technologies are effective for different disasters, both prior to / after a disaster. In addition, we outline the status of those technologies. We also have separate columns showing examples of the technologies and systems that are effective for different disasters during these two stages. Please refer to Appendix 1 for the summary of the various technologies.

1. Before a Disaster: Effective Prevention and Prediction Technologies

Before a disaster (earthquakes, storms and floods, and volcanic eruptions) occurs, it is imperative that measures to mitigate the damage that may occur are implemented (prevent), as well as to appropriately estimate and evaluate that potential damage (predict).

There are a number of engineering measures currently being used in Japan, such as seismic resistant construction and seismic isolation technologies and various seawall construction methods, as well as precise damage simulation programs and systems that support corporate measures to prevent and mitigate damage from natural disasters.

(1) Natural Disasters in General

Companies in Japan have been working on their business continuity plans (BCP) and business continuity management (BCM) following the Great East Japan Earthquake in 2011, with 53.6% of corporations having completed their BCPs by the end of fiscal 2013 (approx. 70% according to the Keidanren survey). The percentage of companies with a BCP in place needs to increase, as does the effectiveness of these plans. Each and every individual living in Japan must also be more self-reliant and actively participate in disaster prevention and mitigation drills and activities.

In order to help corporations and individuals in their efforts to become more self-reliant, it is also beneficial to utilize systems and services whereby more effective BCPs can be created in compliance with international standards,[4] as well as systems that assist in planning and implementing disaster prevention drills.

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[3] Keidanren, *Survey concerning Disaster Prevention and Mitigation Technologies* (August 2014). Responses from 203 companies.

[4] For instance, ISO 22301 (Societal security—Business continuity management systems—Requirements) and ISO 22313 (Societal security—Business continuity management systems—Guidance).

There are also systems that can simulate using mathematical models, and quantitatively evaluate, the damage that may be caused by the different types of natural disaster. Such evaluation allows corporations to revise their BCPs, and helps communities implement disaster prevention drills that are best matched to their circumstances.

(2) Earthquakes

Japan is one of the few countries in the world that frequently suffers from earthquakes and this has led to the continued improvement of world-leading seismic resistant construction and seismic isolation technologies.

It was identified through the Great East Japan Earthquake of 2011, however, that work still needed to be done, in particular to counteract soil liquefaction and the movement of ultrahigh-rise buildings during long-period ground motion, and prevent damage from falling ceilings.

Furthermore, the next 20 years will see a dramatic increase in the ratio of social infrastructure that is 50 years old or older, with a corresponding significant increase in the likelihood of major and life-threatening incidents. We will need simple and efficient maintenance and management regimes for infrastructure.

As of today, there are multiple ways to quickly and cost-effectively improve the seismic resistance or seismic isolation of buildings (office and residential buildings, etc.) and infrastructure (roads, tunnels, utilities, etc.). There are also technologies to improve soil quality to make soil less susceptible to liquefaction, such as via injection of chemicals or air, which can be performed with the buildings in use. The extent of building and infrastructure corrosion or deterioration can also be easily diagnosed with the use of various sensors and instruments.

Combined with these technologies, it is also important for corporations and governments to accurately analyze the risk of damage from large earthquakes as part of the measures to prevent and mitigate this damage. There are systems that can simulate building damage from ground movement, as well as to quantitatively evaluate the time and other factors required for recovery from a disaster.

(3) Storms and Floods

Construction of seawalls is progressing slowly along the coasts of Iwate, Miyagi, and Fukushima Prefectures which were impacted by the tsunami following the Great East Japan Earthquake. There have, however, also been a number of voices that these massive concrete walls are intimidating and destroy the natural scenery. There is also a shortage of materials and labor as many reconstruction projects are happening simultaneously.

A resolution to this issue could come by making seawalls and high-tide/tsunami barriers from acrylic sheets to reduce the intimidating nature of the structures and preserve the natural scenery, and by utilizing construction techniques that minimize the amount of time and labor required on-site while still enabling the building of a resilient and durable seawall.

Localized torrential rains and so called “guerrilla storms” that appear and disappear suddenly have been occurring more frequently in Japan of late, resulting in a significant rise in damage from overflowing rivers, flooded buildings, and landslides. There has also been a sharp increase in damage to buildings from tornadoes and sudden gales. Furthermore, soil weakened by earthquakes may be more likely to cause landslides when there are heavy rains.

To help with these issues, there are systems that can predict the occurrence of the guerrilla storms and whirlwind by using the weather radar and many kinds of sensors. For landslides, there are systems that constantly and automatically monitor ground movement on hillsides, and autonomously evaluate the risk level and sound warnings when required.

We also need to work on effective emergency evacuation plans, and to do so we need to understand to a certain level of accuracy the size of tsunamis resulting from a Nankai Trough Earthquake, how and where rivers will overflow, or other flooding that will occur during typhoons and torrential rains.

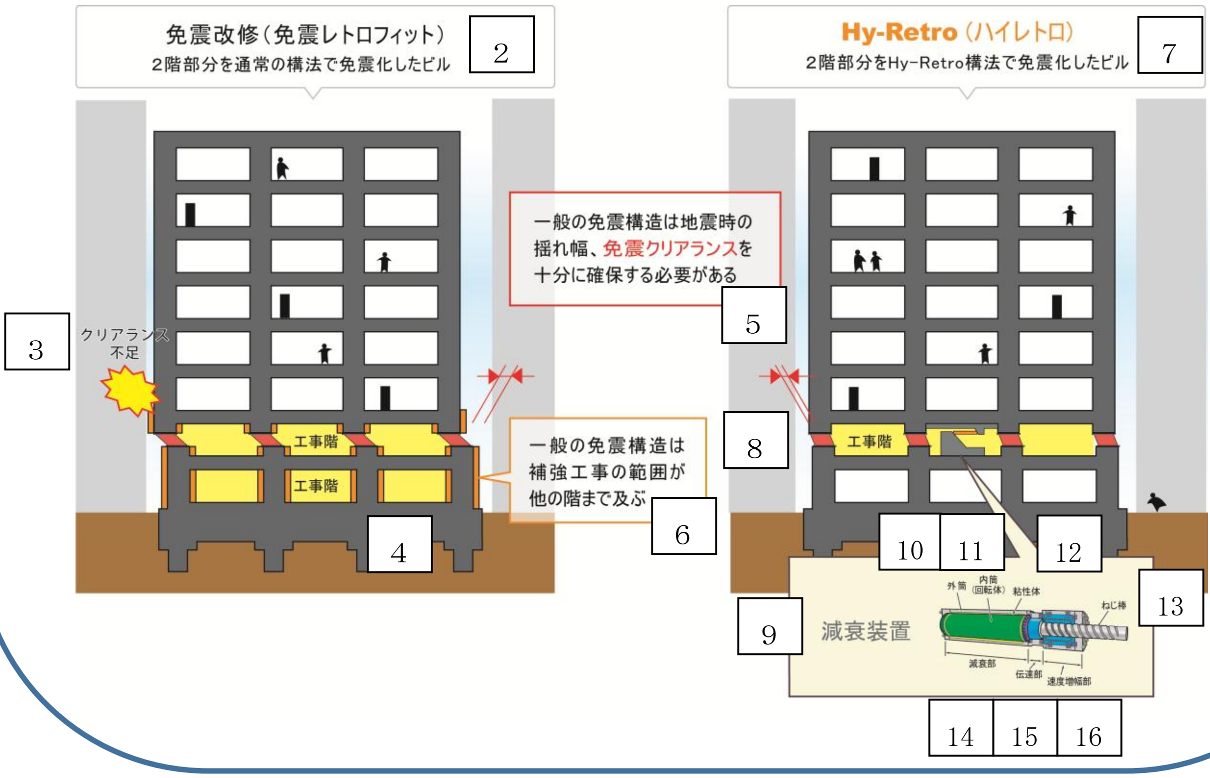
There are systems currently available that use supercomputers to accurately predict the amount of flooding damage that would occur from tsunamis, as well as systems that use multiple data sources to accurately predict landslides and flood damage.

＜Column 1: Technologies and Systems for Effective Disaster Prevention and Prediction(Random Order)＞

➢ 1-1. Hy-Retro(Hybrid Retrofitting) System Method: Sumitomo Mitsui Construction

This is seismic isolation retrofitting that allows existing buildings to withstand large earthquakes. The retrofitting works occur on limited floors of the building, and other floors can be used as normal during the retrofitting stage. It is a highly effective mid-floor seismic isolation method where the columns of the building are cut on one of the middle floors of the building, and a hybrid system consisting of seismic isolation devices, and high-performance damping devices that are highly effective at absorbing seismic energy. The benefits are shown below:

- Shorter construction times and lower costs with increased safety by reducing reinforcement works and using high-performance damping devices;
- The reinforcement works only occur on one floor, so the building can be made highly earthquake-resistant while remaining occupied;
- The building itself is more seismic resistant, and the contents of the building are also protected by the seismic isolation structure, which increases the asset value of the building and helps improve business profitability.

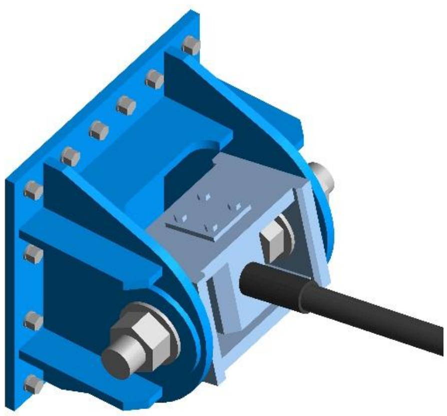


[1] Devices to isolate the building above from the ground and make it earthquake-resistant
Seismic isolation × Damping device
Devices to absorb seismic energy and reduce building movement
[2] Seismic isolation retrofitting
Seismic isolation on the 2nd floor for a building with ordinal construction
[3] Insufficient clearance
[4] Construction floor
Construction floor
[5] Conventional seismic isolation construction methods require significant seismic isolation clearance to surrounding buildings to accommodate movement during earthquakes
[6] Conventional seismic isolation construction methods require work to be performed over multiple floors
[7] Hy-Retro(Hybrid Retrotit) System
Building where seismic isolation occurs on the 2nd floor using the Hy-Retro method
[8] Construction floor
[9] Damping device
[10] Outer cylinder
[11] Inner cylinder (rotator)
[12] Viscous fluid
[13] Screw axis
[14] Damper section
[15] Transmission section
[16] Speed amplifying section

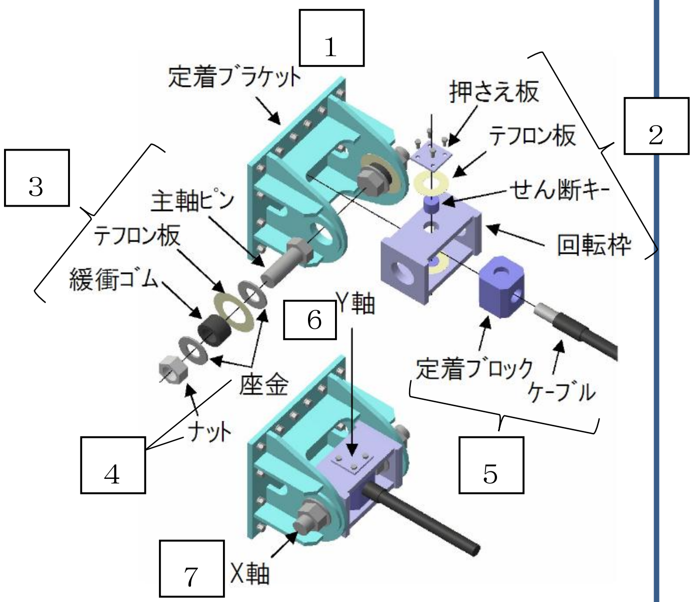
➢ 1-2. Pin-Mounted Bridge Fall Prevention Device: Yokogawa Bridge Holdings

This is a cable-type bridge fall prevention device that is compact and easy to install. It has equivalent impact-absorption properties as conventional rubber bearing systems. Two-axis rotation of the cable mounting also enables the device to be fitted where three-dimensional positional relationships are required.

Installation can be performed approximately 20% faster than bearing-mounted PC cable–type bridge fall prevention devices, and ability to accommodate transversal movement to the axis of the bridge is another strength of this high-performance device.



