7.4.1.1 Environmental Impact Factors Concerning Port Development

(1) Impact by Construction Work

1) Impact on Air

Construction works discharges various air pollutants. The co-relation between the principal types of construction works and main pollutants is shown in Table 7.4.2.

Table 7.4.2 Co-relation between Construction Works and Pollutants

Components / Factors	Dust	SOx	NOx	Smut
Dredging		○	○	○
Foundation		○	○	○
Sand Drain		○	○	○
Superstructure		○	○	○
Backfill	○	○	○	○
Reclamation	○	○	○	○
Land Making	○	○	○	○

The diffusion of air pollutants from construction machinery is a problem within 100m from the source. However, air pollution accompanied with construction works is temporary. And the size of impact is generally less than that generated from the industrial activity or road traffic.

2) Impact on Water/Soil Quality

It is estimated that various polluted substances give loads into water/soil with bottom soil blown up by construction works. The co-relation between the principal types of construction works and main environmental components is shown in Table 7.4.3.

Table 7.4.3 Co-relation between Construction Works and Environmental Components

Factors \ Components		Water Quality		Soil
		SS	noxious-ness	noxious-ness
Dredging	Dredging	○	○	○
	Reclamation	○	○	○
Foundation	Dredging	○	○	○
	Replacing	○		
	Rubble Mound	○		
Sand Drain	Spreading Sand	○		
	Sand Pile	○		
	Counterweight	○		
Sand Compaction Pile		○		
Backfill			○	○
Dumping		○	○	○

Increase of SS is conspicuously seen in the extent of 500 to 1,000km from the work point. It diminishes the scenic view and has a negative impact on recreation facilities and aquatic species.

3) Impact by Noise/Vibration

Construction works occur noise and vibration. The co-relation between the principal types of construction works and occurrence of noise/vibration is shown in Table 7.4.4.

Table 7.4.4 Co-relation between Construction Works and Noise/Vibration

Factors \ Components		Noise	Vibration
Dredging	Pump	○	
	Cutter	●	●
Pile Foundation	Driving Pile	○	○
Soil Improvement	Sand Drain, Sand Compaction Pile	○	○
Concrete	Structure, Block	○	
Land Making	Leveling, etc.	○	○

note : ○;continuous, ●;intermittent

Noise/vibration is temporary. But it aggravates the living environment when residential areas, schools or hospitals exist in the vicinity.

4) Impact of Odor

Odor will be occurred in case of eliminating sludge polluted with noxious and organic materials. Usually, the odor is caused by the H_2S component in the sludge material that has a smell of rotten eggs and is very unpleasant for residents.

5) Impact on Geographical Feature

Construction works might alter the geographical feature of quarry or pattern of ground water system. It could result in a loss of habitat for terrestrial lives and loss of natural vegetation.

6) Impact on Ecosystem

(a) Impact on Aquatic Species

Contamination of water/bottom by construction works threatens the habitat of aquatic species. It might collapse coral reef, change the distribution of benthic organisms and reduce fishery products. Conspicuous water muddiness reduces light intensity in the water, which prevents photosynthesis of plant plankton and seaweed. It reduces the biological productivity of water area. The absorption of sand particles causes plant plankton to sink and prevent photosynthesis of seaweed.

(b) Impact on Terrestrial Species

Changes in air quality and occurrence of noise/vibration during construction works alter the ecosystem of terrestrial species. SO_x, NO_x or fluorine reduces the growth of terrestrial plants and withers them. Terrestrial animals are also threatened through the impact on their respiratory organs. Noise/vibration influences the behavior of terrestrial animals and may prompt them to leave their traditional habitat.

7) Impact of Disposal Wastes

Without an adequate disposal site, residual soil or construction materials are likely to be dumped on land or in the sea, which would be detrimental to water/bottom quality, soil condition and the ecosystem.

8) Impact on Socio-culture

Laborers for construction works will inflow from outside. It is possible that friction between outside laborers and local residents on matters of race, religion, manners and customs might occur.

9) Impact on Socio-economy

Increase of working opportunities/incomes and emergence of new economic activities are expected, thereby contributing to regional revitalization. But, it might cause distortions such as outflow of work forces or occupational change. Passing of construction vehicles and boats might obstruct usual land/sea traffic. In addition, fishing vessels may be hampered by the resulting congestion and tourism/fishery resources may also be adversely affected (e.g. increase in muddiness).

(2) Impact by Existing Port Facilities and Sites

1) Impact on Water/Bottom Quality

Outer facilities such as breakwater and reclamation site, etc. might make water stagnant. Increase of organic matters indicated by COD and depletion of dissolved oxygen due to decomposition of organic matters can lead to eutrophication, in which phenomena such as red tide and hypoxic milky blue-green water occur. On the bottom, when organic materials are accumulated and decomposed under a non-oxygen state, H_2S occurs. Resulting on an offensive odor which negatively impacts marine life.

