

# Promoting Diverse Tsunami Disaster Protection Countermeasures

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## 1. Introduction

In response to lessons taught by the Great East Japan Earthquake of March last year, earthquake and tsunami countermeasures are being widely studied and numerous plans are being reviewed. These reviews should focus on how to protect the lives and physical safety of the citizens of Japan, but in the future, more advanced and diverse disaster protection countermeasures will be needed.

## 2. Impact on industry

In the manufacturing industry, each company builds its own supply chain, because globally procuring components to manufacture superior products at low cost is a major key to survival. However, the Niigata Chuetsu Offshore Earthquake and similar events have proven that the entire production system of a company may be shut down if its supply chain is broken at any point. Firms avoid this risk by, for example, distributing their primary suppliers, but this earthquake and tsunami had a severe impact by halting the production of semiconductors, auto parts etc. and halting distribution due to disruption of logistics of ports, roads, etc. The disruption to economic activities by both the direct and indirect impacts of the earthquake and tsunami will depress the Japanese economy which has been struggling to recover, and will severely impact Japan as a whole, in addition to the burden of restoring the disaster region and reviving the livelihoods of victims. Images of the disaster have been broadcast worldwide, focusing attention on the risk of damage to Japanese industry, and the impact is likely to drag on. It will not be easy to recover lost assets, without which recovery may be impossible.

The total value of shipments of manufactured products from the Tohoku region accounts for less than 10% of the total for Japan, and many semiconductor and automobile parts factories are located inland where they escaped damage by the tsunami and were restored relatively quickly. The

Tokai, Tonankai, and Nankai earthquakes, which are certain to occur eventually, will strike the heart of Japan's industrial and manufacturing region, and as many of these production facilities are located along the coastline, the impact of these earthquakes will be immeasurable. The existing supply chains in Japan cannot adequately absorb and mitigate the risk, and yet moving production centers overseas or beginning to procure components from foreign companies to avoid such risk will destroy the foundation of manufacturing in Japan and weaken the nation. Promoting policies to reduce risk while keeping production functions inside Japan is the key to disaster protection countermeasures in the future.

## 3. Response along the shorelines in ports

The shorelines of ports, where industry is heavily concentrated, are exposed to two risks: earthquake risk and tsunami risk. One way of avoiding the risk of earthquakes and tsunami is to move to a region where earthquakes do not occur or to an inland location which is safe from tsunami. But an earthquake can strike anywhere in Japan, and inland locations face other risks such as landslides. Furthermore, Japan is surrounded by the sea and most physical goods are transported by ship. It is therefore not realistic to avoid the coast, which is convenient for marine transport, in view of maintaining international competitiveness and global supply chains. How can the risk of coastlines and associated risk of tsunami be avoided?

### [1] Structural countermeasures

Unlike people, manufacturing plants cannot be evacuated to another location. Present studies follow a policy of not building coastline plants on protected land to withstand a low-frequency tsunami with a recurrence period of more than 100 years. Countermeasures are necessary to protect many plants located on unprotected port land from high-frequency tsunamis.

Considering the situation during the recent

tsunami, the tsunami surges destroyed structures while the ships and other debris carried by the flow exacerbated the damage. The scattered debris has delayed the restoration effort.

Lowering the flow velocity, controlling its direction, capturing debris, etc. might be effective ways of reducing the impact. For example, could the layout of coastline structures, warehouses or multi-story parking buildings which escape tsunami damage, and shoreline roads, fences, and other public facilities be used to control the flow of water and block the inflow of debris? These structures are used during normal times and reduce the financial burden of new disaster prevention countermeasures. Plans for the layout of structures and for land use must be enacted based on simulations focused on preventing tsunami damage in this way and on the results of the simulations. For unprotected areas in particular, it is necessary to count on the tsunami attenuation effects of normal breakwaters. It is also necessary to study the construction of manufacturing plants resistant earthquakes and tsunami, by publicly requiring owners of manufacturing plants to build their plant on higher ground or take protective measures up to the predicted inundation depth.

### [2] Non-structural countermeasures

To provide information needed for efficient operation of structural countermeasures, it is necessary to provide systems linking wave height gauges to analyze and transmit tsunami information or the predicted time and routes of inundation water.

Not only coastline industries, but also ports play important roles by linking sea and land transport to form supply chains, so their functions must be maintained and quickly restored during emergencies. Corporations determine the mission of their business continuity plans (BCP) in advance to maintain and quickly restore the minimum activities, but many are now gathering experts to study BCP in order to maintain logistics functions in ports and harbors such as Tokyo Bay or Osaka Bay. This recent tsunami caused widespread damage along the Pacific Coast of Tohoku, so networks including ports on the Japan Sea side were effective. In the future, it will be necessary to study and enact port and harbor logistics BCP by linking ports over a wide range, in Tokai, Kinki, Chugoku, Shikoku, Kyushu, which may be struck by the predicted Tokai, Tonankai, and Nankai earthquakes. It is also important to consider comprehensively

providing information about the usability of port and harbor facilities and alternative logistics routes including land transport systems.

### 4. Efforts by the NILIM

The Coastal and Marine Department of the NILIM, primarily the Coastal Disaster Prevention Division, researches damage to facilities caused by floating debris and studies evacuation plans by performing simulations of the evacuation of coastline residents, and has studied the state of damage to ports and coastlines caused by last year's Great East Japan Earthquake in order to establish policies for providing new coastline facilities. The department releases the results of these researches as they become available. But, aware of the importance of research on disaster prevention for coastal regions and the need to diversify and strengthen such disaster prevention measures, the NILIM reorganized the Coastal and Marine Department in early 2012, when it will begin operating as the Coastal and Marine/Disaster Prevention Department in addition to the Research Coordinator for Tsunami Disasters and Crisis Management Research Division.

We are committed to working on existing challenges as well as a broad range of new goals as discussed above. As advanced variations of existing research, we are considering how to use our accumulated knowledge and technologies to develop tsunami observation technologies by applying marine short-wave radar technology, and how to restore marine environments following the loss of marine life or deterioration of the environment, which are now hidden by the human and material damage inflicted by the recent tsunami.

### 5. Conclusions

In his book, "Port Construction (Volume 1, Introduction)", the civil engineer, Hiroi Isami, a pioneer of port construction in Japan, taking the tsunami which struck Urado (Port of Kochi) in 1854 as an example, explained that technologists must enact plans cautiously and meticulously while looking far into the future. Japan is surrounded by the sea, and its major cities, industrial regions, and fishing harbors are along the coasts. Considering Japan's efforts on the last frontier, which is the exclusive economic waters, it is Japan's destiny to defeat and survive disasters such as tsunami, high waves, and storm surges which are unique to coastlines, and it is a

## ● Messages from Departments and Centers of NILIM

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mission that the world requires Japan to accept. We must therefore hypothesize a variety of circumstances, recognize that they could occur, make cautious and meticulous preparations looking far ahead, and undertake diverse research that spans boundaries.