Enhancement of Societal Resiliency against Natural Disasters

A Brighter Future for a Nation Prone to Natural Disasters, Leveraging Industry-Academia-Government Cooperation to Create a Disaster Information System

Huge earthquakes such as the Great East Japan Earthquake, volcanic eruptions, super typhoons, sudden downpours and other disasters and extreme weather events have been a hallmark of Japanese life in recent years. Scientists and citizens are apprehensive about predictions of a colossal Nankai Trough Earthquake at some time in the mid-2000s. And all the while, voices call urgently for the construction of social infrastructure that can withstand such large-scale natural disasters. Our nation needs stronger, more resilient disaster prevention and mitigation functions that provide actionable real-time disaster information. This program is a vital component for ensuring the safety and confidence of both today's and future generations.

Program Director

Muneo Hori

The University of Tokyo
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Research Center for Large-scale Earthquake, Tsunami and Disaster (LsETD)
Professor/ Head of Center

Profile

Professor Hori graduated with a degree in civil engineering from the University of Tokyo in 1984. In 1987, he was awarded a Ph.D. in Applied Mechanics and Engineering Sciences from the University of California, San Diego. His earlier career included serving as a senior assistant professor in the School of Engineering at Tohoku University and as an assistant professor in the Faculty of Engineering at the University of Tokyo. He became a professor at the University of Tokyo's Earthquake Research Institute in 2001, and the head of the LsETD in 2012, two positions he holds presently. Since 2012, he has also served as the unit leader of the Computational Disaster Mitigation and Reduction Research Unit at RIKEN Advanced Institute for Computational Science. His areas of expertise are applied mechanics, earthquake engineering and computational engineering, and his main research topics include the application of high performance computing to earthquake engineering.

Research and Development Topics

1. Prediction: Use the latest observation and prediction analysis technologies to predict the scope and nature of disasters

Develop advanced observation and prediction technologies to quickly determine the scope and nature of disasters. Provide a public-private platform for sharing disaster-related data.

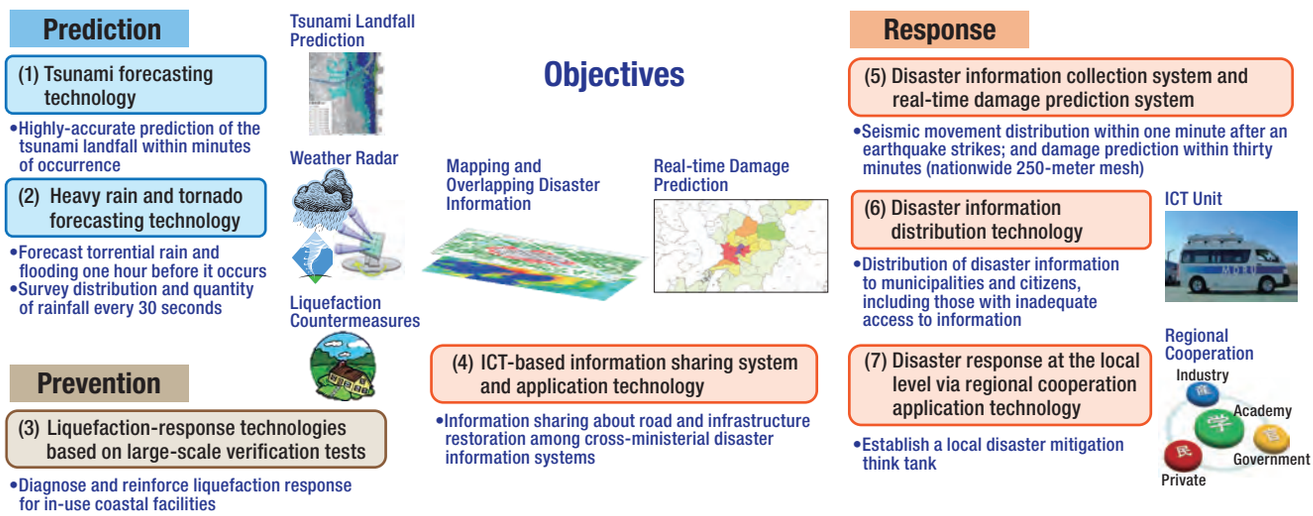
2. Prevention: Improve seismic resistance technologies based on large-scale verification tests

Develop technologies to deal with wide-scale liquefaction; conduct large-scale verification tests and analyses for verification; secure technology and share information to help improve and harden urban infrastructure to resist disasters.