2) Impact on Geographical Feature

Dredging for channel, basin and anchorage and existence of port facilities and reclamation site change the geographical feature of an area. Beach erosion and accretion due to pattern change of littoral drift might occur, which can impact on existing forms of use of land and water area and extinguish tidal flats. In addition, the change of ground water level/pressure and intrusion of seawater into ground water accompanied with reclamation and excavation might impact on forms of water use in surrounding areas and terrestrial vegetation.

3) Impact on Oceanology

The reflection and refraction of wave by channel, outer facility or reclamation site might affect the current flow. Topographical changes and eutrophication due to stagnation or promotion of water flow might be caused around the breakwater, shore protection and underwater structure. Tidal changes are an important factor related to the change of water quality in the port.

4) Impact on Ecosystem

(a) Impact on Aquatic Species

Dredging or occurrence of outer facilities and sites might reduce habitats of aquatic species. And eutrophication caused by the change in current flow or water quality might change the habitation environment indirectly. A change in the current flow could alter the

distribution of planktonic larva, while the quality of water/bottom can change the distribution of species and feeding grounds due to eutrophication, etc.

Although concrete lye increases the pH in the water locally and temporarily, it does not pose a threat to aquatic species because seawater has the capacity to absorb pH. If anything, concrete structures are able to become a new base for seaweed and benthic organisms.

(b) Impact on Terrestrial Species

Use of land for port and port related facilities will reduce the habitat of terrestrial species. Decrease of tidal flat impacts on inhabitants such as birds living and feeding there. Terrestrial animals feeding on them can be damaged indirectly. Mangrove is very sensitive to silting, accumulation, stop of water inflow, water stagnation and oil.

5) Impact on Scenic View

Large-scale reclamation, long breakwaters, land facilities, chimneys and tanks, etc. will result in an artificial view. The impact is large if the area has intrinsic scenic value or value as a tourist resource.

6) Impact on Socio-culture

The residents, cultural assets and historical heritage in the project area might be obliged to relocate due to the appearance of sites. The opposition movements and aggravation of social/racial confrontation might occur due to the loss of living basis and inflow of new community or culture.

7) Impact on Socio-economy

Fishery and aqua-cultural activities might be restricted due to the occurrence of sites, such as a reduction or change of fishing grounds and loss or transfer of nurseries. The volume of fishery resources might be indirectly changed through a change in the current flow, water/bottom quality and ecosystem. If there is existing land use for human activities, these activities will have to be diverted. If it becomes impossible to obtain or drain water, an economic loss would be incurred.

(3) Impact by Use of Water Area Facilities and Wharves

1) Impact on Air

Vessels discharge SO_x, NO_x, dust and CO, which have a negative impact on the human body, mainly the respiratory organs. In addition, SO_x and NO_x damage vegetation and generate acid rain.

2) Impact on Water/Bottom Quality

Vessels discharge bilge water including oil. Inflow of bilge water to the sea area produces an oily film on the surface and spoils the scenic view. It might make the water and aquatic lives smell and damage the physiology of aquatic lives. Water gives off perceptible odor when the concentration of oil reaches 0.01ppm, whereas fish begin to smell in 24 hours. But the odorization does not occur if the concentration is 0.001ppm or less. Fish which come in contact with mud containing over 2mg/g(dry) of oil begin to smell in an extremely short time.

3) Impact on Topography

The furrow waves generated by sailing of vessels might erode natural beaches and riverbanks, which changes terrestrial vegetation and forms of land use.

4) Impact on Terrestrial Species

Physiology of fauna and flora may be affected by SO_x and NO_x from vessels. Impact of NO_2 appears as growth retardation or abnormal coloring of leaves of commercial products such as tomatoes or soybeans, etc. Also, impact of SO_2 appears as abnormal coloring, withering and reduced yields of barley, carrots, cotton, lettuce, spinach, cedar and so on.

5) Impact of Wastes

Oil and wastes are discharged from ship. Wood chips are produced from lumber handling wharves. In addition, it is necessary to appropriately dispose of dredged sand produced by dredging works for maintenance of channel and anchorage. Water/bottom conditions and scenic views are negatively impacted by oil film and floating trash. Decomposition of organic matters such as wood or paper corrupts water/bottom quality. Spilled oil impacts on marine lives and birds feeding on them. Dumping of dredged sand containing hazardous materials pollutes the water/bottom, which can impact on the human body.

6) Impact on Socio-economy

Operation of fishing boats might be restricted if port facilities are close to fishing grounds. Fishing activities may have to be transferred elsewhere or income may be reduced due to restrictions on fishing activities. On the other hand, some employment opportunities will be generated by port related activities.

(4) Impact by Loading, Storage and Movable Facilities

1) Impact on Air

Dust from activities of loading bulk cargo or open storage yards will damage respiratory organs of port laborers and local residents. The extent of diffusion of dust with diameter of 0.1mm and specific gravity of 3 will reach 2km in wind velocity of 10m/s. Inflow of dust to

the sea area deteriorates water/bottom quality.

