

## **Study Conducted in support of Industrial Disaster Prevention Research Group**

### **[Abstract]**

In Japan, various measures are being taken in order to prevent disasters. As the importance of risk management in the world economy grows, the need has grown for management that aims to ensure the "continuity" of important activities and early "recovery" as part of business activities even in the event of an unforeseeable emergency such as a disaster.

The Chubu region is a global industrial center because manufacturers that are working as members of tightly organized and intricately coordinated international or domestic supply chains are concentrated in the region. Some say, however, that Chubu is one of the most threatened regions where the probability of occurrence of a strong earthquake is high. There is concern that if international physical distribution is interrupted because of a disaster, the factories of the world will be unable to continue production.

As if trying to prevent such a disastrous scenario, vigorous efforts have been being made, guided by an idea proposed by the Chubu Regional Bureau of the Ministry of Land, Infrastructure, Transport and Tourism, to ensure logistic service continuity under two slogans: "2 Shifts" and "2 Links." These efforts have been made under the leadership of the Industrial Disaster Prevention Research Group of Port User Companies (hereafter referred to as "Industrial Disaster Prevention Research Group" or "Research Group") composed of industry, academia and government members. The aim of these efforts is to identify industrial disaster prevention needs in the Chubu region and the direction of efforts (what those efforts should be like) to be made in order to achieve business continuity and early recovery in the event of a disaster.

This study was conducted in support of the Research Group, and this paper reports details of the study, focusing mainly on the knowledge gained by the Research Group.



### 1. Study items

The flow chart (study items) for this study is shown in Figure 1.