3. Response: Improve response capabilities by sharing and applying information related to disasters

Collect information related to disasters and disaster prevention/mitigation; develop technologies for a public-private information sharing system for real-time information allowing informed decision-making by national institutions for disaster response, local governments, businesses, organizations and individuals during times of crisis.

•Conceptual diagram of research and development on the enhancement of societal resiliency against natural disasters



Exit Strategies

Contribute to disaster prevention measures

Provide technologies for seamless communications of disaster information collected through public and private sources; this disaster prevention system will allow for officials determining disaster responses to have access to useful information.

Provide continuity

Create a system of consistent disaster prevention training and education to train citizens in immediate safety response during disasters. Share useful disaster information throughout rural communities; foster and utilize regional disaster research centers throughout Japan to ensure continued disaster prevention response improvement at the local level.

Ensure Japanese industrial competitiveness

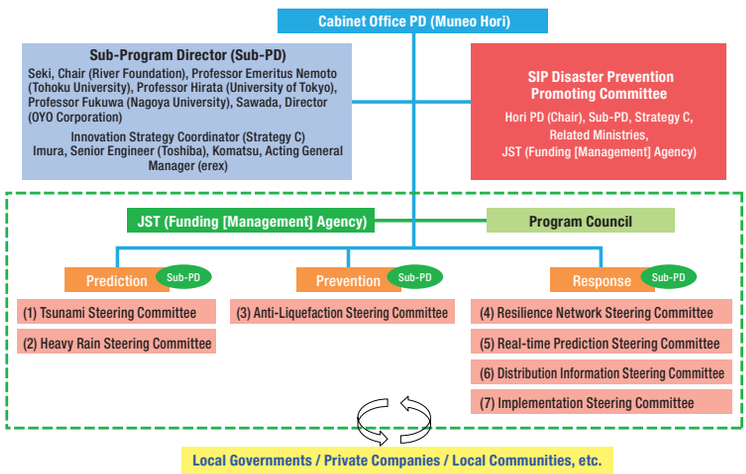
Provide a system for real-time information sharing using the latest scientific technologies to facilitate industrial and community continuity in the aftermath of large-scale natural disasters.

Create industries based on disaster prevention/mitigation

Transfer technology to the private sector (businesses) and local governments related to real-time disaster information and immediate disaster response; transfer technologies to Asia and other nations.

Implementation Structure

The SIP Disaster Prevention Promoting Committee has been established under the Cabinet Office, consisting of a Program Director (PD), Sub-PD, related ministries and the Japan Science and Technology Agency (JST). Below this, along with a Program Council, steering committees have been set up for each research area on prediction, prevention and response. Through this structure, we run research and development projects aimed at creating mechanisms for the "cross-ministerial communication and sharing of information" and "practical and direct application of the latest scientific technology on predicting and surveying to assist in disaster response."