2) Impact on Water/Bottom Quality

Leak or scattering of bulk cargo from open storage yard pollutes water/bottom. Decomposition of organic matters such as cereals or chips advance eutrophication such as increase of COD or nitrogen/phosphorous and decrease of DO. Water and bottom might be polluted due to the efflux of pesticides or heavy metal ion from coal, bauxite, sulfur ore, tin ore and copper ore. Increase of SS by leakage deteriorates scenic view and impacts on physiology and activities of aquatic species.

3) Impact of Noise/Vibration

Noise/vibration from machinery used in operation might threaten the living environment of local residents. Port can not be managed owing to complaints from residents. If residential areas, schools and hospitals exist in vicinity, and operation is continued through the night, impacts would become large.

4) Impact of Odor

Ammonia or trimethylamine might be generated through handling farm/marine products. Although impact of odor is temporary, unpleasant feelings might arise, especially if schools, hospitals or residential areas are in the vicinity.

5) Impact on Aquatic Species

Change of water/bottom condition due to leakage from handling facilities and storage impacts on aquatic species. Increasing the level of nutrient in the water increases photosynthesis of plant plankton and changes species composition. Emergence of oxygen depleted water due to eutrophication makes existence of aquatic species impossible. Pesticides or heavy metal ions from mineral resources damage aquatic species directly. It might indirectly damage human bodies through biological concentration.

6) Impact of Wastes

Abandoned oil and garbage cause sanitary problems. Also, inflow of them into the sea area deteriorates water/bottom conditions.

7) Impact on Socio-economy

New employment opportunities will be generated. Economic activities such as commerce and services together with job creation will be accelerated.

(5) Impact by Operation of Facilities Handling Hazardous Materials

1) Impact on Air

SOx, NOx, hydrocarbon and dust will be generated from petroleum distribution base and other hazardous handling facilities. Generally, as for the impact of SOx, NOx and dust, that from industrial activities or traffic functions is far bigger. But, hydrocarbon is mostly generated by evaporation from hazardous handling facilities. It causes headache, giddiness or disease of respiratory organs. Also, it is causative of photochemical oxidant.

2) Impact on Water/Bottom Quality, etc.

Oil, odor and other materials discharged from hazardous handling facilities cause various impacts on fauna/flora and the socio-economy.

(6) Impact from Waste Treatment and Disposal

1) Impact on Air, etc.

SOx, NOx, dust and odor are discharged from waste treatment facilities and waste disposal sites. These cause various impacts on fauna and flora.

2) Impact on Socio-culture

Slums might be formed by the people who make a living by collection of waste materials. Emergence of slums could create friction with neighboring residents and social unrest due to deterioration of security.

7.4.1.2 Environmental Impact Factors Associated with Activities Closely Related to Port

(1) Impact by Traffic Functions

1) Impact on Air

Transportation of cargo handled at the port will increase road traffic volume. As production and economic activities increase, general traffic increases also. Air pollution by SOx, NOx, CO and dust impacts on human health and physiology of animals and plants, and generates acid rain.

2) Impact of Noise/Vibration

Transportation of cargo and increase of production and economic activities in surrounding area will increase road and railway traffic. This increases noise/vibration that threatens the living environment of residents.

3) Impact on Fauna and Flora

Air pollution and noise/vibration accompanied with use of traffic function site might

change physiology and ecology of terrestrial species.

4) Impact on Socio-culture

Provision of traffic network might change the local population distribution and forms of communication. Population movement may result in the extinction of a unique local culture and cause cultural friction due to encounter with alien cultures.

5) Impact on Socio-economy

Increase of road traffic volume can cause the economic loss by increasing traffic congestion and traffic accidents. On the other hand, there are many cases in which the traffic system has been markedly improved and produced a favorable effect on the local social environment.

(2) Impact by Industrial Production Activities

1) Impact on Air, etc.

Air/water pollutants, noise, odor and wastes are discharged from factories and facilities in industrial estate. These impact on various aspects such as human and flora/fauna.

2) Impact on Topography

Land subsidence might be caused by decrease of groundwater level/pressure due to pumping up. Land subsidence might induce flood and high tide. Also, falling of groundwater level/pressure can cause the decrease of well water and intrusion of sea water into well.

3) Impact on Socio-culture

According to the increase of employment opportunities accompanied with operation of industries, population of surrounding area flows into the industrial area, which changes the population distribution of the region. If regional plan is obliged to be changed due to distortion of the local economic activities, residences and educational facilities may be affected.

4) Impact on Socio-economy

Employment opportunities will increase. And, economic activities such as commerce and service will be vitalized. On the other hand, transfer of laborer from existing industries might cause distortion in the local economy. Air and water/bottom pollution will impact on agricultural and marine production.