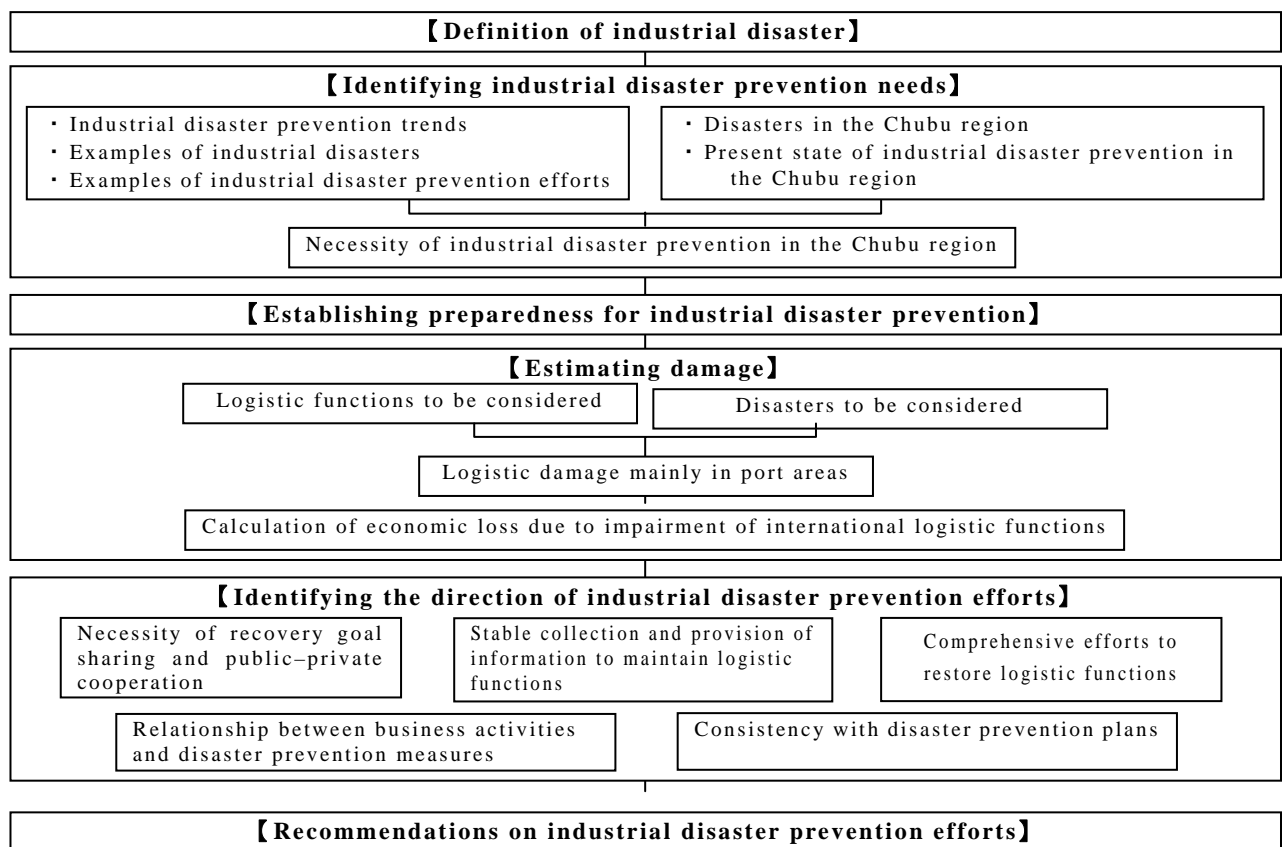


Figure 1 Study flow

## **2. Study method**

### **(1) Definition of industrial disaster prevention**

The new concept of "industrial disaster prevention" is defined, and the scope of the study is clarified.

### **(2) Identifying industrial disaster prevention needs**

The state of industrial disaster prevention efforts in Japan is reviewed by studying the industrial disaster prevention trends in Japan, examples of business and infrastructure damage and examples of industrial disaster prevention efforts of businesses and government organizations. Disaster risks to which the industries in the Chubu region are exposed are also identified by studying the past disasters and likely future disasters in the Chubu region and the present state of industrial disaster prevention efforts in the region.

### **(3) Establishing preparedness for industrial disaster prevention**

This section discusses a system for industry–academia–government cooperation for industrial disaster prevention.

### **(4) Estimating damage**

Logistic functions and disasters to be considered are identified in view of the characteristics of disasters and industries in the Chubu region, and likely logistic damage related mainly to ports and harbors is estimated. In order to quantitatively evaluate damage caused by a major disaster, the amount of economic loss in the event of a complete impairment of international logistic functions in the Ise Bay area is estimated.

### **(5) Identifying the direction of industrial disaster prevention efforts**

In order to achieve the goal of industrial disaster prevention in the Chubu region, which is a region of manufacturing industry, concepts were identified about the "necessity of shared recovery goals and public–private cooperation," "stable collection and provision of information to maintain logistic functions," "comprehensive efforts for recovery of logistic functions," "relationship between business activities and disaster prevention measures" and "consistency with disaster prevention plans."

### **(6) Recommendations on industrial disaster prevention efforts**

On the basis of Item (5) above, recommendations on industrial disaster prevention efforts were developed.

### **3. Study results**

#### **(1) Definition of industrial disaster prevention**

"Industrial disaster prevention" was defined as a series of efforts including not only conventional disaster prevention efforts to protect life and property in the event of an emergency but also efforts to maintain global industrial activities in an emergency and make early recovery possible.

In the study, international logistic functions (logistic services) that require the cooperation among various "players" was also considered.

#### **(2) Identifying industrial disaster prevention needs**

The Chubu region is exposed to the dangers of major earthquakes (Tonankai, Nankai and Tokai earthquakes) and seismically induced hazards such as tsunami and typhoons. Chubu is also a region with a high concentration of manufacturing industries operating as part of highly developed global supply chains. A major disaster in a region like this could not only stop the production activities of the manufacturing industries but also have an immediate global impact (Figs. 2 to 4).