製品外観 A



定着ブラケットの構造 B

ピン定着落橋防止装置の設置事例 C

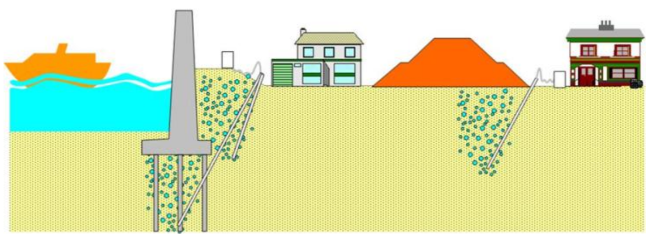
[1] Mounting bracket
[2] Hold plate
Teflon plate
Shear key
Rotating frame
[3] Impact-absorbing rubber
Teflon plate
Principal axis pin
[4] Nut
Metal washers
[5] Mounting block
Cable
[6] Y-axis
[7] X-axis
A: Product image
B: Mounting bracket structure
C: Example of installed pin-mounted bridge fall prevention device

➢ 1-3. Method of Injecting Air for Soil Desaturation (Air-des Method):
Toa Corporation

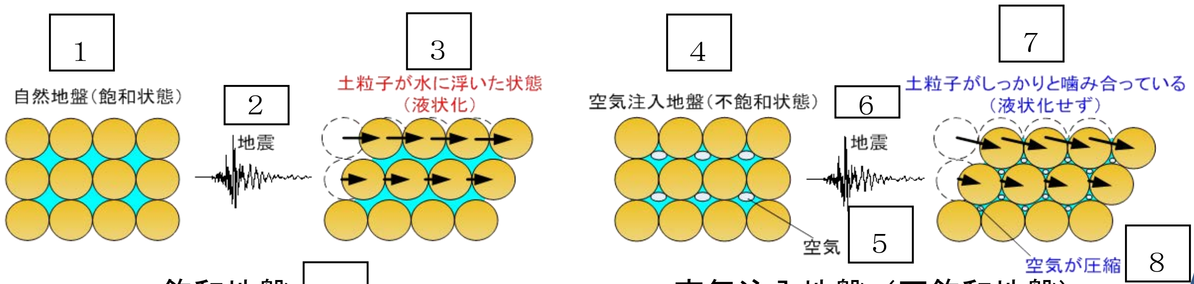
Air-des is a soil improvement method where air is injected into the soil to prevent liquefaction. Toa has been working on the development of this method since fiscal 2008 in collaboration with the Shikoku Regional Development Bureau of the Ministry of Land, Infrastructure, Transport and Tourism, Ehime University, Fudo Tetra Corporation, Oriental Shiraishi Corporation, and Dia Consultants Co., Ltd.

Soil liquefaction often occurs during an earthquake in loosely packed sandy soils in which the pores are saturated with water. All needed to do under the Air-des method is inject air into the sandy soil to make liquefaction less likely. It is an extremely simple procedure and is the first of its kind in the world. During an earthquake, the strength and rigidity of these sandy soils that have been injected with air is maintained as any shear deformation only results in the compression of the injected air, with the soil particles maintaining their mutual contact and interlock. For this reason, just by having the injected air bubbles uniformly at 5–10% of pore water in a soil, the soil will retain essentially the same characteristics such as strength, permeability, and vibration during earthquakes, except that the soil will be much less susceptible to liquefaction.

The injected material is air so the cost is lower than other methods. Another benefit of the method is that it can be used to inhibit liquefaction right under existing buildings while they are in use.



Air-des 工法施工イメージ A



飽和地盤 B

空気注入地盤（不飽和地盤） C

液状化強度の増加イメージ D

A: Image of the Air-des method
[1] Natural soil (saturated state)
[2] Earthquake
[3] Soil particles floating on the water in the soil (liquefaction)
[4] Soil after air injection (unsaturated state)
[5] Air
[6] Earthquake
[7] Soil particles maintain mutual interlock (no liquefaction)
[8] Air is compressed
B: Saturated soil
C: Soil after air injection (unsaturated soil)
D: Image of improved liquefaction resistance

➢ 1-4. Hybrid Tide Embankments: JFE Engineering

Work to help the recovery of the areas impacted by the Great East Japan Earthquake and Tsunami in 2011 is being delayed due to a lack of manpower, materials, and equipment. Hybrid Tide Embankments (Fig. 1) that minimizes on-site construction work were developed to help resolve this issue.

These Hybrid Tide Embankments are vertical seawalls made from steel and concrete. The concrete blocks are precast in the factory which reduces the on-site construction period by 60% (Fig. 2) and significantly reduces the amount of labor required on-site (Fig. 3).

These embankments also have a much smaller footprint (80% reduction from normal embankments), making them suitable for installation in areas with space limitations and less use of on-site materials and equipment (Fig. 4).

These embankments have been used for reconstruction of the seawalls at the fishing harbor in Yamada in Iwate Prefecture, and the port at Kesennuma in Miyagi Prefecture.

JFE Engineering will continue to try and overcome the lack of manpower, materials, and equipment in, and support the speedy recovery of, the impacted areas.

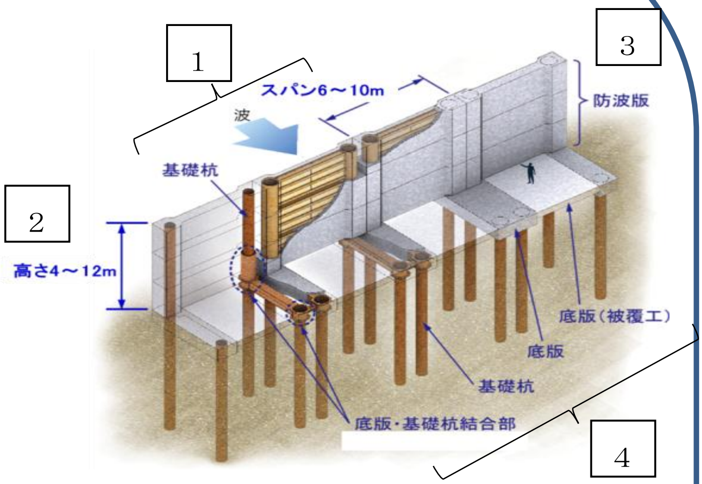


図１　「ハイブリッド防潮堤®」の概要 5

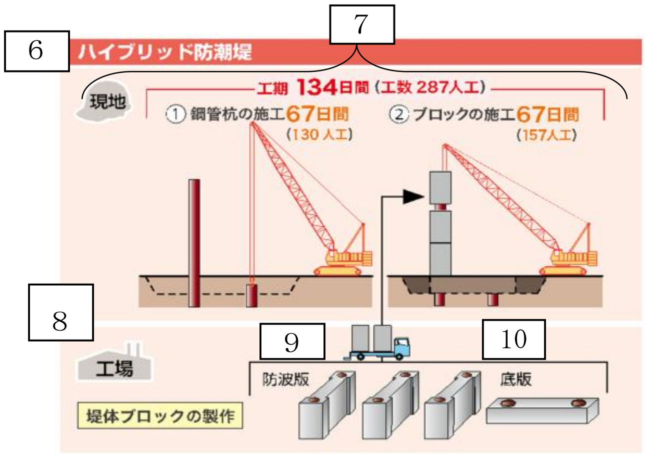


図２　延長 100m の現場工期 11

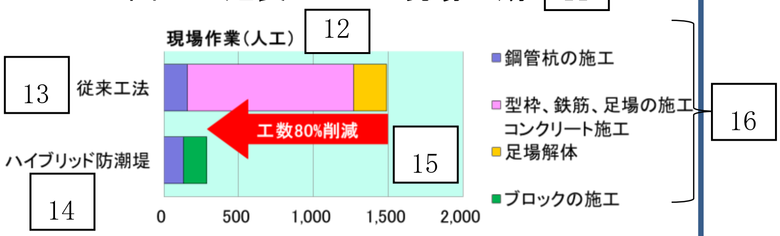


図３　延長 100m の現場作業（人工）の比較 17

19 20

項目	ハイブリッド防潮堤	従来工法	
生コン(m^3)	380	2,160	80%減
型枠(m^2)	70	2,330	95%減

18 21

図４　延長 100m の生コン・型枠の比較 22

[1] Span: 6–10 m
Wave
Foundation pile
[2] Height: 4–12 m
[3] Breakwater plate
[4] Deck (coated)
Deck
Foundation pile
Deck to pile connection
[5] Fig. 1: Overview of Hybrid Tide Embankment
[6] Hybrid Tide Embankments
[7] On-site Construction period: 134 days (287 man-days)
① Steel pile works: 67 days (130 man-days)
② Concrete block works: 67 days (157 man-days)
[8] Factory Manufacture of embankment blocks
[9] Breakwater plates
[10] Deck
[11] Fig. 2: Time to construct 100 m extension on-site
[12] Man-days on-site
[13] Conventional construction
[14] Hybrid Tide Embankment
[15] 80% reduction in man-hours
[16] Steel pile works
Formwork, reinforcements, scaffolding, and concrete works
Dismantling scaffolding
Block works
[17] Fig.3: Comparison of on-site man-days for 100 m extension
[18] Item
Ready-mixed concrete (m^3)
Formwork (m^3)
[19] Hybrid Tide Embankment
[20] Conventional construction
[21] 80% reduction
95% reduction
[22] Fig. 4: Comparison of ready-mixed concrete and formwork for 100 m extension

➢ 1-5. Use of Exponential Rainfall to Determine Train operational Restrictions: East Japan Railway

Previously, Train operational restriction during periods of rain have been determined by a combination of hourly rainfall and cumulative rainfall that are calculated by means of aggregating precipitation to the ground surface in a specific time frame (Fig. 1).

Now we use “Exponential rainfall” to determine operational restrictions. The index corresponds to an amount of soil moisture. It changes over time due to soil penetration and outflow, and is an indicator closely linked to the risk of landslides along rail lines (Fig. 2). Three types of exponential rainfall are determined based on topography, soil quality and information of disasters to implement more refined operational restrictions (Fig. 3).

