Disaster Prevention Management Solution for National Security

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OVERVIEW: Based on lessons from the Great East Japan Earthquake, it is anticipated that even greater steps will be taken at a nationwide level to establish organizations and schemes and provide facilities and systems aimed at mitigating disasters in Japan. In particular, in the case of large disasters that affect a wide area and in which the situation changes rapidly with time, it is vital that an effective response be mounted that includes coordination with national and regional agencies, as well as the general public, in order to reduce the amount of damage and speed up the subsequent recovery and reconstruction. Hitachi already supplies disaster response support systems to central government ministries and agencies as well as local authorities. Currently, Hitachi believes that the best way to ensure national security is by raising awareness through education and training, and through wide-area coordination and decision making that takes account of operational concepts in times of emergency. Hitachi is working to expand disaster prevention management solutions intended to achieve this.

INTRODUCTION

TAKING note of the lessons from the severe damage that resulted from the Great Hanshin Awaji Earthquake in 1995 and the Niigata-ken-Chuetsu Earthquake in 2004, progress has been being made on establishing organizations and schemes and providing facilities and systems aimed at mitigating disasters in Japan. Following the Great East Japan Earthquake that struck in March 2011, it is anticipated that further nationwide measures for mitigating disasters will be undertaken in parallel with ongoing recovery and reconstruction in the affected regions. In particular, there is an urgent need to adopt measures for dealing with large, wide-area disasters that have a high probability of occurring in the next 30 years, such as the predicted Tokai Earthquake, Tonankai/Nankai Earthquake, a four-way simultaneous earthquake in which new Kyushu seismic region is added to these three seismic regions, or an earthquake occurring directly under Tokyo. In response, subjects under discussion include organizational structures and the formulation of a Basic Disaster Management Plan[(1)] aimed at strengthening the nation's capacity for dealing with disasters, with the government's Central Disaster Prevention Council taking a central role.

In addition to these preparatory measures, in order to reduce the amount of damage and speed up subsequent recovery and reconstruction, particularly in the event of a large and severe disaster covering a wide area that exceeds the capacity of local authorities to respond, it is vital that an effective response be mounted that includes coordination with national and regional agencies as well as the general public amid a constantly changing situation.

This article describes two aspects of Hitachi's work in disaster prevention, a field that represents part of national security, including a disaster response support system currently being supplied and a disaster prevention management solution that is being expanded with the aim of supporting the response to multiple large disasters occurring over a wide area.

DISASTER RESPONSE SUPPORT SYSTEM

An essential requirement for ensuring a rapid reaction and an effective response when a disaster occurs is to make information about the situation available and to share it with relevant agencies. Hitachi has developed a disaster response support system to achieve this and has supplied it to central government ministries and agencies as well as local authorities.

The disaster response support system is based around geographic information system (GIS) technology that manages and utilizes data generated during a disaster in the form of geospatial information. It also includes remote sensing technology for data gathering, and search and distribution technologies

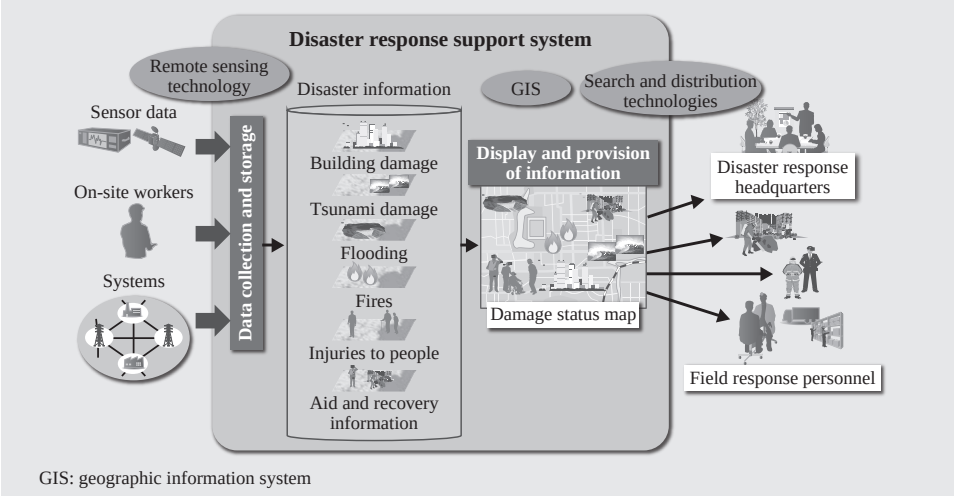


Fig. 1—Disaster Response Support System.
The system collects and collates sensor data and other information about damage acquired from disaster site, and presents it on a map. This provides a visual representation of the situation.

for communications. The system collects and collates information about the disaster and presents it on a map to provide a visual representation of the situation. This includes information acquired from the disaster site or from associated agencies, and also meteorological observations, satellite images, aerial images, and other sensor data (see Fig. 1). Providing the information shown on the map to associated agencies helps these agencies share a common operational picture (COP). Uses include identifying locations where major damage has occurred in order to provide prompt assistance, and enabling different agencies to mount a coordinated response in which each is aware of the others' activities.