The logistic structure (supply chains) of the manufacturing industries in the Chubu region is highly dependent on marine transportation. Consequently, a complete impairment of international logistic functions due to a major disaster could lead to a huge economic loss. International logistic functions are supported by the ports. In the Chubu region (Aichi Prefecture), the percentage of the quantity of container cargo (export) handled at local ports is much higher than at other major ports, and the ports and the local areas (hinterlands) are closely connected. It is therefore necessary to maintain not only the port functions but also the land transportation functions to link the producing areas (consuming areas) and the ports (Figs. 5 and 6).

International physical distribution is supported by various structural and nonstructural functions and many "players." The lack of any single element, therefore, is highly likely to result in functional impairment. It is necessary, therefore, for all players including production, physical distribution and infrastructure development to cooperate closely to contribute to industrial disaster prevention in the Chubu region (Fig. 7).

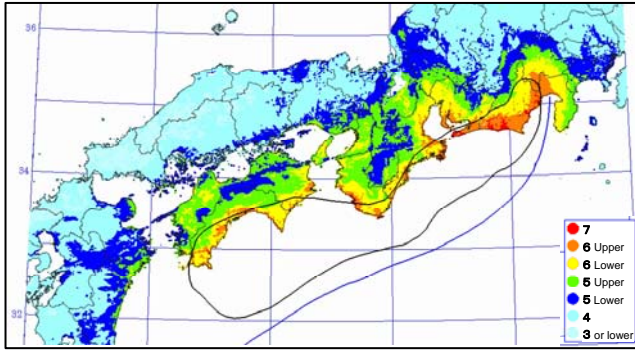


Figure 2 Seismic intensity distribution of the Tonankai, Nankai and Tokai earthquakes

Source: Prepared from the report of the 14th meeting of the Central Disaster Management Council's Special Board of Inquiry on the Tonankai, Nankai and other earthquakes



Figure 3 Earthquake-induced port damage

Source: Kobe City Website, Kobe: Earthquake Damage and War

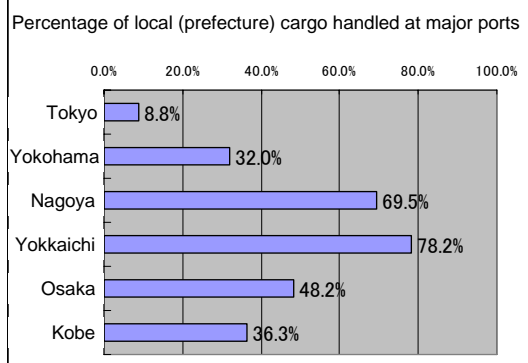
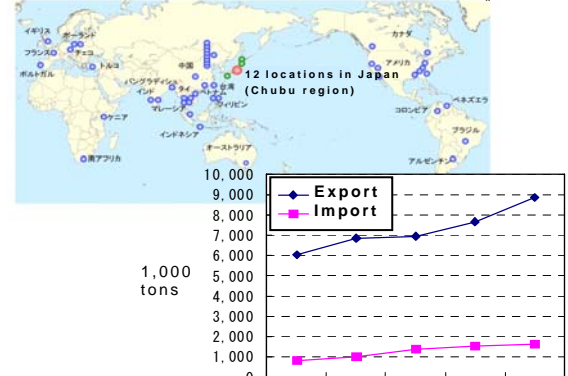


Figure 5 Percentage of local (prefecture) cargo handled at major ports

Source: Prepared from 2003 export and import container cargo survey data

The Chubu region has a high concentration of manufacturers participating in global supply chains (Key production facilities of international automotive manufacturers.)



Quantity of auto parts handled at ports in the Chubu region

- Four Tokai prefectures' share of manufactured product shipment in Japan: 23.6%
- Four Tokai prefectures' share of transportation equipment shipment in Japan:

The four Tokai prefectures are dependent on manufacturing industries.