(3) Impact by Distribution and Storage Functions

1) Impact on Air, etc.

Dusts, noise/vibration and odor are discharged from distribution and storage facilities.

2) Impact on Socio-economy

Laborer will be needed for new activities. But, the scale of employment is generally small because of rationalization by mechanization.

(4) Impact by Use of Recreational Facilities

1) Impact on Water/Bottom Quality and Fauna/Flora

Drainage from hotel or marina might cause eutrophication. On the other hand, it is expected that tidal flats or shallows created in artificial beach will prompt decomposition of organic materials and make water clear. However, at the present time, it is difficult to quantitatively grasp the ability of an artificial beach to purify water quality. Change of water/bottom quality might change the circumstances of aquatic species for better or worse.

2) Impact on Socio-culture

Tourists introduce alien culture. The original function of existing cultural assets might be changed to recreational function. Unique culture may become extinct, which means that the feelings of local residents must be considered if the project is to be successful.

3) Impact on Socio-economy

Fishing activities will be restricted at artificial beaches and areas for pleasure boats. Distortion of the local economy might occur due to labor transfer from existing industries.

7.4.1.3 Environmental Impact by Oil Spills

A large-scale oil spill from tanker seriously impacts on economic activities, operation of adjacent ports and the ocean environment, particularly fisheries in surrounding areas. In such an event all possible measures for collection and treatment as prevention of diffusion must be taken.

Life stage, physiology, metabolism, habitat and breeding patterns of fishery stock are all effected by oil spill. Short-term losses occur with the immediate death or contamination of adult fishes. Long-term losses resulting from the killing of larvae and juvenile are revealed as a reduction of catch in future years. Although the degree of mortality and other effects depend upon the type and concentration of oil spilt, temperature and the time of exposure, the generally estimated concentrations causing lethal toxicity to marine organisms exposed for a few hours are: gastropod molluscs 1-100 μ g/ml, bivalve molluscs 5-50 μ g/ml,

crustaceans 1-10 μ g/ml, finfish 5-50 μ g/ml and larvae of all species 0.1-1 μ g/ml.

Generally, adult fish can move to avoid oil pollution. Sedentary organisms can not move away, though they may avoid contamination by shutting shells or valves. On the other hand, most finfish and shellfish are floating during their egg or larval stage, which therefore makes them vulnerable to oil. And immature organisms of which systems for detoxifying or eliminating oil and metabolites are incompletely developed are physiologically more sensitive. Although ocean fish can readily avoid oil, fish in other habitats such as estuaries or fish farms where the water is shallow and bounded by land may be at a higher risk. This means that the danger would be bigger if fish are in particular season for breeding and move into the coastal shallows.

Oil spill can cause extensive damage to planktonic organisms and affect the larval and adult populations feeding on them. The damage can expand through the food chain.

Population of fish may sometimes recover quite quickly. But, it is possible that a different biological community will emerge, which can reduce the catch of certain species and lead to a change in catching methods and costs. If contaminated sediments continue to release hydrocarbons, oyster farms would be obliged to relocate.

7.4.2 Countermeasures for Environmental Conservation

In the implementation of port development project, various countermeasures for environmental conservation should be proposed according to the type and size of impact. Table A 7.4.1 and A 7.4.2 show the environmental impact worksheet and checklist, respectively.

In actual working, each item that should be subject to EIA will be examined using these worksheet and checklist and estimated the size of impact. The process is that the rough magnitude of impact is grasped for each item first, and then the measurements of forecast/estimation are determined. Secondly, the impact on the background areas and the present environmental circumstances are compared and assessed. In case the predicted level is not in compliance with an environmental conservation target, feasible countermeasures should be supposed for further assessment.

(1) Countermeasures for Air Pollution

As countermeasures for dust, use of adequate machinery, enclosure by fence, sprinkling, provision of buffer zone, covering bare ground and hardening earth, etc. can be considered. When the port is close to the residential areas, progress control not to operate a lot of machinery simultaneously, work hours and provision of smoke protection fences, etc. should be considered in order to control SOx, NOx and smut discharged from machinery.

Efficient port management to reduce the berthing time of vessels is necessary for

emission control. Vessels in harbor limit may need to be obligated to use A-type heavy oil in which content of sulfur is low.

Transportation system should be planned to be free from traffic congestion. Sufficient buffer zones, such as green belts, need to be adopted between traffic facilities and residential areas. Low-pollution factories or commercial facilities can be substituted for buffer zones.

As for the air pollution by industrial production activities, reduction of discharge amount by treatment tank and diffusion/dilution of concentration on the ground by tall chimneys will be needed.

(2) Countermeasures for Water/Bottom Contamination

In case of doing dredging or reclamation, it is fundamentally important to select proper plan (e.g. settling pond), construction method (e.g. using sedimentation coagulant) and machinery.