＜図・写真等＞ 1

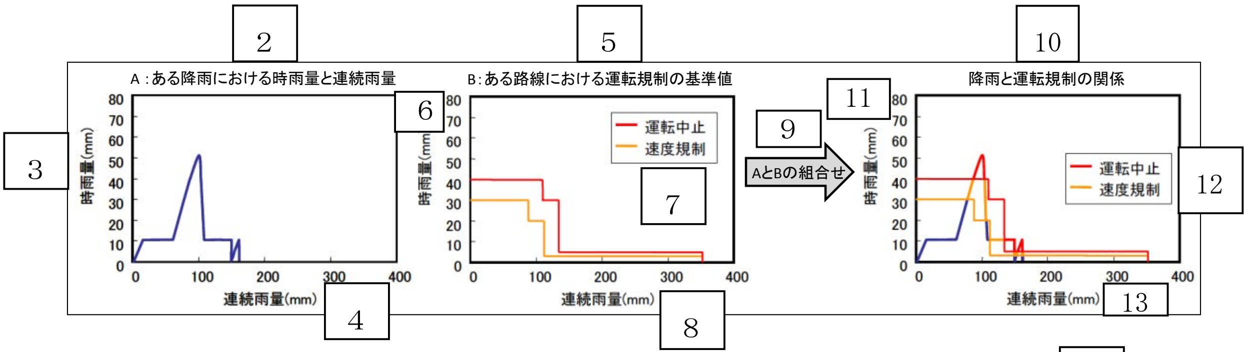


図１「時雨量」と「連続雨量」の組合せによる運転規制 14

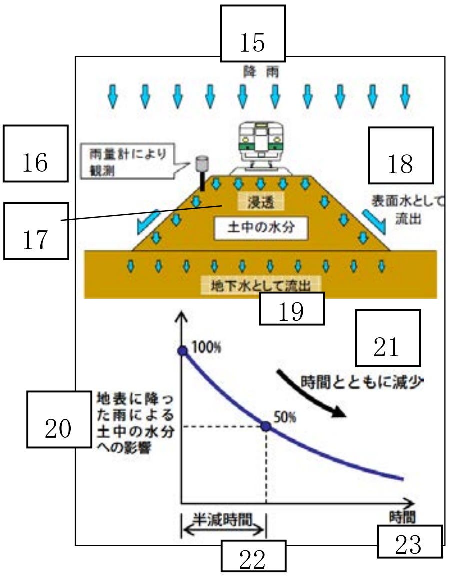


図２「実効雨量」の概念 24

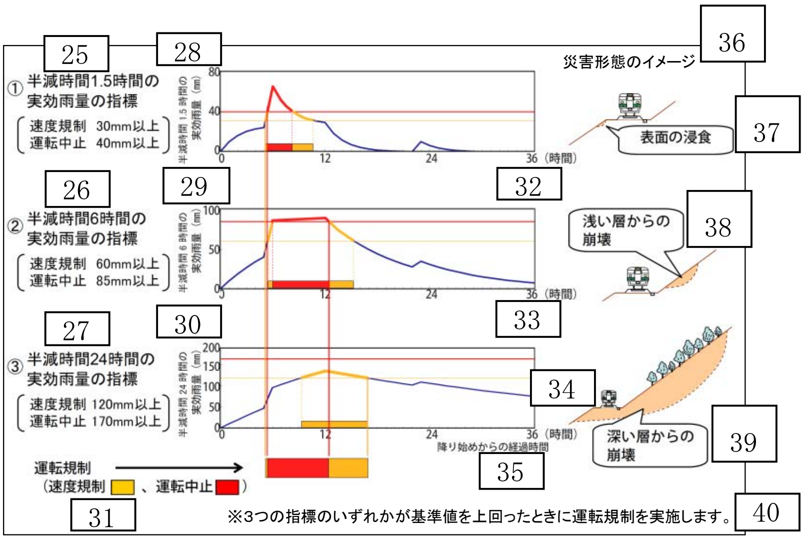


図３「実効雨量」による運転規制 41

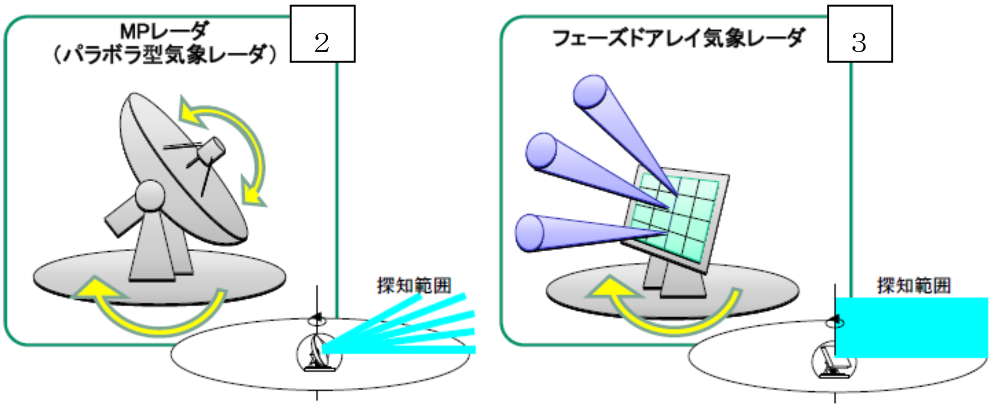
[1] Figures and images
[2] A: Hourly rainfall and cumulative rainfall
[3] Hourly rainfall (mm)
[4] Cumulative rainfall (mm)
[5] B: Operational restriction criteria for specific rail line
[6] Hourly rainfall (mm)
[7] Suspend Operation
Speed restriction
[8] Cumulative rainfall (mm)
[9] Combination of A and B
[10] Relationship between rainfall and operational restrictions
[11] Hourly rainfall (mm)
[12] Suspend Operation
Speed restriction
[13] Cumulative rainfall (mm)
[14] Fig. 1: Operational restrictions based on combination of hourly rainfall and cumulative rainfall
[15] Rainfall
[16] Rain gauge measurement
[17] Penetration
Soil moisture
[18] Ground surface outflow
[19] Groundwater outflow
[20] Effect of rainfall to ground surface on water content in soil
[21] Reduce over time
[22] Half-life time
[23] time
[24] Fig. 2: Exponential rainfall index concept
[25] ① Exponential rainfall index for half-life time of 1.5 hours
Speed restriction: 30 mm or more
Suspend Operation: 40 mm or more
[26] ② Exponential rainfall index for half-life time of 6 hours
Speed restriction: 60 mm or more
Suspend Operation: 85 mm or more
[27] ③ Exponential rainfall index for half-life of 24 hours
Speed restriction: 120 mm or more
Suspend Operation: 170 mm or more
[28] Effective rainfall with half-life time of 1.5 hours (mm)
[29] Effective rainfall with half-life time of 6 hours (mm)
[30] Effective rainfall with half-life time of 24 hours (mm)
[31] Operational
Speed restriction
Suspend Operation

[32] Hours
[33] Hours
[34] Hours
[35] Hours from start of rainfall
[36] Types of incident
[37] Ground surface erosion
[38] Shallow level landslide
[39] Deep level landslide
[40] Driving restrictions will come into force if any of the three indices exceeds the relevant criteria.
[41] Fig. 3: Driving restrictions based on effective rainfall

- 1-6. Phased Array Weather Radar:TOSHIBA

—Be able to observe the 3 dimension structure of localized heavy rainfalls and tornado in only 10 seconds clearly —
By utilizing this technology, it enables to observe the 3 dimension precipitation distribution at 10 seconds interval by 100m optical resolution. This technology was developed in cooperation with the National Institute of Information and Communications Technology and Osaka University.
In recent years、the heavy damage from localized heavy rainfalls and tornado and tornado became a social affair. The cumulonimbus which brings localized heavy rainfalls develops rapidly in about 10 minutes. And the tornado occurs and moves in a few minutes. Therefore, it is needed to observe those 3 dimension structure to sense the sign in shorter time.
The Phased Array Weather Radar shortened the observation time to only 10~30 minutes by adopting the Digital Beam Forming (DBF). And it enabled to observe the detailed 3 dimension precipitation distribution in the range of radius of 15~60 km and height of 14 km by rotating the antenna only one time.
In 2012, the test observation was started in Suita campus, Osaka University. And the observation data is utilized to various system related to disaster prevention.

MPレーダとフェーズドアレイ気象レーダの比較 1



MPレーダ（パラボラ型気象レーダ） 4		フェーズドアレイ気象レーダ 5
仰角 ：機械走査 方位角：機械走査 6	走査方法 7	仰角 ：電子走査 方位角：機械走査 8
3次元スキャン（約15仰角） ／5分程度（地上は1分周期で観測） 9	観測空間 ／観測時間 10	3次元スキャン（約100仰角） ／10秒～30秒程度 11
60 km	観測範囲 12	60 km
反射強度（降雨強度）、 ドップラー速度、速度幅、 偏波パラメータ（Zdr, Kdp, ρhv など） 13	観測パラメータ 14	反射強度（降雨強度）、 ドップラー速度、速度幅 15

[1] The comparison of MP Radar and Phased Array Weather Radar

[2] MP Radar(Parabolic antenna weather antenna)

[3] Phased Array Weather Radar

[4] MP Radar(Parabolic antenna weather antenna)

[5] Phased Array Weather Radar

[6] Angle of elevation: mechanical scanning
Azimuth: mechanical scanning

[7] Scanning method

[8] Angle of elevation: electronic scanning
Azimuth: machine operation

[9] 3 dimension scanning(about 15 angle of elevation)／about 5 minutes(on the ground, observe every one minute)

[10] Observation space/Observation time

[11] 3 dimension scanning(about 100 angle of elevation)／about 10~30 seconds

[12] Observation range

[13] Reflectivity(rain intensity), Radial velocity, Spectrum Width, polarization parameter(Zdr, Kdp, ρhv etc.)

[14] Observation parameter

[15] Reflectivity(rain intensity), Radial velocity, Spectrum Width

➢ 1-7. River Level Monitoring System Using CCTV Footage: IDEA Consultants

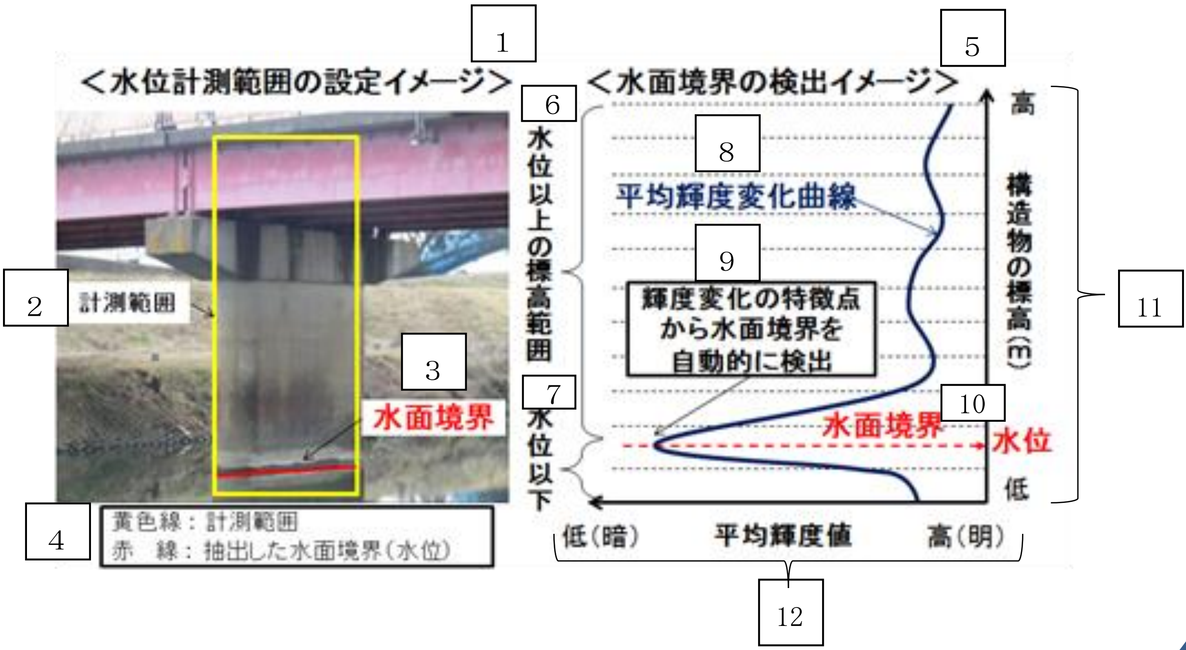
Just a short period of heavy rain can cause a dramatic rise in the water level of small- to medium-sized rivers. Current telemetry systems report river level at 10-minute intervals, but changes in river level needs to be observed at shorter intervals than that.

CCTV cameras* used to monitor the space around rivers are located at a number of sites along the length of the river. There are several times more CCTV cameras than there are water level gauging stations, so IDEA started development on a system called “Dr. i-sensor,” that uses the footage from these CCTV cameras as a noncontact way to measure river levels in real time.

With the Dr. i-sensor system, the elevation of points on bridge piers and other structures are measured and registered to the system in advance. Using real-time footage, the water level measurement range is specified (yellow box below), and the average luminance (brightness) calculated for each point of elevation along that range (image below). Using this luminance value, the point that contacts with the bridge structure and where there is a noticeable change in luminance is judged to be the water surface (red line below), to derive the level of the river.

One of the main strengths of the system is that there is no need to mark river structures or install water gauges or other special equipment since the system uses, as the targets, bridge piers, river dikes, water gates, sluices, gateposts, and other existing structures where changes in luminance on the water surface are easy to recognize.