- About 2 million people are engaged in manufacturing.
- Percentage of manufacturing workers in all workers in the four Tokai prefectures: 26% (national average: 17%, Kanto: 16%, Kansai: 19%)

Figure 4 Concentration of manufacturers in the Chubu region

Source: Prepared from port statistics, 2004 industrial statistics and 2005 census data

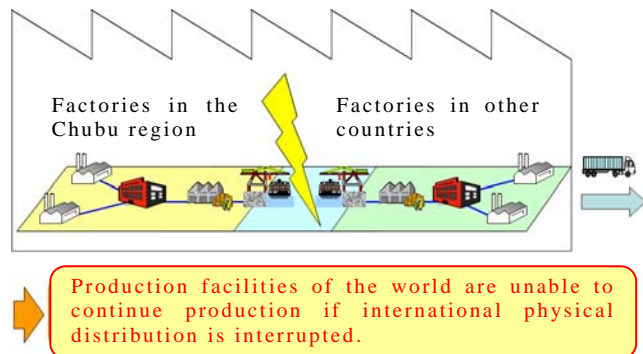


Figure 6 Port-based global distribution network

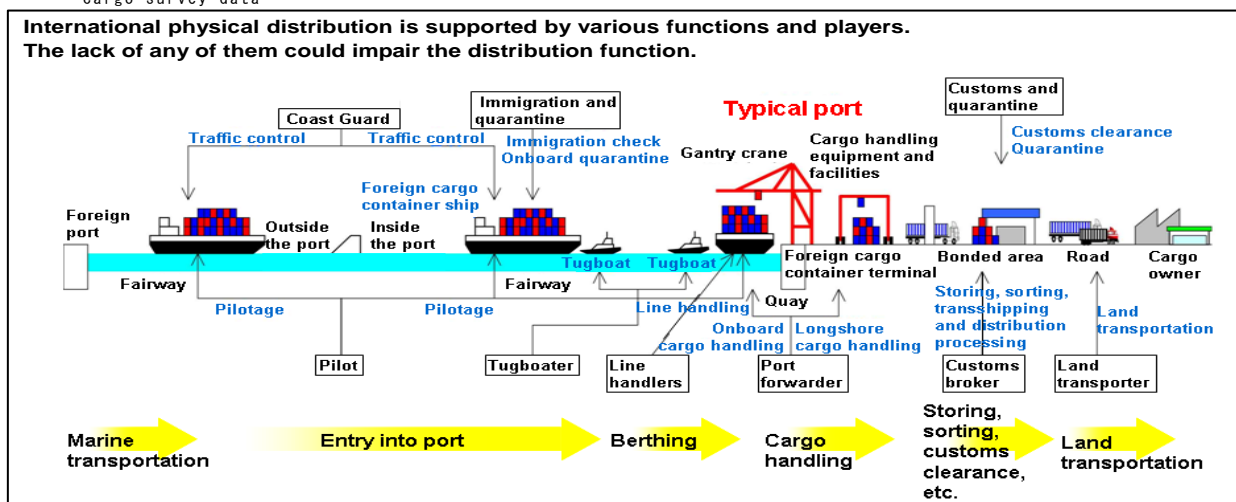


Figure 7 Players in international logistics

(3) Establishing preparedness for industrial disaster prevention

As mentioned in Item (2) above, international physical distribution is supported by many players. In order to maintain the function (logistic services), it is necessary to think of ports as an integrated network consisting of roads and ports instead of regarding ports as individual facilities.

Because of this need, the Industrial Disaster Prevention Research Group of Port User Companies (chaired by Prof. Tatsuo Ito,

Honorary President of Nagoya Sangyo University) consisting of industry–academia–government representatives including cargo owner companies, logistic companies, academic experts and administrators was established as an organization for promoting industrial disaster prevention efforts (Fig. 8). Keeping industry–academia–government in mind, the Research Group is working on a continual basis to share information and enhance industrial disaster prevention efforts