Hitachi is investigating ways of enhancing this system to cope with multiple large disasters that occur over a wide area, and that exceed the scope of response able to be mounted by the affected areas.

The next section describes a disaster prevention management solution devised by Hitachi.

DISASTER PREVENTION MANAGEMENT SOLUTION

Philosophy

To cope with situations where large numbers of different incidents occur all at once, such as multiple large disasters occurring over a wide area, the affected local authorities and associated agencies need support to be able to make decisions quickly and accurately.

Also, multiple large disasters occurring over a wide area may exceed, by a considerable margin, the scope of response able to be mounted by the affected area. In this case, with central government, prefectural government, and local governments from neighboring districts each making decisions within their respective jurisdictions and levels of response, there is a need to share the information acquired, to work together to support cities, towns, and villages, and to maintain an environment in which cities, towns, villages, and the local disaster response can operate quickly and effectively.

Also, maintaining an environment in which cities, towns, villages, and the local disaster response can operate quickly and effectively during an emergency requires that training and education be conducted beforehand, including for the general public. In particular, in the case of activities that only occur during an emergency, such as the deployment of aid supplies, it is important that training be conducted during normal times so that adequate consideration can be given to the potential for dysfunction during an emergency due to factors such as that activities include some in which the participants have little experience, that advance plans include uncertainties such as human assistance and distribution resources operated by private-sector companies under specific agreements, and that demand may exceed expectations due to changes in the damage status. The Cabinet Office, local authorities, and other agencies also undertake ongoing steps to promulgate various knowledge about disaster prevention[(2)]. It is believed that the benefits of performing this education and training in advance include reducing uncertainty and facilitating prompt and accurate actions during a disaster.

The Basic Disaster Management Plan of the Central Disaster Prevention Council states that reducing damage (disaster mitigation) requires that everyone, including central government, public agencies, local authorities, service providers, and the general public, work together to adopt the best possible measures. Hitachi believes that the best approach to national security is for decision making during emergencies,

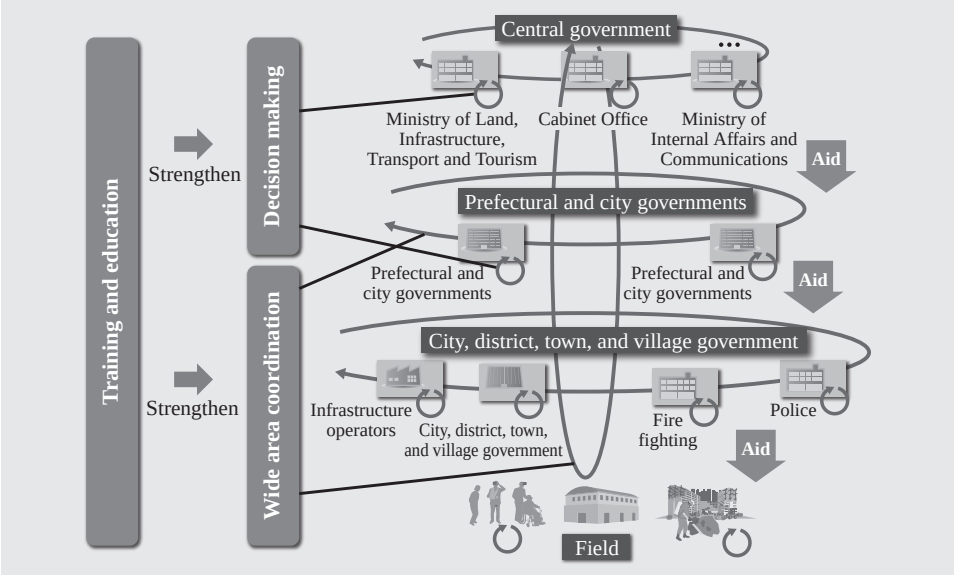


Fig. 2—Best Approach to National Security.
Each organization makes decisions quickly and accurately, with horizontal and vertical sharing and coordination of information. Also, training and education are conducted beforehand to ensure that these organizations function effectively during an emergency.

wide area coordination, and advance training drills to be conducted throughout Japan (see Fig. 2).

