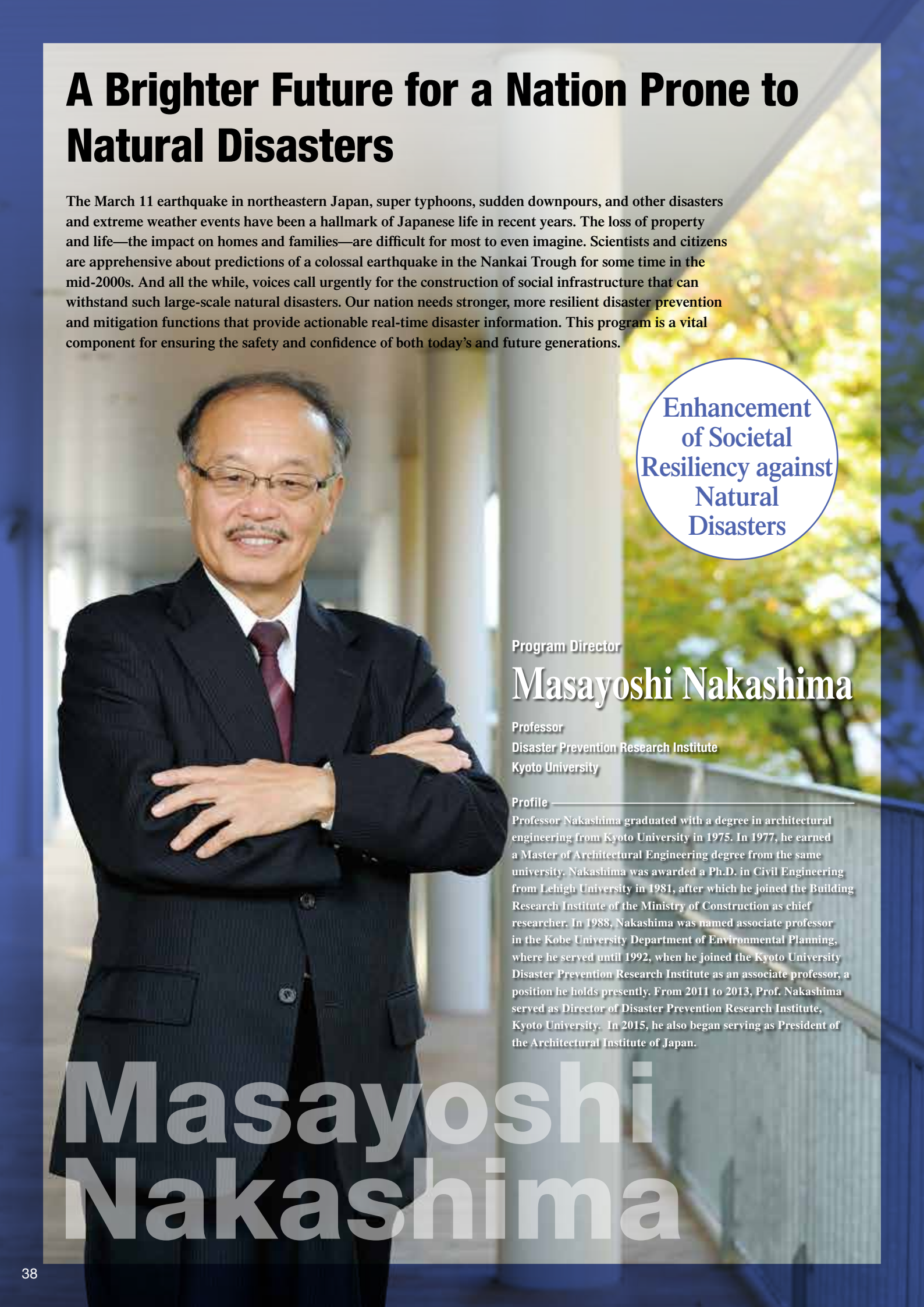
A Brighter Future for a Nation Prone to Natural Disasters

The March 11 earthquake in northeastern Japan, super typhoons, sudden downpours, and other disasters and extreme weather events have been a hallmark of Japanese life in recent years. The loss of property and life—the impact on homes and families—are difficult for most to even imagine. Scientists and citizens are apprehensive about predictions of a colossal earthquake in the Nankai Trough for 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.