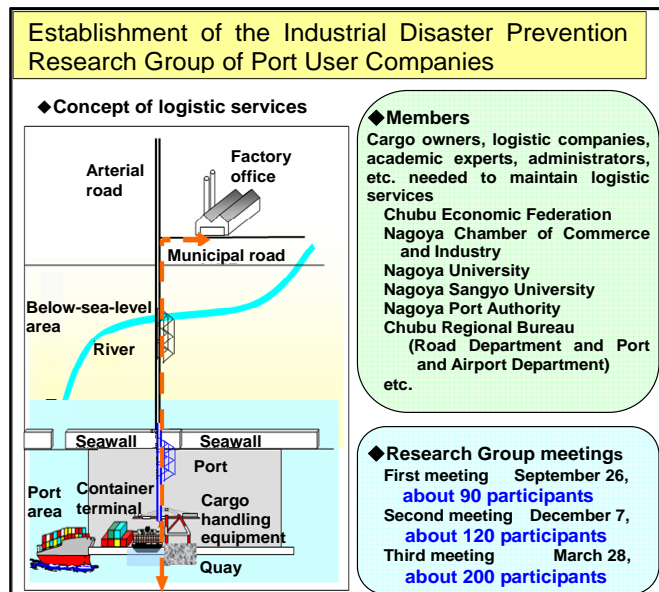


Figure 8 Industrial Disaster Prevention Research Group

(seven preparation meetings and three research conferences have been held). Since the Research Group is an open organization, the number of participants has increased over time.

(4) Estimating damage

(a) Logistic functions to be considered

International physical distribution in the Chubu region is heavily dependent on marine transportation. The impairment of the foreign container cargo transportation function, therefore, could cause tremendous damage to the manufacturing industries in the Chubu region that are working as members of rapidly growing global supply chains. For this reason, in this study "facilities" from the cargo owners' offices to the ports, "logistic services" and "all players" related to foreign container cargo transportation were considered.

(b) Disasters to be considered

Hazards that cause tremendous damage in the Chubu region include earthquakes, tsunami and storm surges. In this study, the long-predicted Tonankai, Nankai and Tokai earthquakes, which are expected to cause extensive damage due to earthquakes and tsunami, were considered

(c) Calculation of economic loss due to impairment of international logistic functions

Economic losses related to foreign container cargo resulting from the impairment of international logistic functions caused by a disaster were calculated by the four methods shown below (Table 1).

Table 1 Results of calculation of economic loss due to impairment of international logistic functions

Calculation method	Concept	Economic loss																		
(1) Loss of sales of major manufacturers in the Chubu region	The sales of the departments of Chubu-based manufacturers whose operation is stopped because of the impairment of international logistic functions are calculated as economic losses.	Company T (automotive) About 124.6 billion yen/week Company B (office equipment, machine tools) About 8.4 billion yen/week Company C (fine ceramics) About 5.6 billion yen/week Company O (machine tools) About 1.4 billion yen/week																		
(2) Loss due to Interruption of international trade	Economic losses due to the interruption of international trade at Nagoya Port are calculated assuming that a disaster at Nagoya Port has caused the international marine transportation of container cargo to be interrupted so that international trade is completely interrupted.	About 137.9 billion yen/week																		
(3) Loss due to falling of prices resulting from cargo flow interruption caused by impairment of port functions	Losses due to cargo flow interruption caused by the impairment of port functions are calculated from "the cost due to falling of cargo (products/merchandise) prices" and "the cost of the interest incurred by a delay in the recovery of investment in cargo (products/merchandise)."	About 13.3 billion yen/week																		
(4) Transportation cost due to the use of alternative routes	Alternative routes of land transportation (container trailer) and marine transportation (RORO vessel) to alternative ports to be used in the event of an impairment of a port in the Chubu region are identified, and the transportation cost in each case is calculated as the amount of loss.	<table border="1"> <thead> <tr> <th>Alternative port</th> <th>Land route</th> <th>Marine route</th> </tr> </thead> <tbody> <tr> <td>Sendai Shiogama Port</td> <td>115,145 yen/TEU</td> <td>70,208 yen/TEU</td> </tr> <tr> <td>Hitachinaka Port</td> <td>82,451 yen/TEU</td> <td>53,393 yen/TEU</td> </tr> <tr> <td>Yokohama Port</td> <td>70,420 yen/TEU</td> <td>39,428 yen/TEU</td> </tr> <tr> <td>Fushiki Toyama Port</td> <td>47,943 yen/TEU</td> <td></td> </tr> <tr> <td>Kobe Port</td> <td>45,098 yen/TEU</td> <td>51,113 yen/TEU</td> </tr> </tbody> </table>	Alternative port	Land route	Marine route	Sendai Shiogama Port	115,145 yen/TEU	70,208 yen/TEU	Hitachinaka Port	82,451 yen/TEU	53,393 yen/TEU	Yokohama Port	70,420 yen/TEU	39,428 yen/TEU	Fushiki Toyama Port	47,943 yen/TEU		Kobe Port	45,098 yen/TEU	51,113 yen/TEU
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(5) Identifying the direction of industrial disaster prevention efforts