Solution Overview

Based on the above philosophy, the disaster prevention management solution supplies solutions that satisfy the following requirements for dealing with multiple large disasters occurring over a wide area.
(1) Decision support solution for faster and more accurate decision making
(2) Wide-area coordination support solution for coordinating activities and sharing information across different organizations
(3) Training and education support solution to improve disaster response capabilities

The disaster prevention management solution uses the observe, orient, decide, and act (OODA) loop decision methodology to facilitate fast and accurate decision making.

Based on insights from aerial combat, the OODA loop concept formalizes the situation response process, including decision making by the commanding officer. It achieves fast and accurate decision making by performing a repeated cycle of observation, orientation, decision, and action. The method is characterized by observation and situation assessment. The OODA loop method observes actual circumstances to obtain an overview of the situation before putting a plan into action. It also involves making predictions based on observations when obtaining an overview. While the method was developed for the battlefield where the aim is to maintain the upper hand without taking casualties amid circumstances that are changing rapidly, a situation that is constantly changing is a feature that both battlefields and large disasters have in common. The basis of OODA is about striving to maintain an understanding of the situation and to identify how far ahead it is possible to see, and these elements also form part of disaster response. How quickly the OODA loop can be worked through when responding to a disaster is the key to a successful disaster response (see Fig. 3).

Based on the OODA loop concept, the disaster prevention management solution overlays the rapid incoming flow of disaster information onto a map to manage it in temporal-spatial terms. This provides a service that produces intelligence for use in decision making and helps achieve a nationwide coordinated approach to Japan's national security that transcends the barriers between different organizations and people. Fig. 4 shows overview of the service.

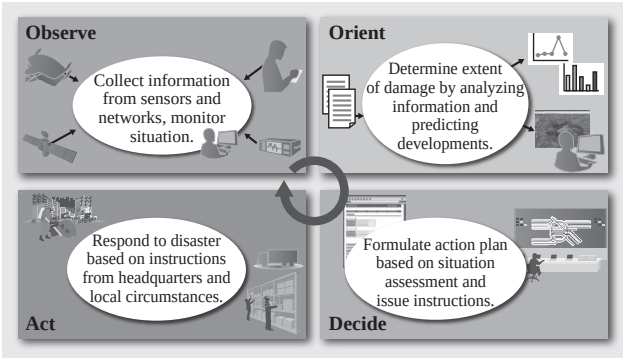


Fig. 3—Use of OODA Loop in Disaster Response.
Disaster response is conducted through an "observe, orient, decide, and act" cycle.