Enhancement of Societal Resiliency against Natural Disasters

Program Director

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Profile

Professor Nakashima graduated with a degree in architectural engineering from Kyoto University in 1975. In 1977, he earned a Master of Architectural Engineering degree from the same university. Nakashima was awarded a Ph.D. in Civil Engineering from Lehigh University in 1981, after which he joined the Building Research Institute of the Ministry of Construction as chief researcher. In 1988, Nakashima was named associate professor in the Kobe University Department of Environmental Planning, where he served until 1992, when he joined the Kyoto University Disaster Prevention Research Institute as an associate professor, a position he holds presently. From 2011 to 2013, Prof. Nakashima served as Director of Disaster Prevention Research Institute, Kyoto University. In 2015, he also began serving as President of the Architectural Institute of Japan.

Masayoshi Nakashima

Japan: A Natural Disaster-Prone Nation at the Crossroads

Like the Hanshin-Awaji earthquake of 1995 or the March 11 northeastern Japan earthquake in 2011, many regions of Japan are still physically and spiritually recovering from the unimaginable impact of super earthquakes and tsunami. Scientists predict with confidence that there will be a colossal earthquake in the Nankai Trough or directly under metropolitan Tokyo sometime this century. According to Cabinet Office damage estimates, an M9-class earthquake in the Nankai Trough would result in the deaths of 323,000 people, the loss of 2.4 million homes, and economic damages running as high as ¥220 trillion.

Landslide damage in Japan after super typhoons, sudden downpours, and other extreme weather events has become ever more serious. If the Tone River ever floods, damage estimates for metropolitan Tokyo project more than 26,000 victims, with 2.3 million flooded out of their homes and more than 1.1 million people isolated in the aftermath. Meanwhile, a look at our nation's population trends shows rapid consolidation in large cities, leading to more apprehension of structural vulnerabilities and the likelihood that natural disasters will result in even greater damage than would otherwise be the case.

This is not to mention Japan's aging population demographics, giving rise to concerns that our nation is losing the labor resources needed to recover after a large-scale disaster. Says Masayoshi Nakashima, program director of this project, "Numerous earthquakes, typhoons, volcanic eruptions, tsunamis…Japan has been called a department store for natural disasters. Our ancestors faced these same disasters for thousands of years, learning to live in conciliation—if not cooperation—with the forces of nature. It's our turn today to create a disaster prevention and mitigation infrastructure that ensures the health and safety of future generations. We must build a resilient social structure."

Disaster Prevention beyond Current Research and Organizational Boundaries

"When I was a boy, I wanted to become a carpenter," continues Nakashima, who eventually found himself on the path to professional architecture at the Kyoto University Architectural Engineering department. "Unfortunately, I realized that I didn't have much talent as an architect. So, with graduation rapidly approaching, I turned my attention to building construction structural research. There, I specialized in seismic analysis and design. Looking back now, I think I might have had a premonition of where my career would take me."

After graduation, Nakashima studied in the United States, accepted a job at the Building Research Institute of the Ministry of Construction, performed research at Kobe University, and ultimately settled at the Kobe University Disaster Prevention Research Institute. Although his path seemed finally set—and with numerous research projects under his belt—Prof. Nakashima says that the 1995 Hanshin-Awaji earthquake made him take close look at his chosen mission in life.

"The Hanshin-Awaji earthquake happened when I was an assistant professor researching disaster prevention. I was shocked at the destruction of so much property and the loss of so much precious life," says Nakashima. "I realized that my research specialization could contribute to preventing or mitigating these types of large-scale disasters. I also came to believe that if our research didn't bear fruit, it would be Japan that stood to bear burden of our failure."