(a) Recovery goal sharing

Judging from the Hanshin Great Earthquake, it is likely that many businesses will start recovery activities in about one week after the occurrence of a disaster. Completing emergency recovery work in one week after the occurrence of a disaster, therefore, was defined as a common goal for the international logistic system consisting of roads, ports and other facilities (Fig. 9)

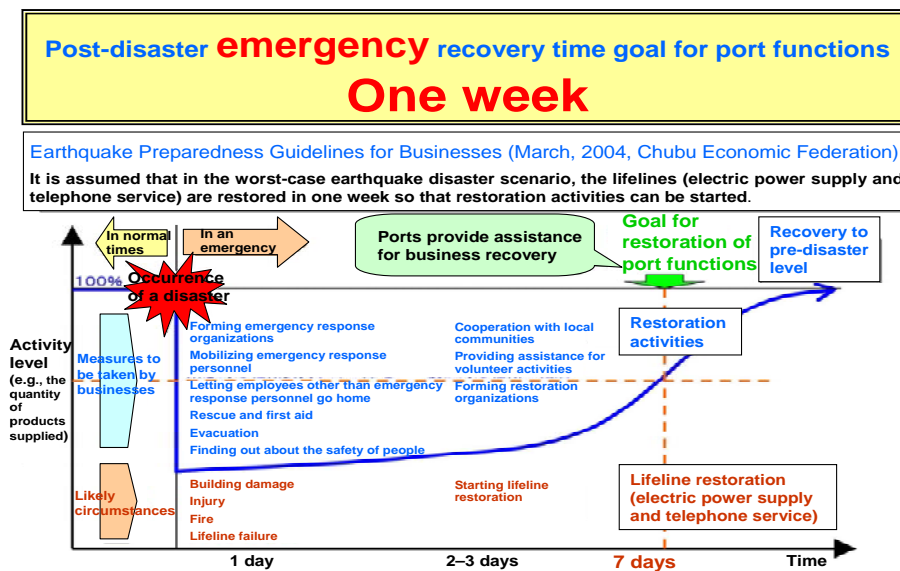


Figure 9 Recovery goal

Source: Prepared from Earthquake Preparedness Guidelines for Businesses

(b) Stable collection and provision of information to maintain logistic functions

It is necessary to create a system that makes it possible to collect and provide information on international logistic system elements such as roads and ports not on a facility-by-facility basis but on an area-by-area basis in the form of comprehensive information that also covers such elements as alternative routes and alternative facilities. Immediately after a disaster or during a restoration period, necessary information such as information on the degree of damage to and availability of facilities and the prospects of restoration activities should be collected and provided, and the information needed by businesses and government organizations to maintain logistic functions should be shared.

(c) Comprehensive efforts to restore logistic functions

In order to share information on logistic functions, businesses and government organizations need to perform a complete review of the functions of the facilities constituting the physical distribution routes that can be performed in the event of a disaster. The complete review needs to cover both structural and nonstructural aspects and also response measures to be taken in the event of a disaster such as securing alternative distribution routes and taking management actions for that purpose.