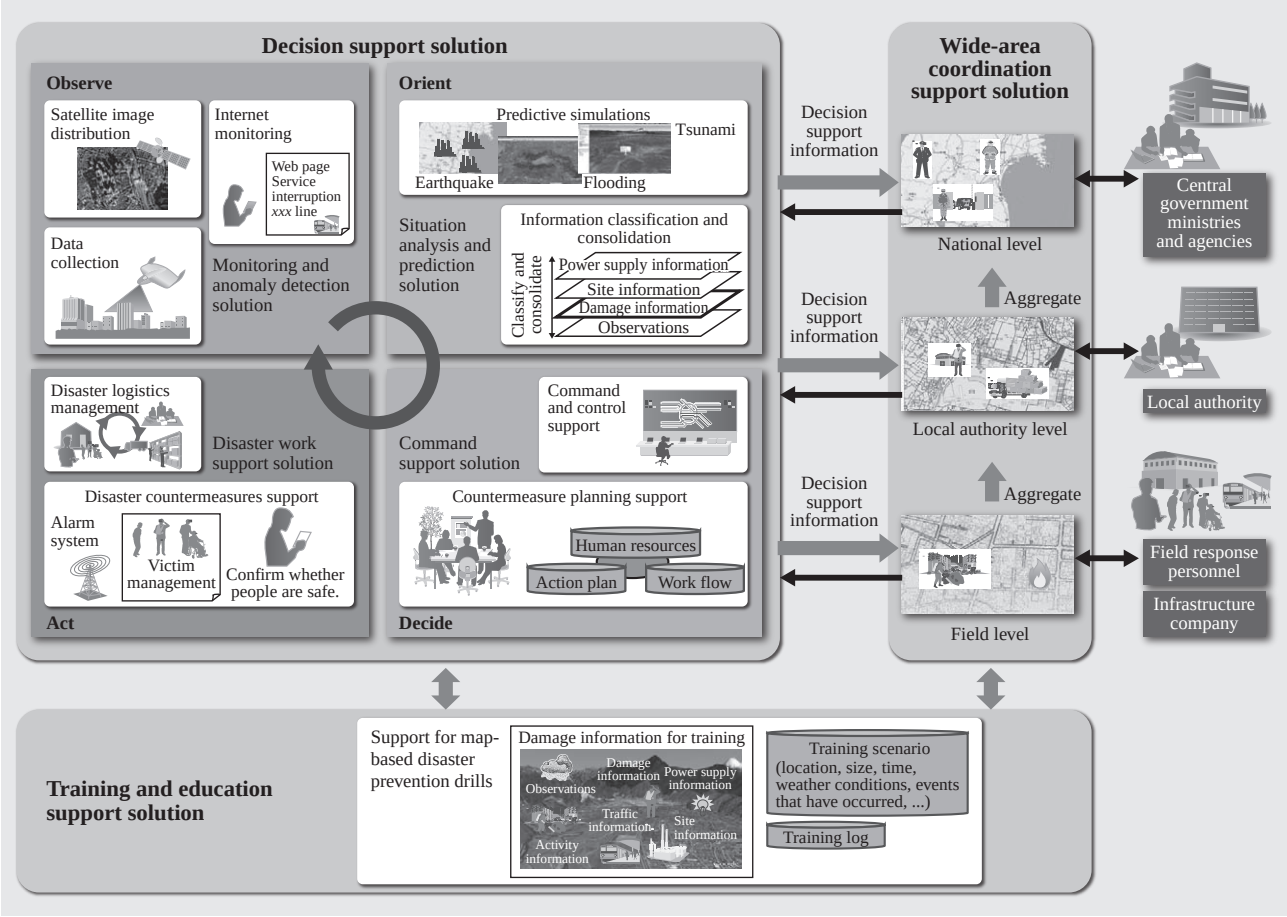


Fig. 4—Disaster Prevention Management Solution.
The disaster prevention management solution supports the best approach to disaster response through a decision support solution for faster and more accurate decision making based on the OODA concept, a wide-area coordination support solution that uses a GIS to share information that has been processed in accordance with OODA and present it with appropriate granularity, and a training and education support solution that supports risk awareness and response training.

Decision Support Solution

As noted above, the key to successful disaster response is to work through the OODA loop decision making cycle quickly and accurately. Hitachi supplies the following solutions that support this cycle.

Monitoring and anomaly detection solution

This solution collects information from sources such as sensors [seismometers, river level gauges, surveillance cameras, unmanned aerial vehicles (UAVs), satellites, and so on] and Internet social networking services (SNSs) to enable functions such as status monitoring in which this collected data is integrated with geospatial information, and anomaly detection is performed using techniques such as difference extraction (see Fig. 5).

Situation analysis and prediction solution

This solution provides functions for collating and classifying the information collected by the monitoring and anomaly detection solution and other systems to enhance its value as intelligence for use in situation analysis and prediction (see Fig. 6). It uses information classification techniques to classify