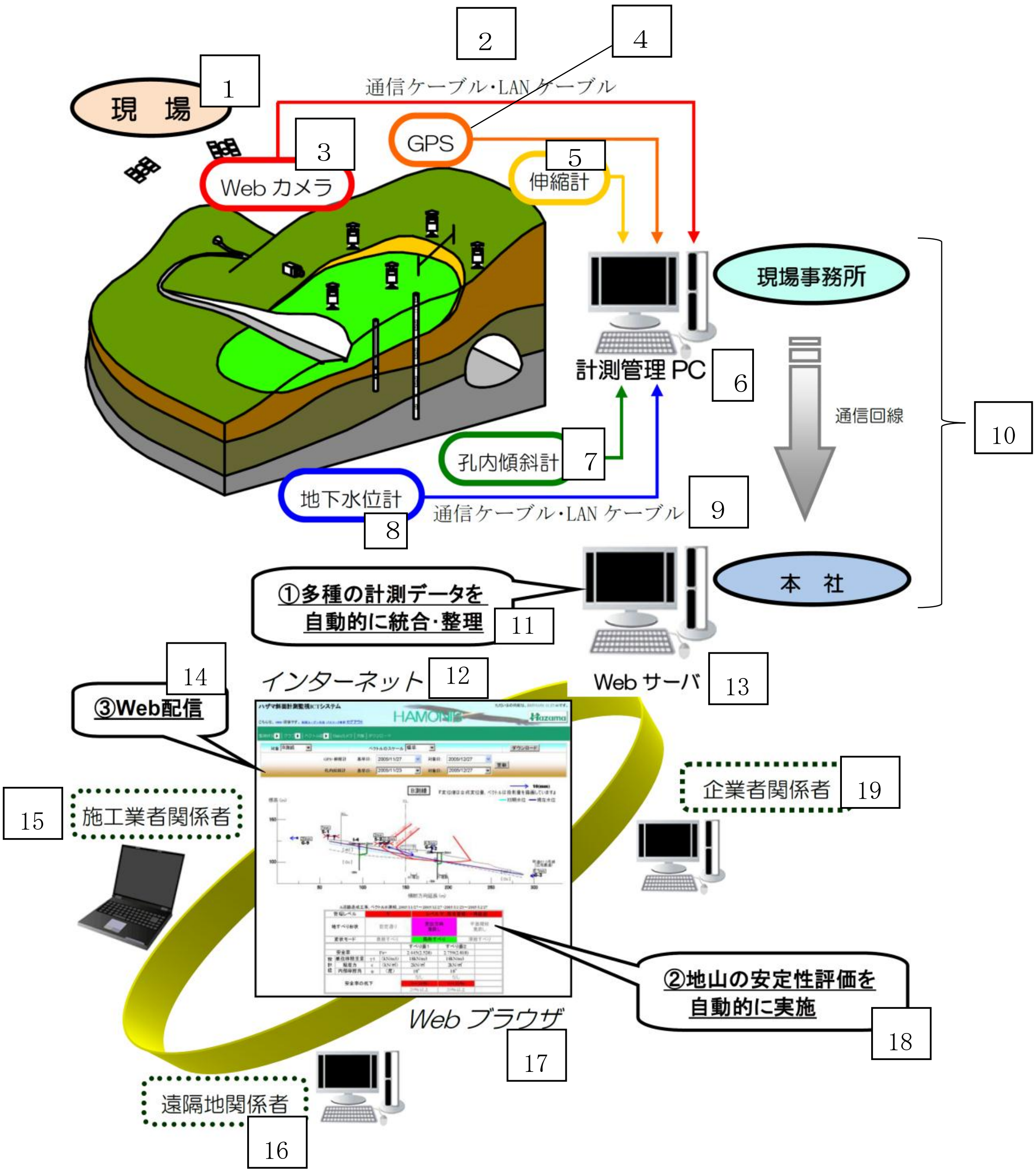
*CCTV: An acronym for closed-circuit television and describes a system in which digital cameras are used for continuous monitoring and remote equipment operation.



[1] Example of water level measurement range setting
[2] Measurement range
[3] Water surface
[4] Yellow box: Measurement range
Red line: Detected water surface (water level)
[5] Water surface detection example
[6] Elevation above water level
[7] Below water level
[8] Curve of change in average luminance
[9] Automatically detect water surface by looking at nature of change in luminance
[10] Water surface
[11] High
Structure elevation (m)
Water level
Low
[12] Low (dark)
Average luminance
High (bright)

- 1-8. "Hamonis" Slope Measurement and Monitoring System Utilizing Information and Communications Technologies: Hazama Ando Corporation

This system collects, collates, and integrates a range of measurement data from web cameras, GPS, and other sources, automatically evaluates bedrock stability, and shares that evaluation with stakeholders over the Internet.



斜面計測監視 ICT システム「ハモニス」の概念図 20

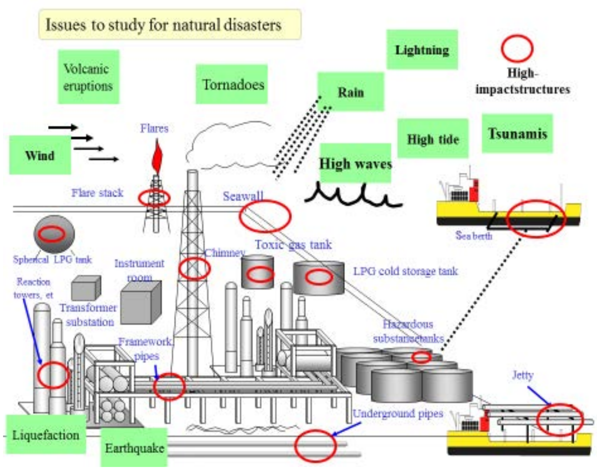
[1] On-site
[2] Communication or LAN cable
[3] Web camera
[4] GPS
[5] Extensometer
[6] Measurement control PC
[7] Borehole inclinometer
[8] Groundwater level gauge
[9] Communication or LAN cable
[10] On-site office
Communication network
Head office
[11] ① Automatically collate and integrate a variety of measurement data
[12] Internet
[13] Web server
[14] ③ Transmit over web
[15] Various construction stakeholders
[16] Off-site stakeholders
[17] Web browser
[18] ② Automatically evaluate bedrock stability
[19] Corporate stakeholders
[20] Overview of Hamonis slope measurement and monitoring system utilizing information and communications technologies

- 1-9.Proposal to Identify and Fix Potential Weaknesses during Natural Disasters: Idemitsu Kosan

Idemitsu Kosan proposes effective measures to help prevent and mitigate damage from earthquakes and other natural disasters, by predicting the maximum value of each natural disaster, matching that to the reoccurrence interval, and using these values to identify the weaknesses in facilities for risk management assessments.

For oil refineries and chemical plants that handle large volumes of high-pressure gas and other hazardous substances, it is critical that, even if a large earthquake or other natural disaster occurs, damage to the facilities is prevented and leaks or explosions avoided. In addition to the potential for direct damage, disrupted operations will also have a significant impact on the wider society. There are, however, no specific domestic regulations or standards on preparedness required of companies for natural disasters of differing scales, and there is also the potential that unexpected events may occur. The nature of any potential damage also differs with the nature of the location where the facility is. It is therefore critical that the evaluations are performed for the exact location where the facility is located.

Furthermore, reinforcing all facilities comes with significant costs. For these reasons, when preparing measures to prevent and mitigate damage from natural disasters, it is critical to identify and implement measures for weaknesses in the facility with the aim of preventing the long-term disabling of these oil refineries and of minimizing any human loss, facility damage, and environmental contamination. In order to achieve this, clear, specific values are calculated for predicted disasters, with consideration of the reoccurrence interval and severity of any disaster, and are then used. Below is an example of earthquake risk management, along with the issues that must be studied for natural disasters, proposed by Idemitsu Kosan.



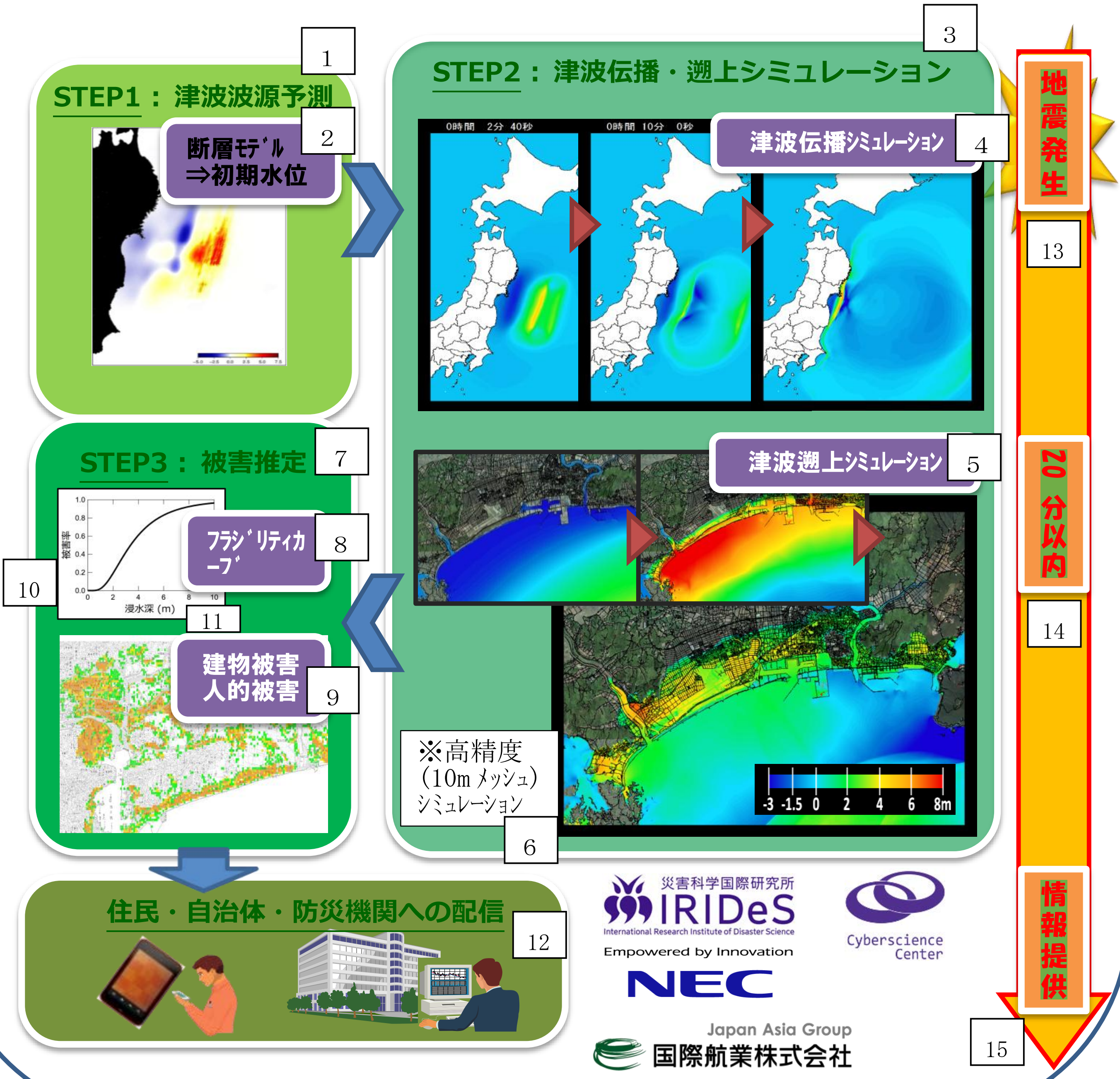
Earthquake risk management

Reoccurrence interval (percentage chance of occurrence)	Required capabilities	Specific facilities to be studied
Reoccurrence interval: 970 years (5% chance of occurrence in 50-year period)	1. Prevent loss of life or injury 2. Prevent widespread damage	・Refineries, factory buildings (built under the pre-revised Building Standards Act) ・Spherical and cold storage tanks (facilities with importance of I, I-a, and II)
Reoccurrence interval: 475 years (10% chance of occurrence in 50-year period)	3. Prevent environmental contamination 4. Prevent long-term shutdown of entire refinery	・Hazardoussubstance tanks (large-scale spills to the ocean) ・Chimneys, flares, large-scale jetties (structures that will take more than 6 months to rebuild)
Reoccurrence interval: 100 years (50% chance of occurrence in 50-year period)	Able to continually operate facility (countermeasures implemented on existing equipment)	Other than the above

1-10.Real-Time Tsunami Inundation Forecasting and Damage Estimation:
Kokusai Kogyo

After an earthquake has occurred and a tsunami has been generated, a supercomputer can be used to accurately simulate the extent of inundation caused by that tsunami and estimate the level of damage before the tsunami arrives (within 20 minutes from the earthquake).

This technology is being codeveloped by Kokusai Kogyo, NEC, and the International Research Institute of Disaster Science and the Cyberscience Center of Tohoku University, and verification is being carried out on the cities of Kochi, Shizuoka, Ishinomaki, and Higashimatsushima as part of the G-spatial City Project for fiscal 2014.