It is desirable that disposition of port facilities be planed not to make the closing water areas which can stagnate the tidal flow. When the port is located in polluted area, for instance, replacement of rivers may need to be considered as well as the selection of project site. Also, when polluted river water flows into the port area, provision of adequate infrastructures such as sewage treatment facilities in inland areas should be suggested to the responsible organs in order to control pollution load in sea area. As countermeasures feasible to be implemented by port administrator, dredging at the stagnated areas, sand overlaying on the contaminated seabed and purification by inducing water from elsewhere can be considered.

Aprons need to adopt reverse slope not to leak the toxic substances spilt on the wharves into waters. Drainage system should be provided in order to collect such toxic substances and convey them to sedimentation tank. Substances possible to pollute water/bottom are desirable to be stocked in indoor facilities or covered by sheets not to leak outside by rain.

Establishment of acceptance facilities for bilge water based on the "1978 Protocol on the International Treaty for Prevention of Pollution by Ships of 1973 (MARPOL 73/78)" should be considered in the planning stage. The concentration and volume of bilge discharged from vessels into the port area need to be regulated.

As for the countermeasures for water pollutant from industrial facilities or others, reduction of drainage by water saving and decrease of sludge by adequate selection of production process are necessary. And location of outfalls should be selected adequately considering stream and forms of water use.

(3) Countermeasures for Noise/Vibration

Adequate construction method and machinery should be selected. Setting soundproof

apparatus, work hours and location of source should be taken consideration in the step of planning.

Trunk roads or other sources of noise/vibration should be located distantly from residential areas, schools or hospitals.

(4) Countermeasures for Offensive Odor

Dredging method, machinery and dumping site should be selected appropriately. Surface of reclamation site needs to be covered rapidly. Working hours, transportation method of dredged soil and application of deodorant, etc. should be considered.

The facilities possible to generate odor should be detached from sensitive areas such as schools, hospitals or residential areas. Sealing warehouse and installing deodorant apparatus will be taken.

(5) Countermeasures for Topographic Change

Project site and face lines need to be determined prudently. Construction plan should be established based on the sufficient investigation for ground water system. Deliberate pumping up of groundwater by restriction on use will be needed as a countermeasure for subsidence. Provision of sheet piles or water gates can be useful for prevention of seawater intrusion into well water. Construction of banks, groynes and diversion channels, and protection of beaches, etc. are available as countermeasures for erosion or accretion. If disappearance of precious terrestrial ecosystem is predicted, transplant of lives will need to be considered.

It is desirable to set the upper limit of navigation speed or vessel's size in the channel adjacent to natural coastal line.

(6) Countermeasures for Oceanographic Change

Project site and face lines need to be determined prudently. Construction of wave dissipation revetments and jetties may need to be planned. Impacts will be reduced by proper selection of the type of facilities, for instance, introduction of non-reflection type or penetration type breakwaters.

(7) Countermeasures for Conservation of Ecosystem

A project should be planned to conserve the ecosystem through the appropriate investigation of ecology in the subject areas and sufficient countermeasures for air and water/bottom pollution. Zoning plan should be considered to save existing untouched areas as much as possible. Particularly, it needs to greatly pay attention to wetlands. Destruction or degradation of wetlands may directly impact on the biological resources of other countries, because fishes and birds do not recognize national boundaries or may migrate

long distances.

Adequate prevention measures against the generation or spread of muddiness from the construction works should be adopted. The low-noise/vibration construction machinery should be introduced also. And the construction timing needs to be selected adequately considering distribution, migration and spawning seasons of species. Construction of artificial beaches or shallows and adoption of gentle slope revetments are available for the rebirth of habitats. In addition, feeding, release of useful fish or shells, creation of alternative habitats and establishment of conservation areas may be necessary.

Operating costs for conservation of ecosystem may fall on agencies, such as parks and recreation departments, which are not participating in the main components of the project. In that case, port administrator needs to consider certain contributions, such as returning a portion of profits, establishing linkage with ecological conservation projects and providing monitoring data, etc., in order to obtain positive cooperation from them.

(8) Countermeasures for Views

Legal compliance should be considered sufficiently in the special areas such as national parks. In the planning stage, facility location, land use and colors of structures need to be taken into consideration. Implementation of planting and afforestation may be necessary.

(9) Countermeasures for Wastes

An adequate planning for collection, transportation and disposal site is important. And, for instance, use of remnant harmless construction materials for artificial fish reefs need to be considered.

Wastes discharge in the port area must be strongly banned through the legal regulations. Preparation of machinery and materials for cleaning or establishment of garbage treatment system is necessary.

(10) Countermeasures for Socio-Culture

Project site should not involve the points important as a locally unique culture. Sufficient dialogues with residents or specialists and information publicity should be implemented before construction works. Vocational training programs for technical transfer to local laborers will be needed in order to reduce the number of outside laborers for conservation of locally unique cultures.