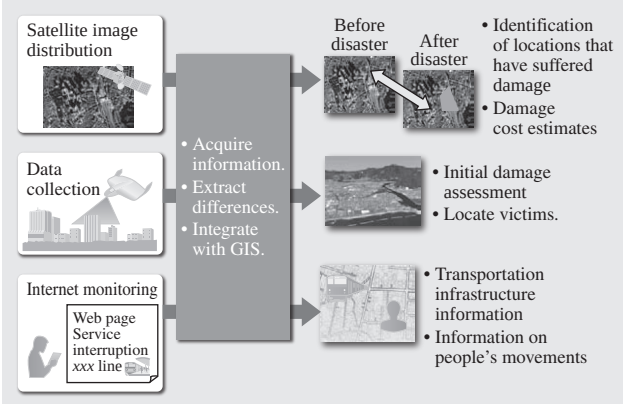
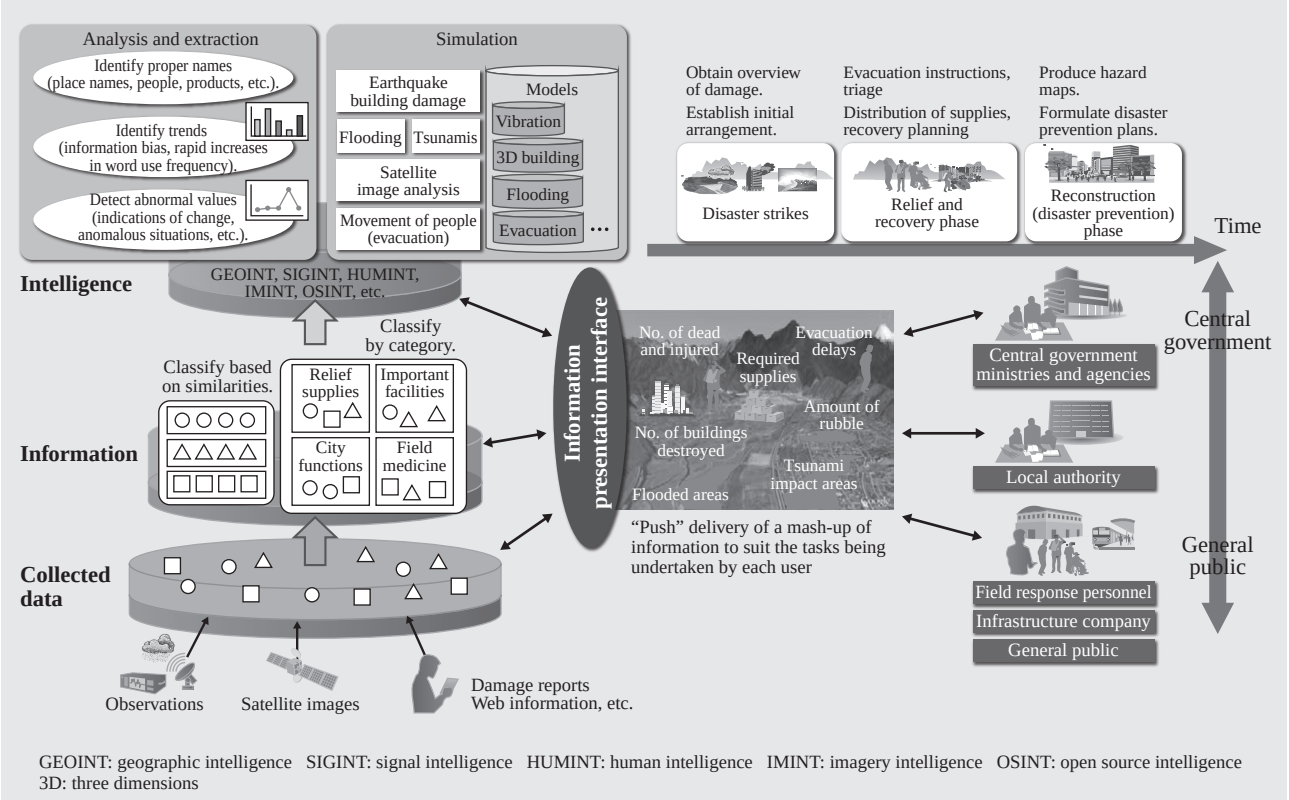


Fig. 5—Monitoring and Anomaly Detection Solution.
The solution collects information from sensors, the Internet, and other sources and detects any anomalies.



GEOINT: geographic intelligence SIGINT: signal intelligence HUMINT: human intelligence IMINT: imagery intelligence OSINT: open source intelligence
3D: three dimensions

Fig. 6—Situation Analysis and Prediction Solution.
The solution collects sensor data, damage reports, and other information, adds value by transforming it into intelligence, and presents each user with a mash-up of information suitable for the tasks they are undertaking.

and collate information based on similarities and categories, making it easier to obtain the desired information. This includes processing information in various ways such as collating damage statistics by region or sorting information by purpose (relief aid, healthcare, and so on), for example. It also generates intelligence that helps determine further action by, for example, using data mining technology to perform analyses and extract proper names, place names, and other identifiers to convert text data into geospatial information for display on a map, or detecting trends in word use on the Internet to identify what issues are concerning the general public. The solution also uses simulation techniques for earthquake building damage, flooding, tsunamis, or the movement of people to conduct risk simulations and provide information to help determine the current situation and assess changing circumstances and possible future developments.

The solution classifies and collates information from sensors, such as river level gauges, to calculate the rise in river levels, and incorporates information about upcoming weather conditions to perform flooding simulations. This can be used to generate intelligence such as warning that a particular district is at risk of a levee breach in an hour's time, for example. Intelligence like this facilitates fast and accurate decision making on evacuation alerts.