[1] Step 1: Estimation of tsunami source

[2] Fault Model

→Initial water level

[3] Step 2: Simulation of tsunami propagation and run-up

[4] Tsunami propagation simulation

[5] Tsunami run-up simulation

[6] *High resolution (10 m grid simulation)

[7] Step 3: Damage Estimation

[8] Fragility curve

[9] Damage to buildings and human losses

[10] Ratio of damage

[11] Inundation depth (m)

[12] Dissemination of data to residents, local governments, and stakeholders

[13] Occurrence of Earthquake

[14] Within 20 minutes

[15] Information Dissemination

2. After a Disaster: Effective Response and Recovery Technologies

One of the most urgent tasks after a disaster has occurred is to quickly and accurately assess the extent of the damage and the safety of those in the impacted area and promptly share information with citizens and other stakeholders. Such information sharing is needed to provide appropriate rescue and relief to the affected areas. It is also critical to help return the impacted regions to pre-disaster levels as quickly as possible after the disaster.

There are currently systems available that enable post-disaster information sharing by collating damage, evacuation, and safety information and disseminating that information over the Internet. Robots that can be controlled remotely to assess the damage and rescue people in the stricken areas, as well as temporary bridges that can be quickly assembled are extremely useful during the rescue and relief phase. There are also technologies that are useful during the recovery phase, such as systems to safely and efficiently reconnect utilities, and technologies to restore farmland damaged by tsunamis.

(1) Natural Disasters in General

The most important thing in evacuating and recovering directly after a disaster is to establish lines of communication. There are technologies available that are effective in obtaining a wide range of information from the stricken areas by using electrical devices and high-performance sensor that can quickly and stably connect to the telephone network and the Internet. There are also integrated systems that can perform big data analysis on the disaster and evacuation information collected from these devices and systems while using social media to share information with the stricken areas, and other systems that can control traffic flows and prioritize road reconstruction.

Saving human lives in the first 72 hours after a disaster occurs is also an enormous and critical challenge. To safely carry out these rescue activities, it is important to utilize personal protective equipment to protect the rescue teams from fire, chemicals, bacteria, and dust; devices and systems to find those in need of rescue quickly and efficiently prioritize where to devote resources; and robots that can be operated remotely to assess the damage and rescue people in the stricken areas.

Relief activities for the stricken areas and implementation of corporate BCPs must also begin without delay. Self-contained, high-performance power generators for emergency power supply and temporary bridges that can be quickly assembled where existing bridges have fallen would be useful at these times.

When the process moves from immediate recovery to long-term rebuilding efforts, technologies exist that can decontaminate and clean contaminated domestic and industrial water and farmland, as does a disaster victim ledger–based system to help people rebuild their lives.

(2) Earthquakes

Just after an earthquake has occurred, we need to be able to accurately estimate the magnitude of the earthquake, and if and how high a tsunami is coming, so that people can evacuate safely and then start the immediate recovery efforts. It can also be expected that large fires that often occur as a result of earthquakes will be an impediment to evacuation and recovery efforts, so widespread and sustained firefighting capability is required. In the case of the predicted Metropolitan Earthquake, it has been predicted that multiple fires may occur simultaneously, leaving people surrounded with nowhere to escape, and that fire whirls may also occur, sending people into a panic trying to escape. It is estimated that up to around 16,000 lives may be lost in the fires alone.

Depending on the time the earthquake occurs, a large number of people may not be able to return to their homes, meaning that temporary accommodation will need to be prepared. It is important that the safety of each temporary accommodation facility is ensured to prevent any secondary incidents.

Technologies and systems that will be effective in these situations include the aforementioned technologies to accurately measure long-period ground motion, systems to monitor submarine earthquakes and tsunamis, and systems that can continue to supply a large volume of firefighting water for 10 or more days which would be needed to subdue large, long-burning fires such as those at petrochemical complexes or in densely populated areas. There are also systems that can, soon after the earthquake, quickly assess building damage and determine if the building is safe to use.

(3) Storms and Floods

Flooding of factories, subways, underground shopping malls, underground car parks, and other enclosed spaces could be expected as a result of a tsunami or torrential rain.

Effective measures in these cases are to have in place water guards on the ground floor entrance to the building or underground facility that can be raised immediately after the disaster occurs without the need for external power, as well as having drainage pump trucks that can operate over extended periods of time by having in-house power generators installed in case of floods.

(4) Volcanic Eruptions

The eruption of Mount Ontake in 2014 reminded us of the difficulty to predict such disasters, the importance of volcano disaster prevention plans, and the significance of volcanic gas removal to rescue efforts.

Technologies that are effective for volcanic eruptions include those that use information from historical eruptions and computer simulations to help the preparation of volcano disaster prevention plans, technologies to measure falling volcanic ash, as well as systems to clean the external air supplied to residential spaces following the eruption.

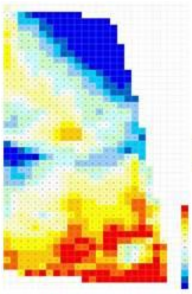
＜Column 2: Technologies and Systems for Effective Disaster Response and Recovery (Random Order)＞

2-1. Technology to Repair Tsunami-Damaged Farmland: Hitachi Zosen and Sumitomo Chemical

This technology is used to repair farmland that has been so damaged by salt and small debris deposited by a tsunami that it can no longer be used for agriculture. There are seven characteristics to the technology:

1. Quick and accurate assessment of the volume of the sediment deposited by the tsunami;
2. Faster and more accurate digging and removing when compared to conventional techniques;
3. Desalination of sediment, followed by separation of topsoil, construction-use soil, and other foreign matter;
4. Accurate leveling of the recovered topsoil;
5. Usability of recovered topsoil for wet-land rice farming;
6. Creation of data depicting the status of the land; and
7. Integrated single system from sediment analysis through to regeneration of farmland.

GPSトラクターにより高低を把握 1



堆積物除去前 2

堆積物除去後 3

Hitz LaRWS(ラーズ)工法（Land Renovation by Washing and Separation) 4

[1] GPS tractor to identify height differences
[2] Before removing sediment
[3] After removing sediment
[4] Hitz LaRWS (land renovation by washing and separation) Method

➢ 2-2. TORAYPEF® Electron Beam Cross-Linked Polyolefin Foam Usable as Emergency-Response Insulation Sheets: Toray Industries

This is a closed-cell polyolefin foam developed by Toray that has superior heat insulation, cushioning, and water resistance properties. It can be supplied in 1 m wide rolls (50–300 m long), easy to cut and can be quickly put into use during emergencies. TORAYPEF® is currently used in a number of different applications.

＜製品写真＞ 1

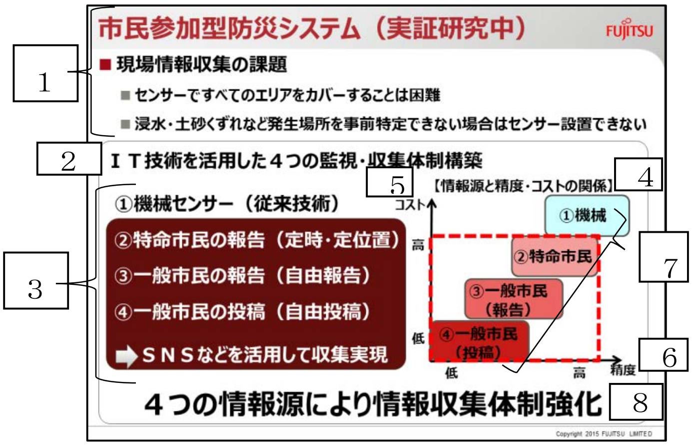
＜用途例　保温、クッションシート＞ 2

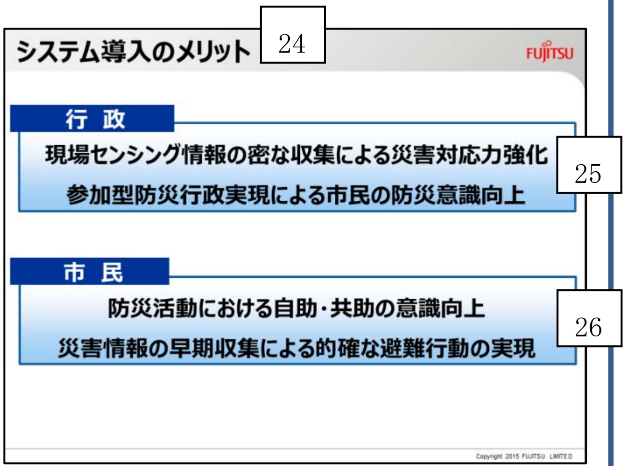
東日本大震災の際には、避難所へ送付し、断熱マットとして利用された。 3

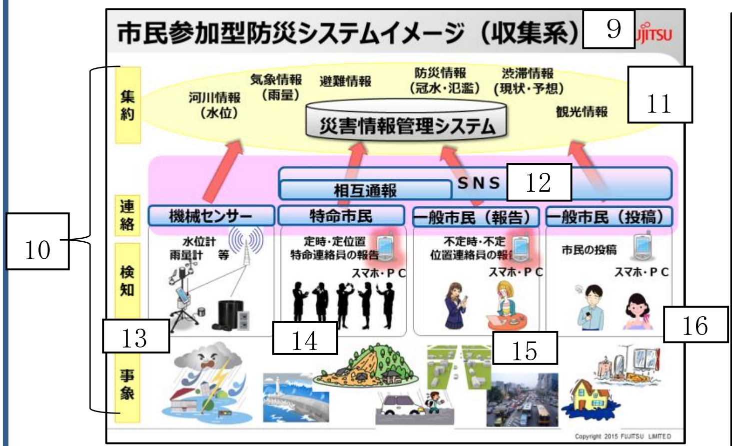
[1] Product photo
[2] Example of use: insulating cushion sheet
[3] Distributed to evacuation centers after Great East Japan Earthquake and used as insulation mats.

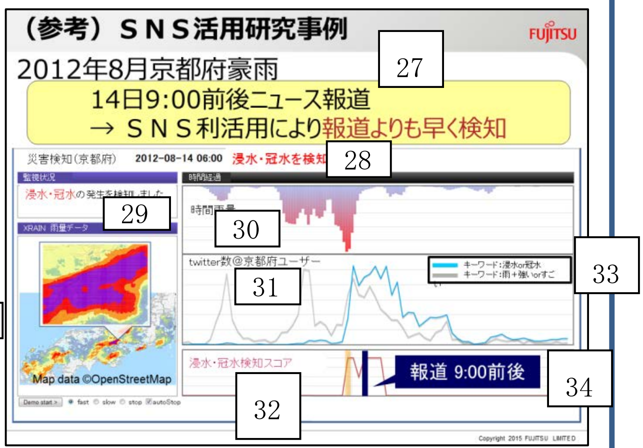
➢ 2-3. Participatory Disaster Prevention System: Fujitsu

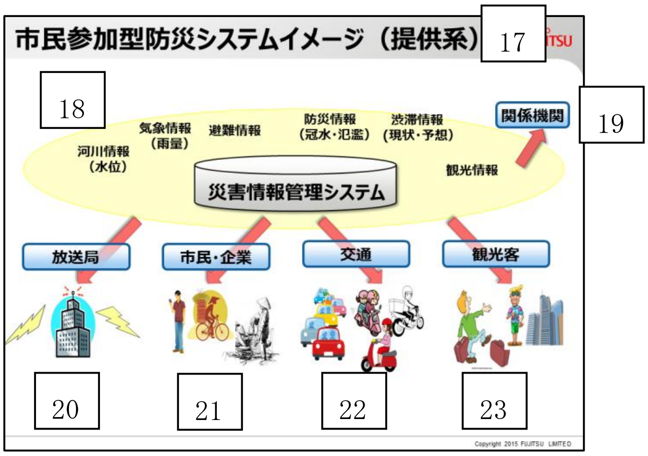
This system, while gathering observation data from mechanical sensors, allows citizens to cooperate in gathering disaster prevention information and share other information that facilitates evacuation, through social media and other interactive communication services. Use of this system makes it faster to detect a disaster and ascertain the extent of the damage.