There are many cases that the replacement of cultural assets declines the value of them. Securing adequate place for transfer including museums, establishment of proper transfer schedule and compensation for economic and cultural loss must be taken into consideration prudently.

Archaeological and historical assets that are not found in preliminary survey may be discovered during the project implementation. Certain procedures for such unanticipated discoveries, for instance, notification to the relevant departments, request of site inspection by experts and cessation of work, etc. should be mentioned in project design and construction contracts.

(11) Countermeasures for Socio-Economy

Rights to farm land or fish may not be recorded or registered outside the area. And the components of a production system are more complex than they appear to outsiders. Therefore, it is important to hold sufficient dialogues with residents and open information. In where vulnerable minority people are to be affected by a port development, a separate plan for individual groups suited to their specific needs and local situations is necessary. If resettlement is needed due to construction works, replacement areas should secure at least equal living standards that the settlers had before. Resettlement will increase population density, which may newly require providing sanitary and public health systems none were needed before.

Employment planning may need to be established in order to keep deliberate industrial activities in the regional economic system. Employee training will be necessary for the new employment opportunities.

The function of fishery ports and marine products distribution should be improved or expanded. The plan for effective uses of artificial structures such as breakwater which have a function of gathering fish needs to be established. If economic losses for fishermen are evident, certain compensation is necessary. Also, certain fields for alternative economic activities may need to be provided for local residents who suffer economic loss by land expropriation.

Oil distribution base or treatment facilities handling hazardous materials should secure sufficiently safe distance from agricultural and fishery production sites.

If traffic stagnation is predicted, relocation of existing or planned roads and provision of traffic safety facilities are necessary.

(12) Countermeasures for Oil Spill

1) Corralling Oil and Using Treatment Agents

In case of spill of gasoline, corralling should never be attempted because the danger of fire and explosion is far bigger. The best choice is to allow gasoline to spread and diffuse naturally. Small-scale spill of diesel oil may not significantly damage to surrounding environment. It is better to wait for evaporation and natural dissipation. Because, it is difficult to effectively disperse by agents due to its low gravity. Under the poor mixing

condition, dispersed droplets tend to return and re-form oil films.

As for the heavy oil, use of treatment agents is effective. However, treatment agents should be used in case of that oil films are thin and difficult to collect by mechanical or physical methods. Because, oil treatment agents are not perfectly harmless. If oil films gather locally and there is no fear high density or damaging the fishery resources and ecosystem, the best approach is to wait for natural purification by microbes, etc. And treatment agents should not be used in shallow water because it can damage benthic organisms.

Treatment agents need to be used immediately before the oil spreads. Also, they must be sprayed on an appropriate scale as soon as the mechanical containment will be evident to fail. Prudence must be given not to damage to the ecological precious areas.

2) Deploying Defensive Booms, etc.

If methods mentioned above can not contain or disperse oil films, deploying defensive booms or fishing nets filled with wood chips and bulldozing sand barriers are effective to prevent damages in adjacent areas. The booms, etc. must be deployed before the oil arrives. Prior careful planning for selection of locations and means of deployment, etc. is necessary. Suitable boats, communications and well-trained, experienced personnel are needed also for immediate and appropriate deployment. Subsequently, the spilt oil must be skimmed and pumped in order to collect, store, transport and dispose appropriately.

In bad weather, the oil will escape past the booms. But at least every conceivable effort such as using absorbent materials must be taken in order to contain the oil and minimize damage.

3) Establishment of System

In case of extremely large-scale oil spill, a party responsible for the accident alone can not deal with such a situation. Various related parties must cooperate each other to alleviate the disaster. Therefore, a system to cope with accidental oil spills should be established.

It is desirable that each ADPEL establishes a committee consisting of DGSC, KANWIL, ADPEL, port administrator and representative of province, etc. for collecting information and coordinating the related parties. In addition, it is desirable to set up units that clarify the individual roles of each party. Individual port administrators should always have certain equipment such as oil recovery vessels, oil fences and oil treatment agents. And, proper information network should be established in order to unify and share information.

7.4.3 Promoting Sea Transportation from the Viewpoint of Environmental Conservation

In urban areas, the environmental issues such as air pollution and noise/vibration by

vehicular traffic need to be solved. The efficiency of urban activities needs to be raised through the mitigation of traffic congestion. The conversion to transport with high energy efficiency should be accelerated so that the energy consumption can be saved and the emission of CO_2 which causes the green house effect of the earth and SO_2 which is causative of acid rain can be reduced.

In Indonesia, it is reported that one fourth of total CO_2 emissions by using fossil fuels was from the transportation sector and over 90 percent of that were discharged from vehicular traffic. (source ; The Basic Study On Strategic Response Against The Global Warming, Climate Change And Their Adverse Effects, 1992, Japan Environment Agency)

The sea and railroad transportation are both highly energy efficient and gentle to the environment (see Table 7.4.5). Because of their high transportation capacities, the so-called "Modal Shift" can assist in the reduction of labor, dissolution of traffic congestion, saving of energy and conservation of the global environment. Figure A 7.4.1 shows the co-relation between cargo volume share and travel distance by transport means in Japan. It indicates that vessels tend to be used for long distance transportation.