Utilizing this calculated intelligence in the actual disaster response requires screen information design that allows users to obtain knowledge in ways that take account of their responsibilities as well as where and in what circumstances they need this knowledge. This solution uses the concept of universal design and is based on screen designs that enhance situational awareness and prevent users from overlooking or misunderstanding information, regardless of their ability to utilize it. Meanwhile, the interface can be customized to display different information to suit each user, providing a mash-up that prioritizes information based on the nature of the user's activities, from the initial time of the disaster through to the reconstruction phase.

Command support solution

This solution supports effective and efficient command and control for relief and recovery. For example, it provides the disaster response headquarters with a map of the disaster situation that they can refer

to as they assign people, organizations, and other resources in accordance with the evolving situation on the ground.

This solution builds a database from which the data required for the tasks associated with the event and their execution can be accessed quickly based on an event model of the time when the disaster strikes, a disaster response model (work flow), a data model that specifies the relationships between data, and a disaster management model that links these other models together. This allows the "push" delivery of information based on users' circumstances and responsibilities (see Fig. 7). For the people assigned the task of distributing relief supplies, for example, the solution supplies the information needed to compete this task, namely the information associated with the distribution of relief supplies (road damage status, where to distribute supplies, recommended routes, and so on).

Disaster work support solution

This solution provides functions for managing the activities of local authorities (confirming the safety of staff, evacuation site management, issuing victim certificates, and so on) as well as requests for relief supplies, stock control, dispatch instructions, and other aspects of logistics.

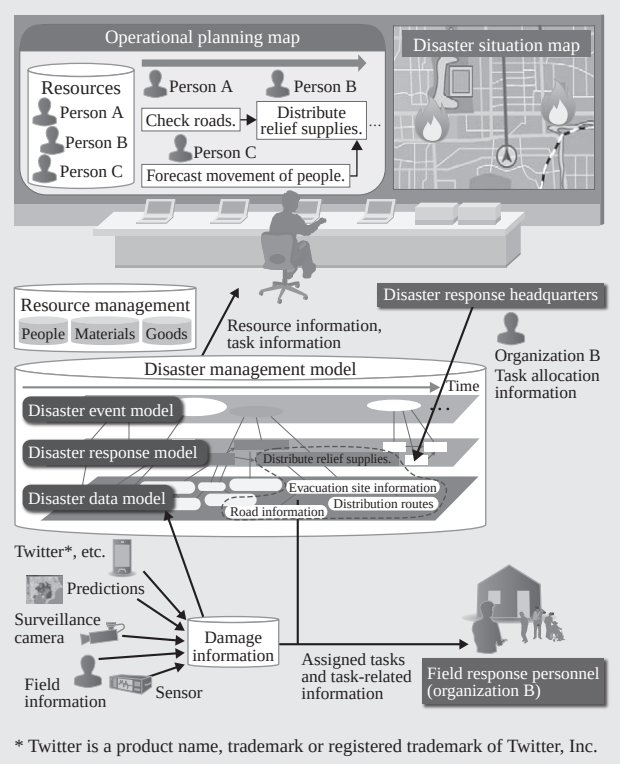


Fig. 7—Command Support Solution.
This solution is used to prepare an activity plan and support the assignment of personnel, organizations, and other resources. When a task is assigned to a person or organization, the information required to complete that task is extracted from the database and supplied to the person or organization using "push" style delivery.

Wide-area Coordination Support Solution

This solution uses a GIS to supply information that has been processed in accordance with OODA at an appropriate level of granularity. By sharing common information, the solution provides a consistent understanding of the situation while also presenting information in ways that suit the different response levels of each organization, thereby enabling coordination over a wide area. Information can also be provided in a range of forms to facilitate its distribution and reuse, including the international standard emergency data exchange language distribution element (EDXL-DE) format and public information commons[(3)] format (see Fig. 8).

Training and Education Support Solution

When it comes to saving people's lives, assisting people and having them help themselves to evacuate (survive) are both important. To assist people to evacuate, it is essential that disaster training be carried out beforehand so that the decision making and wide-area coordination described above can function immediately when a disaster strikes, particularly in the area of administration. For people to evacuate themselves, it is necessary to identify all the potential hazards and features of the place where they live, and to give them an idea of how a disaster will unfold.

This solution supports disaster response training for official personnel, residents and other participants by using a simulation to create a virtual disaster, displaying the situation on a map, and assigning missions from a training scenario (map-based disaster prevention drill). The solution also helps improve awareness of disaster prevention by providing individual residents with a hazard map based on their own residential circumstances and living arrangements (commuting, travel, and so on) (see Fig. 9).