[1] Participatory disaster prevention system (currently under experimental study)
Challenges in collecting on-site information
Difficult to cover entire area with sensors
Impossible to install sensors where flooding or landslides not predicted in advance
[2] Use IT to construct four systems to monitor and collect information
[3] ① Mechanical sensors (conventional technology)
② Designated citizen reports (designated time and location)
③ General citizen reports (free reports)
④ General citizen posts (free posts)
→ Use social media to collect information
[4] Relationship between information source and accuracy/cost
[5] Cost
High
Low
[6] Low
High
Accuracy
[7] ① Mechanical
② Designated citizens
③ General citizens (reports)
④ General citizens (posts)
[8] Enhance systems to collect information by four different sources
[9] Participatory disaster prevention system (collection)
[10] Collection
Communication
Detection
Phenomena
[11] River information (water level)
Weather information (rainfall)
Evacuation information
Disaster information (inundation, flooding)
Traffic information (now and predicted)
Tourism information
Disaster Information Management System
[12] Interactive communication
Social media
[13] Mechanical sensors
River level gauges
Rain gauges, etc.
[14] Designated citizens
Reports from designated individuals at designated time and location
Smartphones, PCs
[15] General citizens (reports)
Reports from citizens at non-designated times and locations
Smartphones, PCs

[16] General citizens (posts)
Citizen posts to social networks
Smartphones, PCs
[17] Participatory disaster prevention system (information provision)
[18] River information (water level)
Weather information (rainfall)
Evacuation information
Disaster information (inundation, flooding)
Traffic information (now and predicted)
Tourism information
Disaster Information Management System
[19] Relevant organizations
[20] Broadcasters
[21] Citizens and corporations
[22] Traffic
[23] Tourists
[24] Merits of introducing this system
[25] Government
Enhance disaster response by highly dense collection of on-site sensing information.
Introduce participatory disaster prevention policies for enhanced citizen awareness.
[26] Citizens
Raise citizen self-help and group-help awareness in disaster prevention activities.
Collect disaster information early for fast and effective evacuations.
[27] Reference: Case study on social media use
Torrential rain in Kyoto Prefecture, August 2012
News report around 9:00 a.m. on August 14
→ Information detected on social media prior to news report
[28] Disaster detection (Kyoto Prefecture): 6:00 a.m., August 14, 2012. Flooding and inundation detected.
[29] Monitoring status
Flooding and inundation has been detected.
XRAIN rainfall data
[30] Timeline
Hourly rainfall
[31] Number of tweets by users in Kyoto Prefecture
[32] Flooding/inundation detection score
[33] Keywords: Flooding OR inundation
Keywords: Rain AND strong OR heavy
[34] News report around 9:00 a.m.

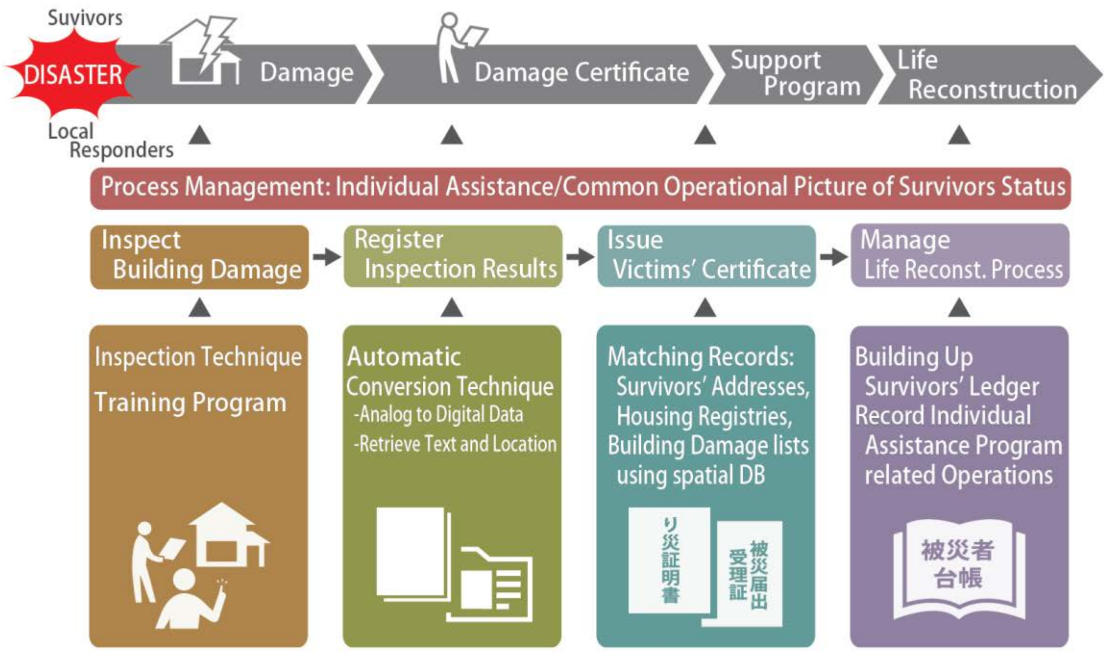
➢ 2-4. Life Recovery Support System Using the Survivors' Ledger—An Integrated System to Support Victims due to the Disaster and Help Them Rebuild Their Lives: InterRisk Research Institute & Consulting

This life recovery support system using the survivors' ledger comprehensively assists local governments, in the wake of a disaster, with helping disaster victims rebuild their lives, including the issuance of disaster victim certificates. It has been developed through an industry-academia collaboration among Kyoto University, Niigata University, NTT, and others.

The system makes it possible to quickly and fairly assess a significant number of damaged structures, and also includes programs to train the inspectors required for these assessments. It also includes information processing systems to input the assessment data and get related information from existing processing systems to ensure the linkage of such systems to disaster damage information and the smooth issuance of disaster victim certificates. It also includes functionality to manage the survivors' ledger so that all of the support operations have unified management.

InterRisk Research Institute & Consulting has developed the inspection tools and documentation used to assess building damage, as well as training programs and materials to enable people to effectively acquire the knowledge and skills needed to respond to disasters in a short time frame.

The Firm hopes this system will do its part to create a society where disaster victims can return to a rewarding, independent lifestyle as soon as possible.

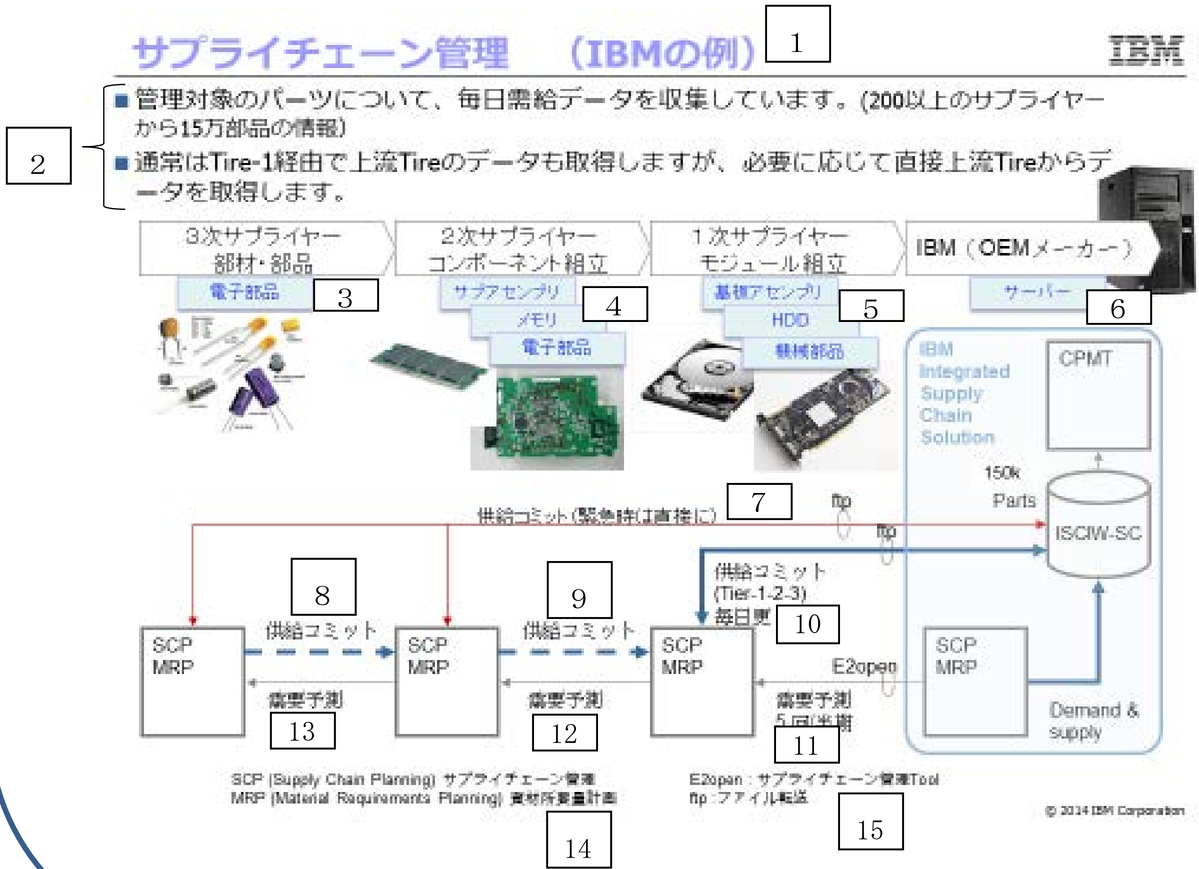


Overview of the life rebuilding support system using the disaster victim ledger:

This system was designed to support disaster victims, from the time the disaster occurred until they manage to rebuild their lives, by integrating the various interactions between the victims and the various relevant government bodies. The system was awarded the Good Design Award by the Japan Institute of Design Promotion.

- 2-5. Supply Chain Management System: IBM Japan

This tool provides supply chain risk information, as database, for all parts used for IBM System products, which covers 150,000 components supplied by over 200 suppliers. The tool reduces lead time and costs for problem solving by visualizing the supply chain logistics network and quickly responding to changes of component supplier. This make it possible for responsible buyers to acknowledge and confirm how critical each focused components' shortage is by referring its signal. IBM uses this tool to monitor supply-ability of the critical component at 26 weeks prior to the planned delivery date. This allows the Company to place optimum orders and take appropriate actions to ensure operations are proceeding to plan, and has reduced the average lead time for problem solving from 33 to 14 days, and reduced related cost by 10%



[1] Supply chain management (IBM example)
[2] Daily supply and demand data is collated for targeted components (information on 150,000 parts from 200 or more suppliers).
Components' supply status data of Tier. 2 and Tier .3 is usually provided through Tier 1, but they can be obtained directly in case of emergency.
[3] Tier 3 suppliers
Material and components
Electrical components, such as Memory
[4] Tier 2 suppliers
Component assembly
Subassembly
Memory
Electrical components
[5] Tier 1 suppliers
Module assembly
Motherboard assembly
HDD
Mechanical components
[6] IBM (OEM)
Servers
[7] Supply commitment (Directly in emergency)
[8] Supply commitment
[9] Supply commitment
[10] Supply commitment
(Tier 1-2-3)
Daily
[11] Demand forecast
5 times/half year
[12] Demand forecast
[13] Demand forecast
[14] SCP: Supply chain planning
MRP: Material requirements planning
[15] E2open: Supply chain management tool
ftp: File Transfer Protocol

- 2-6. Mammoth Disaster Prevention and Mitigation System: Teikoku Sen-i

This system can use difficult-to-access water resources and those required pomp lift(15–60 meters) to supply a large volume of water ranging from 4,000 to 30,000 liters per minute, and thanks to an automatic, safe fuel supply system, can do so for about 10 or more days continuously. The system creates a high-powered jet spray from this water source to suppress large fires at petrochemical complexes from a distance.

[1] In preparation for the predicted Metropolitan Earthquake and Nankai Trough Earthquake
Standing up to the challenges of the impending major disasters
Teikoku Sen-i's
Mammoth Disaster Prevention and Mitigation System

[2] Cutting-edge equipment Turbo Hydrojet

[3] Mobile water sources HydroSub

[4] Supply water

[5] Can spray 8,000 liters per minute up to a distance of 150 meters for safe firefighting and fire abatement activities.

- Fire abatement
- Tank cooling
- Explosion prevention
- Dispersion prevention
- Prevention of dispersion of radiation and flammable toxic gases

[6] Can continuously supply between 2,500 and 30,000 liters of water per minute from sources with high water head over prolonged periods.

[7] Three-dimensional
Cutting-edge equipment
The power of the Turbo Hydrojet

[8] Large-capacity jet spray system

[9] Jet spray was successful in extinguishing oil field fires during the Gulf War.

[10] What is the Mammoth Disaster Prevention and Minimization System?
It is the world's first three-dimensional, continuously operating disaster prevention and mitigation system. Water is supplied from the high-volume HydroSub water delivery system to the large-capacity Turbo HydroJets spray system, which can then spray water to great distances on high-powered jet streams continuously for a prolonged period. The system is effective in extinguishing large fires at petrochemical complexes, subduing nuclear power station incidents, and tackling other unexpected major disasters.