Table 7.4.5 Environmental Characteristics by Transport Means

Means	Cargo Volume (million ton • km / labor)	Cargo Volume (ton / one time)
Truck	0.264	5~10
Railroad	2.225	500~650
Vessel	3,712	3,000~5,000

Means	Energy Consumption (kcal / passenger • km)	CO_2 Emission (C-g / passenger • km)
Vehicle	580	44.6
Taxi	1,295	89.3
Public Bus	247	19.4
Railroad	100	4.7
Ferryboat	295	23.9
Aircraft	394	30.2

Means	Energy Consumption (kcal / ton • km)	CO_2 Emission (C-g / ton • km)
Truck	616	48.3
Railroad	114	5.9
Vessel	120	9.7
Aircraft	5,250	402.4

Source : Japan Transport Economic Research Center

Increased capacity and efficiency of transportation and the unification of sea and railroad transportation should be striven for in order to improve the environment. The access between the wharves and passenger terminals and the trunk roads and railroad stations should be strengthened through the construction of road, railroad, chassis yards and car parks, etc. In order to promote the domestic trade by ferryboat or Ro-Ro vessels, unit load terminals and ferry terminals should be constructed or expanded.

Interagency cooperation, especially with agencies responsible for road and railroad planning, is very important. Port administrator should appeal to such responsible agencies to strengthen the urban land transportation network between ports and inner cities.

7.4.4 Basic Concepts for Port Environmental Consideration

(1) Importance of Environmental Consideration

A port development planner must consider environmental conservation and pollution prevention in addition to economic and technical aspects. The result of the environmental consideration can lead the planner to change the project. Although design changes resulting from EIA findings may increase capital costs, the value of avoiding negative impacts and maximizing positive impacts will outweigh the costs of design changes in the long term.

Environmental impact is defined through the analysis of physical, chemical, biological and social factors which have the potential to impact on all organisms directly or indirectly, immediately or in future. Environmental consideration should be executed by identifying, estimating and dealing with all impacts.

The EIA procedure in Indonesia is enforced just before the construction works. Environmental conservation in port development should be considered from the beginning of planning because of its size. It needs to be fully discussed and reflected in formulating the port master plan. Substantial alterations to the port master plan should be considered according to the degree of environmental impacts.

(2) Factors to be Considered

In an undeveloped area, preservation of the natural resources is rather important. In urban areas, improvement of the present environmental circumstances should be stressed. Although the air or water quality in natural areas such as Eastern Indonesia can be examined by relatively simple measures, prudent examinations for fauna and flora or scenic view might be needed. On the other hand, in urban areas where the environmental situation is not always good, prudent examinations of the air and water quality are required. There will not be serious problems concerning fauna and flora in urban areas.

In the previous EIA reports reviewed in this study, many items were estimated only

qualitatively. To suitably grasp each environmental impact factor, the impacts should be analyzed quantitatively as much as possible. And it is desirable to select and use suitable estimation methods according to the magnitude of impacts and present circumstances of the project area. All results of analysis must be illustrated in detail. In addition, an EIA report must clarify how environmental information is assembled, analyzed and used in selecting, planning, designing and executing of the project. And, it is very important to clearly indicate the basis of evaluation.

(3) Scope of EIA

The Ministry of Communication has established the Technical Guidelines on the Environmental Impact Assessment for Harbor. The guideline says the boundary of EIA and collection of basic data can be limited according to available money, time or manpower. But, EIA should cover all related areas. If existing data are not adequate to predict and evaluate the impacts, field survey must be conducted in order to collect all needed data. Particularly, the scale of port development is generally large and environmental impacts extend across a wide area. Accordingly, determination of the subject area is very important.

Several existing EIA reports are insufficient, for instance, in the aspect of grasping future traffic demand of adjacent areas. In EIA, future environmental circumstances of the port and adjacent area need to be envisioned as clearly as possible. Therefore, future background of air and water quality, etc. including the impacts which will be not always directly related to the port development or activities should be grasped as accurately as possible and reflected in the evaluation.

(4) Necessity of Detailed Standard for EIA

The contents of EIA reports reviewed in this study are not always sufficient. The bases of prediction and estimation as a whole are obscure. In particular, soil erosion and soil contamination were not sufficiently covered. This is likely due to the lack of firm standards or guidelines.

Considering the need for high accuracy in an EIA report, the EIA guideline seems to be insufficient in the aspect of methods or standards for extraction, analysis and evaluation of the environmental impacts. As a result, analysis procedure tends to depend on the experience and subjective opinions of the individual person in charge. This means that the preparation of EIA report will be very difficult, time consuming and costly.