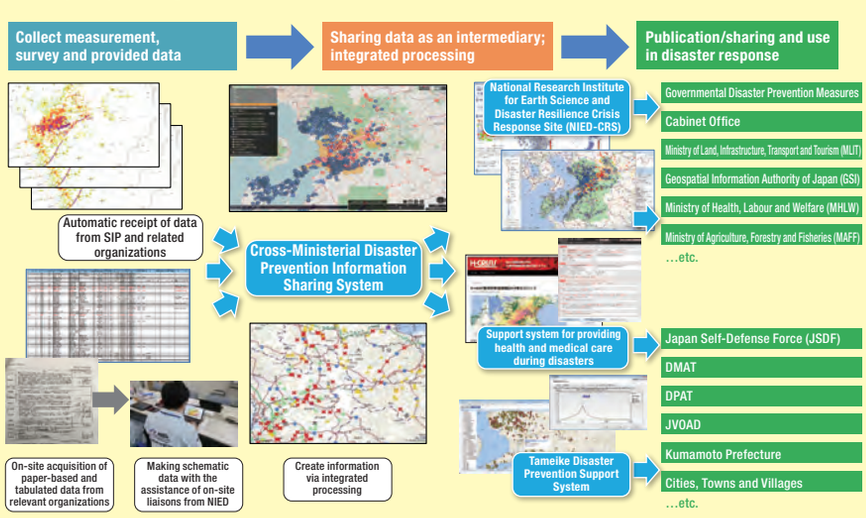


Progress to Date

Advancements in building a resilient disaster information system

We are making progress in building a resilient disaster information system to ensure effective disaster prevention and mitigation. We will accomplish this by fostering cooperation among disaster prevention organizations to collect and consolidate their disaster information and provide it to users in the most optimal way. During the September 2015 floods that occurred in Joso City, Ibaraki Prefecture, we integrated information held by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Geospatial Information Authority of Japan (GSI) into a prototype for this system. We have already achieved notable results. This includes being able to provide information on passable roads not affected by floods which could be used to send medical teams to disaster-affected areas.

•Concept of providing disaster information



Program Director **Muneo Hori** Interview

Shifting gears from research and development to social implementation: Strengthening society's resiliency against natural disasters, with a focus on SIP4D

Reducing the damage caused by frequent natural disasters has long been a wish of Japan. The plan for enhancing the nation as a whole against natural disasters is to build a system using SIP4D for sharing information among government ministries and agencies, and then in the future, to also pull together the capacity of local governments and the private sector.

Leveraging Research Results for the Next Phase

Three years into the program, newly appointed PD, Muneo Hori, discusses the current situation and future outlook.

"The objectives of SIP research projects are research development and social implementation. After three years, we have achieved the research development that was originally planned. Going forward, it is my role to promote social implementation in cooperation with government ministries and agencies. In the remaining two years, we will work with researchers and people in the field of disaster prevention in considering how to utilize the research results and putting them into practice. We only get one shot at preparing for a disaster. I see our next phase as making the technologies easy to use in real-world situations."

Specifically, what does the next phase involve?

"It involves taking the outcomes of research and development that were demonstrated in the earthquake in Kumamoto and in the torrential rains in Joso City and Kyushu, and applying them to possible future catastrophic disasters such as the Metropolitan Earthquake or Nankai Trough Earthquake. We believe that full preparation is crucial."

On further questioning about this full preparation, Hori smiles: "Above all else is 'people.' It's about getting the people who actually use the developed technologies to understand and use them correctly. That's the issue."

Use Science and Technology for Mitigating Damage

Let us take a closer look at each the research and development topics under this Program.

First up, what are the topics for prediction?

"Two topics under prediction are 'tsunami' and 'storm and flood damage.' Tsunami are observed using the world's most advanced network of undersea cables, and the observation data is used in tsunami evacuations and so forth. If we could extend this to predicting the extent of flooding in a town given certain types of tsunami, we could go one step further with evacuations. As for storm and flood damage, we anticipate being able to make quick, quantitative predictions of sudden, localized downpours by means of the multi-parameter phased array weather radar (MP-PAWR). Our aim is for this to be operational by the Tokyo Olympic and Paralympic Games in 2020."

With respect to prevention, concrete steps are being taken in testing and verification.

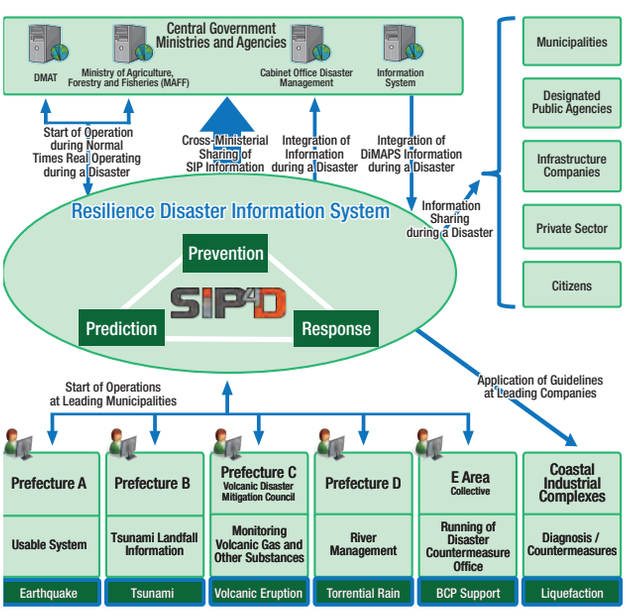
"The goal of prevention is measures against liquefaction in regional clusters of industry along the coast. Be that as it may, though, we do not just implement liquefaction countermeasures for everything. We follow a process of an initial investigation, and then if there is a need, we examine countermeasures. It is important to include a consideration of cost when taking appropriate action. The effects of investigation and countermeasures have been confirmed in tests using the world's largest seismic simulator, E-Defense, located in Miki City, Hyogo Prefecture."