[11] Incidents against which system use was tested

- Fires and explosions at petrochemical complexes
- Flammable gas leaks
- Fires and radiation dispersion at nuclear and thermal power stations
- Fires in densely populated areas
- Large tunnel fires
- Hydrosub has been used to supply large volumes of water to fight large fires, perform high-volume drainage during flooding, and supply large volumes of water for residential use during disasters

[12] Spray distance and firefighting area
Spray distance and effective firefighting area

- Spray distance: 150 m → Effective Fire Extinguishing: 3,500 m^2
- Spray distance: 120 m → Effective Fire Extinguishing: 2,200 m^2

Water spray capacity (two turbines)

- 8,000 liters per minute (max.)

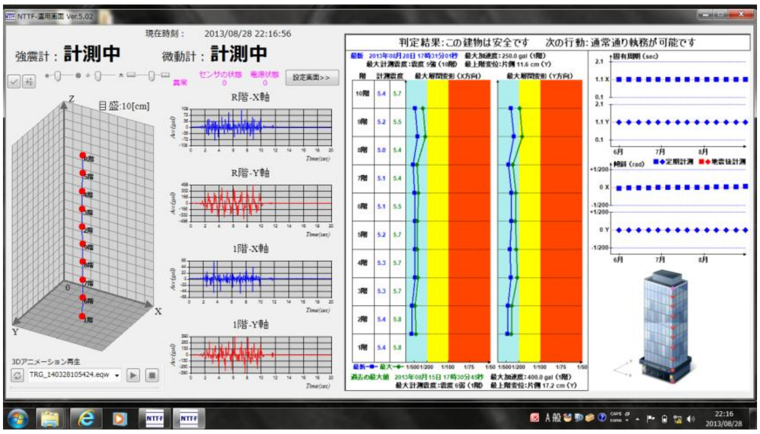
[13] Teikoku Sen-i Co., Ltd.
2-1-10, Nihombashi, Chuo-ku, Tokyo 103-0027, Japan
Tel: +81-3-3281-3033 Fax: +81-3-3274-6397
E-mail: bousai@teisen.co.jp
URL: www.teisen.co.jp

➢ 2-7. "Yuremoni" Building Safety Assessment Support System:
NTT Facilities (an NTT group company)

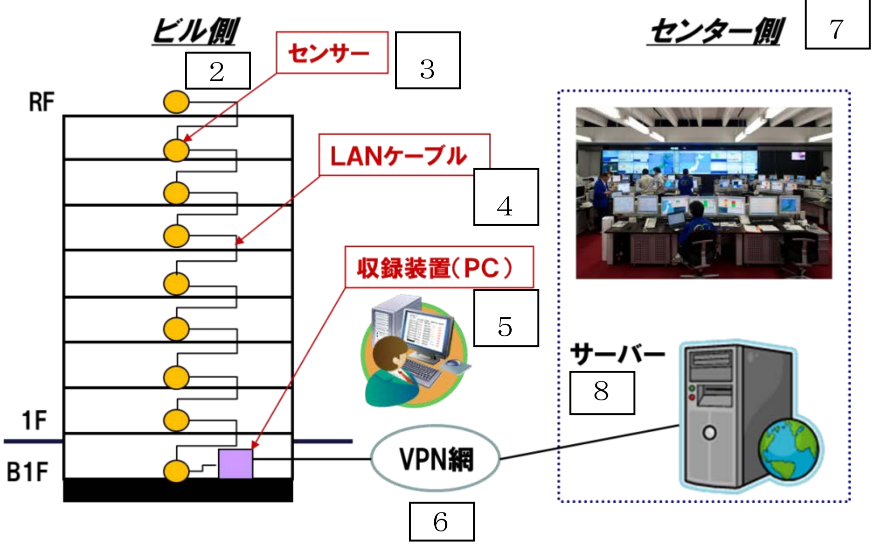
In this system, sensors are fitted at every floor of a building to acquire acceleration data, which is then analyzed using the Company's proprietary program to assess building safety following the earthquake. Unlike damage to equipment or secondary members, it is normally impossible to visually identify damage to the building's structural skeleton. By introducing this system, however, the building's safety after an earthquake can be assessed to red, yellow, and green levels, and instantly judged whether it is safe to continue to use the building, or whether the inhabitants should evacuate. It is also possible to gain a centralized understanding of the state of multiple buildings in the same way.

Yuremoni data also enables assessors to pinpoint the floors with significant damage and conduct efficient assessment, reducing assessment time and costs.

■表示画面



■システム図 1



[1] System overview
[2] At the building
[3] Sensors
[4] LAN cables
[5] Recording device (PC)
[6] VPN
[7] At the monitoring center
[8] Servers

➢ 2-8. "Mizguard" Watertight Barriers and Doors: Howa Machinery

Watertight barriers can be quickly and easily raised during sudden torrential rain to prevent water from entering through entrances to subways, underground shopping malls, office buildings, and public facilities.

Watertight doors can be opened and closed like regular doors during normal times, but become highly watertight and prevent water from entering through doorways during emergencies.

ミズガード（防水板） 1

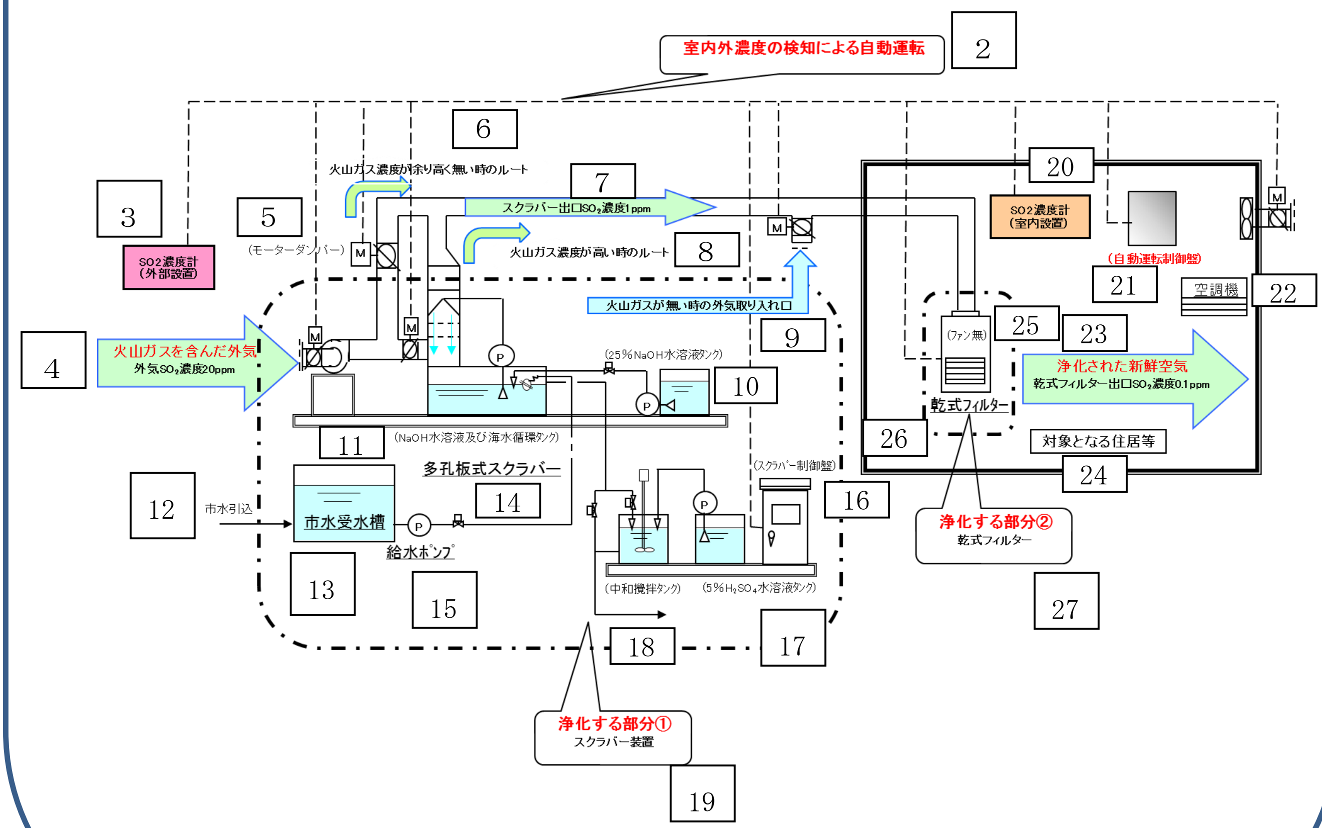
ミズガード（防水扉） 2

[1] Mizguard (watertight barrier)
[2] Mizguard (watertight door)

- 2-9. Volcanic Gas Removal System: Shinryo Corporation

This system works around the clock to remove volcanic gas (sulfur dioxide) from external air being supplied to residential spaces, reducing volcanic gas concentrations low enough so that the air is clean and fresh enough to live normal lives. Two cleaning units are installed for continuous use in times of emergency to ensure high safety levels, while also automatically detecting external and internal concentrations and adjusting system operation to suit for minimum use of resources.

＜火山ガス成分を含んだ外気の浄化システム概念図＞ 1



[1] Overview of system to clean external air containing volcanic gas
[2] Automatic operation by detecting concentrations both inside and outside the structure
[3] SO_2 concentration gauge
(located externally)
[4] External air containing volcanic gas
SO_2 concentration of 20 ppm
[5] Motor damper
[6] Route when low volcanic gas concentrations
[7] Scrubber outlet: SO_2 concentration of 1 ppm
[8] Route when high volcanic gas concentrations
[9] External air intake when no volcanic gas
[10] 25% NaOH aqueous solution tank
[11] NaOH aqueous solution and seawater circulation tank
[12] Town water intake
[13] Town water receiving tank
[14] Perforated plate scrubber
[15] Water supply pump
[16] Scrubber control panel
[17] 5% H_2SO_4 aqueous solution tank
[18] Stirred neutralization tank
[19] Cleaning unit 1
Scrubber
[20] SO_2 concentration gauge
(located internally)
[21] Auto-operation control panel
[22] Air conditioner
[23] Clean, fresh air
Dry-type filter outlet: SO_2 concentration of 0.1 ppm
[24] Residential space
[25] Fanless
[26] Dry-type filter
[27] Cleaning unit 2
Dry-type filter

III. Actions Needed to Promote Further Use and Development of Disaster Prevention and Mitigation Technologies

As seen in Chapter II, some of the challenges related to prevent and mitigate damage from natural disasters are expected to be resolved with the effective use of existing technologies and systems. These technologies and systems are also extremely useful for the contribution they can make internationally.

In this chapter we will propose corporate actions, collaborative actions between industry, academia, and government, as well as actions required of government, to promote the further use and development of Japan's disaster prevention and mitigation technologies, and to disseminate those technologies internationally.

1. Corporate Actions

As seen so far in this proposal, Japan's corporations have a suite of technologies that are effective at preventing and mitigating damage from a variety of disasters. Through tireless innovation, these corporations must continue to work to make these world-leading technologies. They are also required to continue their efforts to promote and expand the use of these technologies both in Japan and worldwide.

2. Collaborative Actions between Industry, Academia, and Government

(1) Enhancing Collaboration

In our policy proposal entitled "Improving Cooperation among Companies with Regard to Their Business Continuity Plan (BCP) and Business Continuity Management (BCM)" of February 2014,[5] Keidanren stresses the importance of actions taken by forward-thinking companies in enhancing collaboration across supply chains, regions, and industries. In the light of that, we need to consider providing opportunities for related parties to share examples of the introduction, and gain a deeper understanding, of disaster prevention and mitigation technologies, as well as disseminating technologies relevant for each industry.

Under the banner of a national innovation system, the Japanese government is currently working to enhance the nation's innovative capability by organically drawing on the wisdom and knowledge of industry, academia, and government. It is critical that this leads to robust mechanisms for collaboration between industry, academia, and government concerning the promotion of further development and use of disaster prevention and mitigation technologies.

Creating collaboration mechanisms between core industry, academia, and government in each region of the country will help maximize the strengths of the disaster prevention and mitigation measures of each entity, and will lead to a stronger and more resilient society

[5] Keidanren, *Improving Cooperation among Companies with Regard to Their Business Continuity Plan (BCP) and Business Continuity Management (BCM)* (February 2014).
https://www.keidanren.or.jp/en/policy/2014/010.html

as a whole. More specifically, regional resilience plans are being prepared by the various prefectures and municipalities in Japan under the Basic Act for National Resilience,[6] but more emphasis needs to be given to coordinating the various regional resilience plans and to enhancing industry, academia, and government collaboration mechanisms.