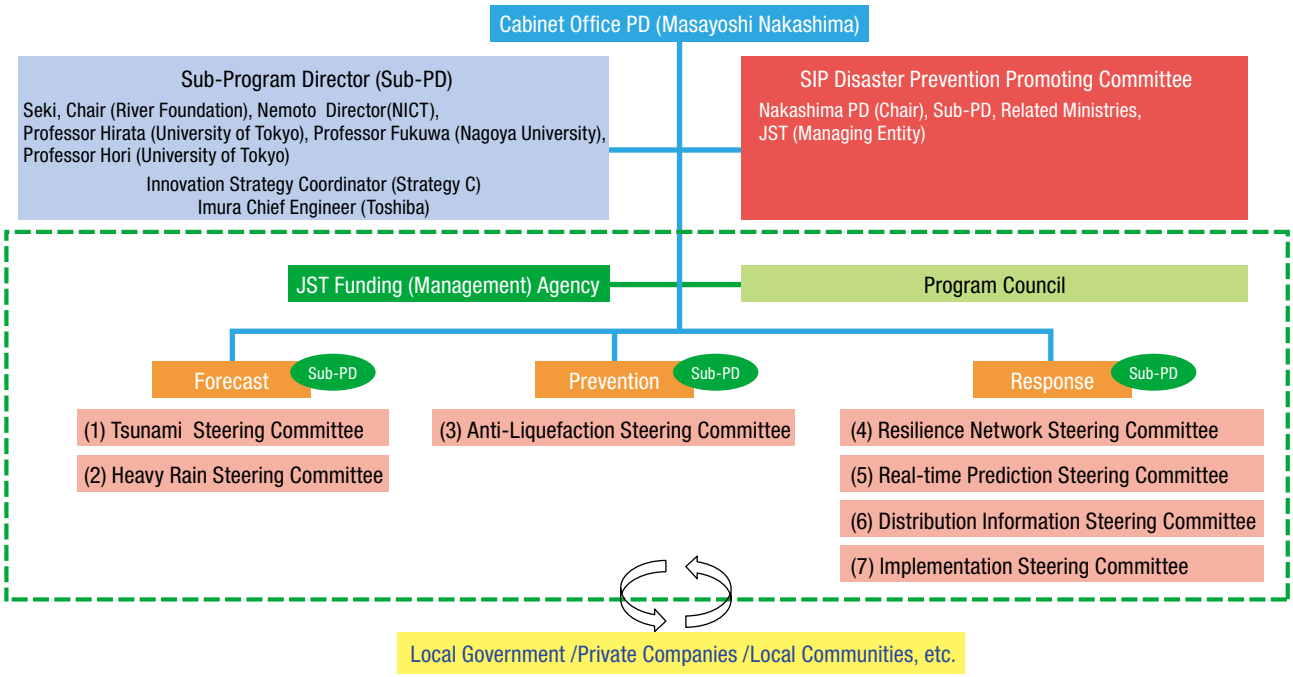
On the subject of disaster prevention and mitigation Nakashima says, "To accomplish our goals, we need to move beyond the boundaries of a limited few fields of research. We need to include basic sciences, engineering, and even the social sciences. We have to put together a team of experts from a wide variety of fields to take one disaster forecasting, prevention, and response." Nakashima further relates that this project must not engage in research for its own sake; the results of this necessarily cross-ministerial program must translate into business opportunities for Japanese industry as well.

Forecast, Prevention, and Response are the Three Key Pillars to Success

Given this background, this project has been tasked to make significant contributions in three main areas: (1) Develop forecasting warning technologies that indicate nature and scope of disasters; (2) create hardened cities and infrastructure that prevent disasters; (3) develop disaster response functions that minimize damages during and in the aftermath of an event. In other words,

•Structural Damage Detection Experiment
Ongoing experiments involving mechanisms using installed sensors to determine immediately whether a building has suffered damage after an earthquake. (Kyoto University Disaster Prevention Research Institute). Such systems are expected to contribute to post-earthquake disaster response and corporate business continuity planning.

Masayoshi Nakashima



•Implementation Structure

the mission of this program is to create a more societal resiliency against natural disasters for the Japanese people.