Striving to Construct a System for Disaster Information Sharing through Public-Private Cooperation

The next requirement after prediction and prevention is response. And the first step in responding is information sharing.

"SIP4D, which collects, processes and shares disaster information held by individual government ministries and agencies, was developed cooperatively by disaster-prevention

•Conceptual diagram of Resilient Disaster Information System centered on SIP4D



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researchers and ICT engineers. It achieved great success at the time of the Kumamoto Earthquake in April 2016, pulling together information on damage prediction for building collapses plus a variety of disaster-related information issued by multiple organizations, and providing that information to organizations and local governments mounting their own disaster responses."

Communications were also interrupted during the Kumamoto Earthquake. What actions were taken in this instance?

"We deployed a communications system (ICT Unit) to the site, complete with an attaché case packed with necessary functions to provide a communications environment to the local town hall and surrounding area. The system is designed to be resilient during disasters and it allowed local government personnel and residents to make phone calls using their own mobile phones and smartphones. Verification tests were also performed in the Philippines which suffered extensive typhoon damage, and it is expected to be rolled out further around the world, especially to developing countries."

Are preparations during normal times important to ensure technologies can be used in a real disaster?

"Led by Nagoya University, we are also promoting an initiative gathering local governments and private businesses together for discussion, developing applications and getting participants to actually use them to see whether the various technologies can be used for BCP for instance."

Realization of a Super Smart Society "Society 5.0"

Hori explains that this initiative has extra significance.

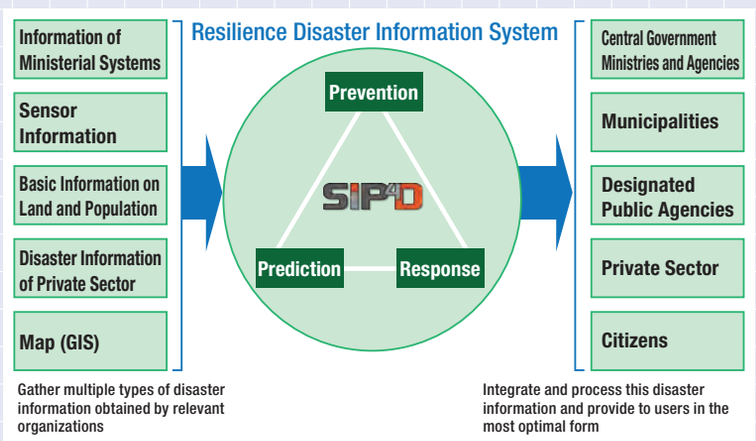
"We are planning to export SIP disaster prevention/mitigation technologies to the world. The truth is that, because Japan is prone to disasters, disaster prevention technologies researched and developed here attract a high degree of credibility. It is highly likely, therefore, that a system that packages together disaster prevention/mitigation technologies for prediction, prevention and response could be rolled out to various countries around the world. International standardization should also be a significant attraction."

Hori concluded by discussing creation of Society 5.0.

"To this point, we have promoted information sharing among government ministries and agencies. Going forward, we will need to build information systems based on SIP4D so that disaster information can be also shared among local governments, private businesses and communities. Such an initiative would support better disaster prevention/mitigation functions for society as a whole. I believe that this would also help in realization of a super smart society 'Society 5.0' where everyone can lead safe, secure and comfortable lives."

Future Plans

From research and development to social implementation. In addition to promoting the practical application of developed technologies in disaster-prevention training and verification tests, we will promote social implementation enabling nationally integrated disaster prevention activities to be carried out, by taking the links with government systems centered around SIP4D and expanding them further to include local governments, private businesses and communities.



Verifying disaster prevention/mitigation technologies before a disaster occurs is impossible. During the next phase, our aim is to make the technologies truly useful in an actual disaster when it really counts. We will also create a platform for disaster prevention/mitigation technologies where they can be shared widely across the whole of society.