Disaster Prevention Cloud Service

Taking note of what happened during the Great East Japan Earthquake, there is a growing need for remote support and the provision of information via networks by the central government, participating local authorities, volunteers, and others, and for the rapid restoration and maintenance of administrative services in situations in which government offices

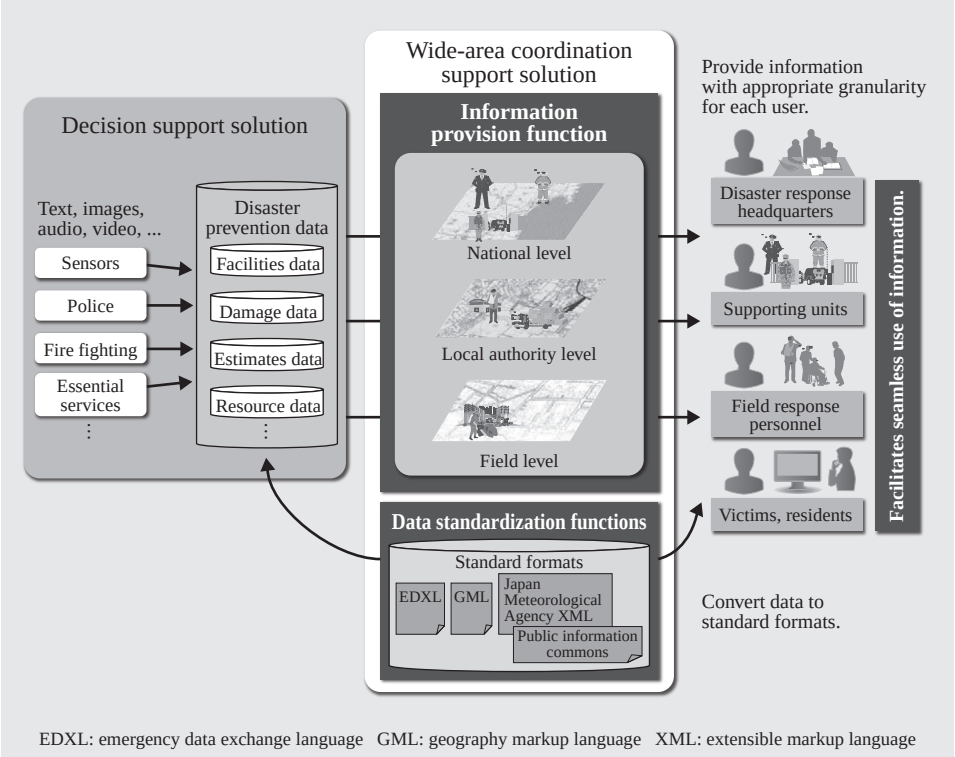


Fig. 8—Wide-area Coordination Support Solution.
This solution facilitates seamless use of information across different organizations.

have been damaged. By providing systems such as the disaster response support system and disaster prevention management solution via Hitachi's cloud (including Hitachi cloud computing solutions), which is referred to below as the disaster prevention modeling and simulation (M&S) cloud, Hitachi aims to satisfy these needs by supplying a wide range of disaster prevention services in accordance with users' actual circumstances (environment, cost, and robustness requirements). The forms in which these services can be provided include software-as-a-service (SaaS), in which a disaster prevention management solution is implemented at a robust Hitachi data center and supplied to the customer as a service; as a private solution, in which a customer-specific disaster prevention M&S cloud is implemented at a Hitachi data center; and as an on-premises solution, in which a disaster prevention M&S cloud is implemented on the customer's own systems. In addition to providing a disaster prevention management solution via a disaster prevention M&S cloud, the data standardization functions described above also support the sharing and utilization of information across different customers and support organizations. Hitachi also supplies autonomous and decentralized cloud services that perform data backups and similar functions for Hitachi data centers, customers who have installed a disaster prevention M&S cloud on their own systems, or across multiple customer sites, so that services can be restored quickly using an alternative healthy site if these are put out of action during an emergency (see Fig. 10).