Toward the development of industry-academia-government collaboration mechanisms concerning disaster prevention and mitigation measures, we should encourage interaction between technology developers of different industries, while endeavoring to share information on the need for disaster prevention and mitigation technologies, and core ideas that could be the seed for further development. It is conceivable for the government to take the initiative in this area. We can anticipate a new outburst of innovation in disaster prevention and mitigation technologies through this organic communication.

From the perspective of promoting regional disaster prevention and mitigation measures and enhancing regional resilience, plans need to be prepared and implemented that leverage and utilize corporate technologies and know-how and that are matched to the unique circumstances of the region. Opportunities for the various local governments and relevant corporations to discuss thoroughly and provide feedback to each other are required for this process to be successful.

The collaboration in Japan between industry, academia, and government described above is the best way to create world-leading disaster prevention and mitigation measures, and can act as a model for countries around the world.

From the perspective of regional revitalization, which both the government and the ruling parties view as one of their high-priority policies, Keidanren intends to continue with our comprehensive investigations into the current status and challenges facing disaster prevention and mitigation measures.

(2) Promoting Disaster Prevention and Mitigation Technologies to Contribute to the International Community

In our vision entitled "Toward the Creation of a More Affluent and Vibrant Japan—Innovation & Globalization" of January 2015, Keidanren emphasizes the importance of disseminating Japan's disaster prevention and mitigation technologies overseas. The results of collaboration between industry, academia, and government here in Japan should be used to promote disaster prevention and mitigation technologies in developing countries, both as part of Japan's contribution to the international community, and also as part of our national economic growth strategy.

This has already begun, with the Ministry of Land, Infrastructure, Transport and Tourism establishing the Japan Disaster Prevention Platform in June 2014. Through this platform, the ministry works together with industry and relevant organizations to reinforce, during normal times, bilateral cooperative relationships in disaster management, primarily with emerging countries which face challenges preventing and responding to potential

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[6] *Basic Act for National Resilience Contributing to Preventing and Mitigating Disasters for Developing Resilience in the Lives of the Citizenry* (Act No. 95 of December 11, 2013).
http://www.cas.go.jp/jp/seisaku/kokudo_kyoujinka/pdf/khou1-2.pdf

disasters.

Hence, the foundations to identify emerging countries' disaster prevention and mitigation needs and disseminate Japan's solutions have already been prepared, and now these foundations just need to be effectively and continuously put to use. Through this process, we must be constantly aware of the different types of disasters individual developing countries face, as well as the differing levels of technical and social infrastructure development.

We then must categorize the disaster prevention and mitigation technologies and expertise Japan's public and private sectors have by the type of disaster and application, and match them to the needs of the developing countries, while also informing the international community of the ways industry, academia, and government collaborate in Japan. It is particularly important to create a package of the different technologies and systems that are effective for quick recovery and rebuilding following a disaster and to have continuous dialogue with a variety of countries in the aim of identifying the best way to deploy these technologies in times of emergency. We must utilize these opportunities to become keenly aware of the state of different disaster prevention and mitigation measures around the world, and then use this knowledge for improvements and new developments to create the disaster prevention and mitigation technologies that are truly needed.

Based on our vision, Keidanren will work over the medium to long term to help promote Japan's disaster prevention and mitigation technologies, and provide guidance on the best way for the various entities to work together.

3. Actions Required of Government

Strong leadership from politicians and the government is required for the promotion of disaster prevention and mitigation measures, especially for emergency response during large-scale disasters and the promotion of further use and development of disaster prevention and mitigation technologies. From that perspective, with the strong leadership of the Minister of State for Disaster Management, the Cabinet Office needs to further enhance the effectiveness of their control function concerning disaster prevention, and to take the following actions in order to promote the further use and development of disaster prevention and mitigation technologies.

(1) Information Provision and Sharing

It is important that there be a greater depth and breadth of disaster prevention and mitigation information provided by the government, as well as more open access to the data, to help make disaster prevention and mitigation measures more robust. It is equally essential to provide information in a manner that leads to more effective use of the technologies.

Prevention

Greater disclosure and common awareness of a variety of disaster-related information is required as part of disaster prevention, as well as a review of the conventional methods of assessing disaster damage.

First of all, hazard maps need to be constantly developed and refined through ongoing surveys and reviews of areas of potential flooding and areas at risk of fire spread and other disasters, taking into account information from the most recent disasters, so that each region can enhance its disaster prevention capabilities. Following the experience of the damage caused by torrential rain in Hiroshima in August 2014, the Act on Sediment Disaster Countermeasures for Sediment Disaster Prone Areas was revised in November of the same year. This revision calls for surveys and increasing common awareness of disaster-prone areas, and these actions need to be performed within a defined time frame. It is also preferable for governments to disclose the areas where it will be difficult to ensure that necessary utilities are maintained, and to conduct surveys and make people known about emergency water sources that will play a crucial role during times of evacuation.

Next, to ensure that disaster prevention and mitigation technologies are used appropriately, it is important to have focused release of information about the vulnerabilities in society as a whole, while also being aware of potential impacts on security and crime prevention. In terms of seismic resistant technologies, it is desirable that seismic diagnosis results for roads and bridge piles are released, that the public is informed of the public facilities that require repair or reinforcement to extend their useful lives, and that information is provided on the cross section and design requirements for the nation’s seawalls. It is also important that data is provided on which areas will be treated to improve liquefaction resistance, as well as when these actions will be taken. Governments must also grasp, and make people aware of, who is responsible for management of mountain areas, cliffs, and slopes, and to ensure that all the required actions are taken.

As part of the review of the conventional damage assessment methods, it is worth considering utilizing a time series evaluation of tsunami force acting on structures. The maximum tsunami height is the only criteria currently used to evaluate tsunami force, but maximum wave force does not always occur at the time of maximum wave height. Furthermore, criteria to determine housing foundation damage and building incline damage for liquefaction countermeasure purposes should be harmonized between the different local governments.

In addition to these, concrete progress needs to be made on mechanisms that enable engineers to readily utilize G-space information from quasi-zenith satellite systems.

Prediction

Improving the accuracy of predictions for the kind of disasters that will occur, and what kind of damage they will cause, requires open access to a wide range of information that includes national land data.

More specifically, prediction of damage from earthquakes would improve with provision of ground structure data, supply of earthquake acceleration data, and release of information on the seismic resilience levels of fundamental utilities, for each area.

Predicting damage caused when rivers overflow is currently the largest challenge. Industry, academia, and government need to work together to improve this situation by consolidating ocean and land topographical data, together with data on weather and hydrographic conditions, to share the flow volume and depth, as well as the state of flood control mechanisms, of each river. Government should also disclose river outflow analysis parameters, and flow velocity and time series information used for tsunami flooding predictions, so that the private sector can also contribute to improving damage prediction accuracy.

Responses

When a disaster has occurred, it is essential for relevant public and private bodies to ascertain the extent of the damage in the affected areas, confirm the safety of residents, and disseminate necessary information to the wider community in a swift and seamless manner.

To ascertain the extent of the damage, we need to share information on the level of damage to the information and communications infrastructure in the affected areas, and on locations and times where there will be increased telecommunications demand. Furthermore, as the Cabinet Office guidelines for the operation of household disaster damage assessment criteria do not specify the disaster damage assessment criteria and methodologies for nonresidential offices, the government needs to determine and publish such criteria as well.

Guidelines also need to be prepared on how local governments should collect and release information concerning the safety of people affected by a disaster.

In terms of the dissemination of various kinds of information and the evacuation activities based thereon, the public needs to be informed, to the extent possible, of the criteria government will use when giving evacuation instructions, as well as strategies for how the media will be used to relay information. This will help minimize confusion following a disaster. Furthermore, it is crucial to promote and put into wider use the L-Alert disaster information sharing system that enables information gathered from local governments to be disseminated over a variety of different mediums.

(2) Regulatory Reform

Deregulation and regulatory reform are required to support further development and use of disaster prevention and mitigation technologies. Some specific examples are provided in this section.

Prevention

Given the state of Japan's national finances and business environment, it is critical to make buildings and structures more resilient and give them longer useful lives through the use of technologies that are able to deliver the maximum possible benefit with the minimum possible cost.

To achieve this, we need to provide opportunities to test and verify new materials and processes while streamlining necessary procedures in order to encourage development of seismic resistant and other technologies.

Furthermore, there needs to be a more flexible application of regulations, such as overshadowing regulations under the community rules of the Building Standards Act and setback requirements under local government ordinances, in order to enable the effective use of seismic resistant methods in the external reinforcement of existing buildings. In cities, there are still many condominiums and apartment buildings that were built according to the pre-revised seismic resistance requirements. In order to urge the antiseismic reinforcement of these buildings, the method of evaluating such reinforcement should be specified under the housing performance indication system of the Housing Quality Assurance Act. Additionally, in an effort to encourage the rebuilding of structures that are in an excessive state of disrepair, consideration should be given to the expansion of what can be considered as valid reasons when refusing renewal of or requesting termination of contracts under the Act on Land and Building Leases, as well as to a review of the items requiring resolution under the Act on Building Unit Ownership, Etc.

For reinforcement of wharves and river or sea embankments that are at risk of collapse due to tsunamis or liquefaction, moving the boundary of the reclaimed land forward should be permitted, and the procedures required for reclamation projects should be simplified, including the environmental assessment process. There should also be consideration given to exempting the installation of ground displacement instrumentation from property boundary restrictions.

Responses

Remembering the network congestion that occurred after the Great East Japan Earthquake, it is critical that multiple communication methods are made available before any disaster occurs to ensure the uninterrupted collection of disaster and damage information.

To that end, existing local government communication systems need to be interconnected to construct the communication infrastructure that will enable information sharing over a wide area.

Consideration should also be given to the sharing of communication infrastructure, prioritized access to alternative networks, and the opening up of general-purpose frequencies, to ensure that network congestion does not disrupt the flow of information from the various sensors monitoring disaster status.

Local governments need to work with the private and other relevant bodies in each region to quickly gather disaster damage information and confirm the safety of people in the affected areas. There needs to be a specific frequency band established that relevant regional bodies can share for this to occur.

Conducting efficient rescue operations and letting people know which roads are accessible require the analysis, disclosure, and provision of information gathered from a large number of individuals, and these activities would benefit from a more flexible application of the Act on the Protection of Personal Information and other similar laws and regulations.

(3) Provision of Appropriate Incentives

Providing appropriate incentives for corporations to voluntarily implement disaster prevention and mitigation measures is another aspect that should be considered.

Toward that end, the government must first specify, as much as is possible, medium- to long-term targets for disaster prevention and mitigation measures. This is expected to result in disaster prevention and mitigation measures that will go beyond individual companies and be further encouraged through private investment.

Based on an evaluation of vulnerabilities to different types of disaster, prioritized financial and other support needs to be given to the urgently required seismic resistance, fire resistance, and liquefaction countermeasure for critical facilities and offices.

Furthermore, development of smart cities and compact cities[7] can be effective ways to both maintain regional ability to respond to disasters, and efficiently utilize social infrastructure, in this time of rapidly decreasing birthrate and aging population, and regional depopulation. For this reason also, it is important that medium- to long-term disaster prevention and mitigation targets are linked to next-generation urban planning strategies such as smart cities and compact cities, and that thorough discussions are held between the relevant stakeholders to draw out the vitality of the private sector to the maximum extent possible.

IV. Closing

Japan has been struck by natural disasters a great number of times over the ages, and great wisdom concerning preventing and mitigating disasters lives and breathes in our traditions. We are now in an age where disasters causing massive damage are occurring somewhere around the world every year, and we must do more to promote the use of the experience and knowhow we have accumulated to other countries around the world.

As stated above, the technologies of Japanese companies can be used to advance disaster prevention and mitigation measures. In this globalizing society, corporations should have a management strategy that involves promoting their disaster prevention and mitigation technologies, products, and services around the world, as well as using the needs of other countries to advance development of their technologies.

Keidanren will take every opportunity, both within Japan and internationally, to promote the superior disaster prevention and mitigation technologies of Japanese corporations.

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[7] Keidanren, *Keidanren's Basic Stance towards National Resilience* (September, 2013). https://www.keidanren.or.jp/en/policy/2013/078.html