(d) Relationship between business activities and disaster prevention measures

The basic rule is for individual businesses to take disaster prevention measures on their own in their business activities. However, regional measures that must be taken to protect the national interests or that are beyond the control of many businesses, such as information the maintenance and safety of international logistic functions, need to be implemented as a concerted community effort by the central government, local governments and businesses. The government needs to exercise its influence on disaster prevention measures to be taken for facilities whose damage could affect a large area such as hazardous materials handling facilities. For these reasons, it is necessary for the government to provide assistance to businesses in connection with their disaster prevention measures.

(e) Consistency with disaster prevention plans

In accordance with the Disaster Countermeasures Basic Act, local governments are implementing disaster prevention measures such as drawing up a "regional disaster prevention plan" with the aim of protecting the land of Japan and life and property from hazards.

From the industrial point of view, because local residents are employees of businesses and because the maintenance of industrial activities leads to the protection of the livelihood of the local residents, industrial disaster prevention and the regional disaster prevention plan share many goals. It is therefore necessary to take measures to achieve consistency with the regional disaster prevention plan by, for example, identifying the requirements for industrial disaster prevention in the regional disaster prevention plan.

(6) Recommendations on industrial disaster prevention efforts

In view of the direction of the efforts to be made described in Item (e) above, the Research Group has drawn up the recommendations shown below. For reference purposes, Table 2 shows examples of measures that can be taken.

Summary of recommendations

- The Chubu region, the region of manufactures, is an industrial center not only of Japan but also of the world. Maintaining business activities in the Chubu region, therefore, is of vital importance, and it is the social responsibility of the businesses in the Chubu region to aim to restore their activities in the event of a disaster.
- Business activities and road and port activities must be restored concurrently. About 70 percent of the container exports from Nagoya Port, which is the third-ranked port in Japan in terms of container throughput, come from within Aichi Prefecture. This considerably differs from the percentages for other major ports, which range from 10 to 50 percent

**(1) Working toward common restoration goals, conducting public-private joint studies and establishing systems**  
It is recommended that common goals for the restoration of business and port activities (e.g., quantifiable goals such as restoration in a week) be shared, and concrete measures to be taken be identified through public-private joint studies, and that systems for doing that be established.

**(2) Stably collecting and providing information to maintain logistic functions**  
It is recommended that a system be established for providing information on the degree of recovery of international physical distribution at ports and other relevant matters including access routes in a stable manner even in the event of a disaster.

**(3) Comprehensive efforts to restore logistic functions**  
It is recommended that comprehensive efforts including finding ways to secure access routes be made so that logistic functions concerned with many entities such as port management, customs clearance, shipping service and cargo handling can be performed smoothly.

Table 2 Examples of measures to be taken

(2) Stably collecting and providing information to maintain logistic functions	
Measures	Description
(i) Establishing a system for providing and sharing information in the event of a disaster	Establishing a system that enables port authorities, road authorities, logistic companies, cargo owner companies, etc., to share relevant information such as information on the status of damage, alternative transportation routes and the recovery status
(ii) Conducting studies on plans and systems for maintaining port functions	Drawing up plans for preparatory measures, emergency measures and restoration measures to be taken to maintain port functions in the event of a disaster and conducting studies on systems for implementing it

(3) Comprehensive efforts to restore logistic functions

Measures	Description
(i) Complete review of weaknesses in distribution routes and studies on alternative routes	Conducting a complete review of the structural and nonstructural elements of distribution routes from cargo owner companies to ports, identifying their weaknesses, and determining alternative transportation routes on the basis of the findings
(ii) Conducting a complete review of port plan (using a redundant arrangement of port facilities)	Conducting a complete review of port plan details and redesigning the arrangement of facilities for redundancy to make sure they function in the event of a disaster