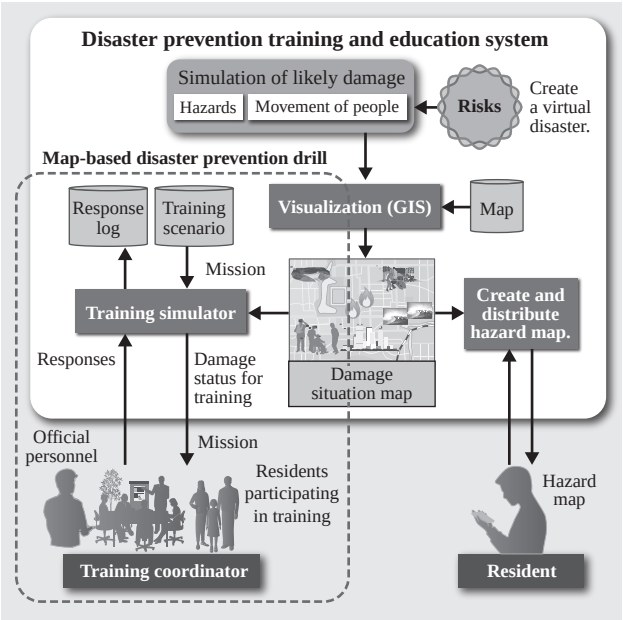


Fig. 9—Training and Education Support Solution.
This solution supports the conducting of map-based disaster prevention drills by residents and official personnel. It also provides individual residents with a hazard map based on their own residential circumstances, living arrangements, and other factors.

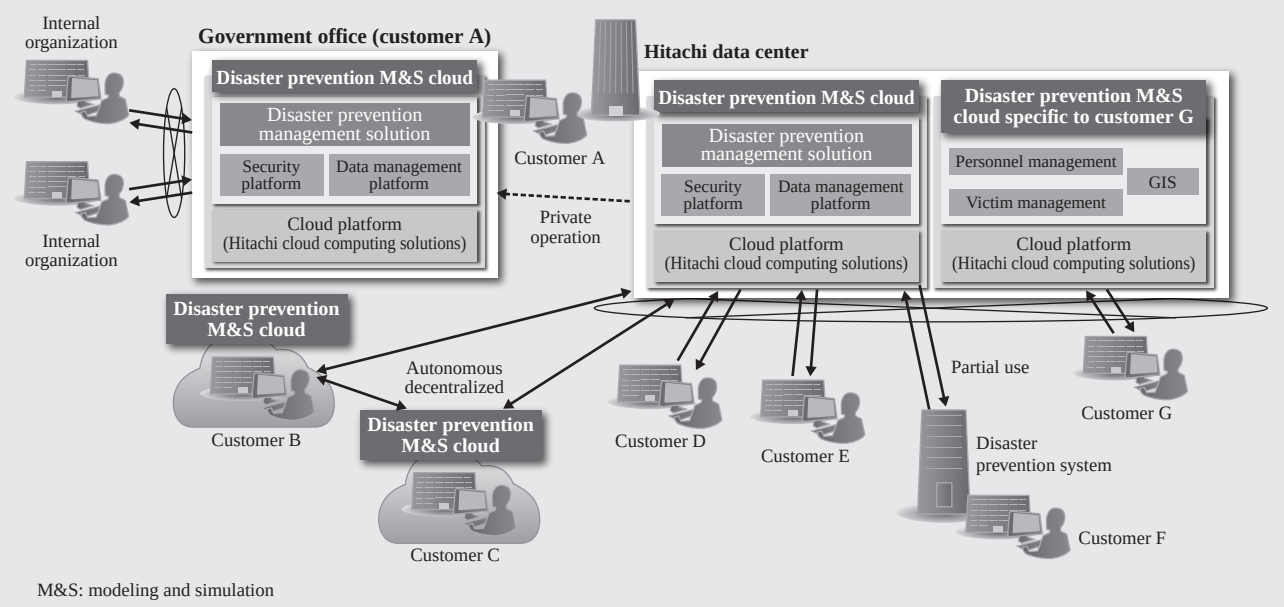


Fig. 10—Disaster Prevention M&S Cloud.
Hitachi provides a wide range of disaster prevention management solutions to suit users' actual circumstances (environment, cost, and robustness requirements).

CONCLUSIONS

This article has described two aspects of Hitachi's work in disaster prevention, a field that represents part of national security, including a disaster response support system currently being supplied and a disaster prevention management solution that is being expanded with the aim of supporting the response to multiple large disasters occurring over a wide area.

In the future, Hitachi aims to contribute to the achievement of national security, in which central government, local authorities, private-sector companies, and the general public work together, by helping to achieve safety and security from the perspective of disaster prevention in the planning, construction, and operation of smart cities and other types of next-generation cities (a field that Hitachi is pursuing globally), while also keeping in mind the prospects for initiatives such as international cooperation on disaster prevention to reduce the impact of disasters around the world, and international collaborations such as international relief aid when disasters strike.

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