This program's assignment related to forecasting disasters involves developing technologies to predict tsunamis, torrential downpours, and cyclones. The results of this work will lead to a more accurate understanding of the nature and scope of damages occurring in the wake of an earthquake or other extreme event. The program intends to share the data collected by these new systems in a public-private arrangement to help achieving greater precision in disaster response, observation, and forecasting efforts.

Under the banner of (2) Prevention, this project plans to focus on developing technologies to deal with large-scale liquefaction, performing large-scale verification tests and analyses. Here, proposed construction methods and guidelines will incorporate liquefaction countermeasures, and the team will share information about seismic performance gained through our tests and experiments.

Finally, Nakashima addresses his views on the project's goals related to (3) Response. "Creating a resilient social infrastructure must include better mechanisms to recover from large-scale disasters and bring life back to normal as quickly as possible. This is exactly the benefit we hope to see from this cross-ministerial approach." More specifically, this program aims to develop technologies for real-time sharing of damage estimates and on-the-ground damage information, creating a comprehensive Cabinet Office disaster prevention system and seamless integration with other related systems for better communications between and among federal and local governments, businesses, and groups. This seamless communication platform should allow for better decision-making during times of disaster. This program will also develop technologies for instantly sharing information with individuals and groups, supporting the ability for these to make their own informed decisions during disasters. In this way, this project hopes to strengthen resilience in the face of major events on both the individual and social levels.

Stronger Disaster Prevention Countermeasures and Industrial Competitiveness

This disaster prevention and mitigation research and development program also includes aspects that may have an impact on Japan's industrial competitiveness. This takes the form of a socio-economic system resistant to interruptions caused by natural disasters or other major events. Further, we believe our work here will have applications in promoting business continuity planning for small- and mid-sized businesses that don't have the resources to hire in-house staff. Nakashima also believes that the results of this program could lead to packaged systems and technologies tailored for export or transfer for global disaster prevention and Japanese industrial growth.

Prof. Nakashima emphasizes that he hopes this program leads to a nation and citizens with greater disaster prevention awareness and education. "There are public, cooperative, and individual aspects to provide aid in time of disaster. Any more, we are faced with times in which individuals must be prepared to help themselves in times of disaster, rather than relying solely on government aid. I hope if anything, this program can communicate that message to our nation. Fostering a greater attitude toward self-reliance is perhaps the ultimate form of disaster prevention."

Research and Development Topics

1 Forecast: Use the latest forecast analysis technologies to predict the scope and nature of disasters

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

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; 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 local governments, businesses, organizations, and individuals during times of crisis.

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.

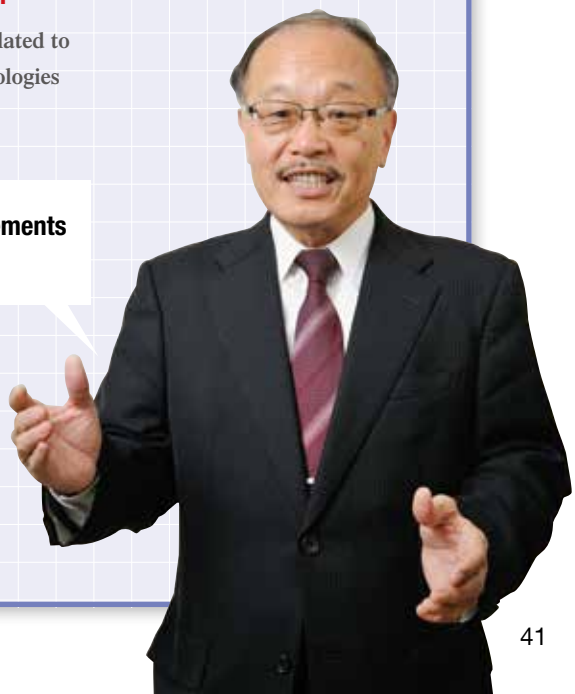
☑ Ensure Japanese industrial competitiveness

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 nationals throughout Asia.

This cross-ministerial program will lead to great improvements in Japan's ability to prevent and mitigate disasters.



Use and application of disaster-related information in real time