Therefore, detailed standards or guidelines of environmental consideration need to be established. Countermeasures for minimizing negative impacts and maximizing positive impacts as well as the methods for estimation of the environmental impacts should be indicated in the guidelines.

(5) Necessity of Proper Monitoring System

There is an environmental monitoring system already in Indonesia. But, it seems to be obscure in the aspects of obligation and responsibility to implementation, scope and publicity. In actual fact, the monitoring survey, as a part of the EIA procedure, is hardly conducted in spite of being obligated. An entrepreneur who does not implement the monitoring should be given a certain penalty. In Japan, the name of such an entrepreneur is officially announced.

It is very important that an adequate monitoring system is established and securely implemented so that various data can be accumulated and reflected in other port projects. An adequate monitoring system is very effective for future development projects. For instance, there will be a number of impacts occurred by induced development, which tend to be overlooked in the planning stage. Some of these impacts can be predicted by past experience.

(6) Public Participation

It is important to hear the opinions of people who could be affected by the proposal, particularly those who live near the proposal site. This is because an impact may be significant for the people living and working near the site even if it may not be so to the experts. Local people may have more information and insights not available to an outsider. It is also necessary to investigate the characteristics of ethnic/tribal groups, occupational groups, socioeconomic stratification, age and gender in the proposed area, because each groups may be affected in different ways, to different degrees and in different locations.

The necessity of public participation will be elevated accompanied with the progress in living and educational standards. Public participation may be time consuming and increase costs, but conflicts and delays can be minimized by gaining the public's acceptance.

The "right-to-know" of any community that may be affected by a project should be respected. They need information on the project cycle, decision making process and related regulations. In addition, they want to know how and when they may intervene and how they can influence the project. Everyone should be able to receive the same basic information about the project. Therefore, it is desirable that a meeting with representatives of affected groups and relevant NGOs be held in the early stage of planning, which can lead to securing public confidence in a fair environmental analysis and decision making process and facilitate following processes.

All reports related to EIA must be made public. The opinions of residents should be accurately grasped and reflected in each EIA report. Therefore a certain report which refers to the public opinions and views of the proponent obtained in the course of the formation of a port master plan should be made public. In addition, to grasp the effect of the countermeasures for environmental conservation and to make improvements to the

environment, if necessary, the system of the post-EIA based on the monitoring results should be established. Post-EIA documents including collection and analysis of monitoring data can be effectively used by agencies responsible for taking remedial action or by those who could improve future projects. The time and manner in which findings of the post-EIA report will be made public must be included in the EIA report.

(7)Reinforcement of Organization

Environmental concerns should be considered through all of planning, financing, implementation, monitoring and enforcement activities. Therefore, special environmental units should be established within DGSC in order to be directly involved with environmental issues. In large and intersectoral projects, environmental units are necessary at the project level to monitor impacts and implementation of mitigation measures and to promote information exchange across sectoral and agency boundaries.

In case of establishing such units, two factors deserve special attention. First, the units must be empowered not only to carry out EIA work but also to use EIA findings to influence the design and implementation of projects. Second, since there is a tendency for such units to become isolated from other agencies involved in the development process, lines of communication and operating procedures should reinforce integration. Coordination with local and state permit-issuing agencies is especially important, because project implementation and operation may impose burdens directly or indirectly upon the local governments.

(8) Environmental Management

A port environmental management plan should be established. And based on that, the port administrators should preserve the environment, accurately grasp the environmental situation and make efforts to appropriately maintain the environment with the cooperation of related organs. For the reduction of pollutant loads and improvement of the port environment, cooperation with the administrators of sewage or rivers is necessary. The relationship and cooperation with enterprises or other administrative organs will need to be enhanced through the establishment of a certain committee.

The by-products such as coal ashes, slugs, dredged sand and concrete lumps produced from construction and operation of the port should be recycled as materials for port construction. And collection of garbage and oil in the port should be regularly performed.

(9) Securing of Amenity and Access

Urban waterfronts will not only be used for conventional purpose but will also be an integral part of the community. Along with the improvement in living standards and changes in people's lifestyle and perceptions, people will become more conscious of their

living environments. The more mature and sophisticated urban life is, the greater the need for waterfronts becomes. Parks, promenades, fishing places, restaurants and shops, etc. available at waterfronts should be dealt with in the port planning. Ports will need to contribute further to the creation of an environment where people can live and enjoy their lives by meeting other people and encountering other cultures. It is a direction which needs to be carefully looked at in coming years.

7.5 Navigation Safety and Channel Maintenance

7.5.1 Safe Navigation Control in Port Basin, Long Sea and River Channel

(1) Formulations of Sailing Rules in Ports and Prescribed Channels

It is desired to formulate sailing rules in ports and prescribed channels to assure the safe navigation of vessels and maintenance of good order in ports.

Although some port authorities have been formulating a set of sailing regulations, which are in force within their administrative water areas, a fundamental law stipulating common essential provisions and covering entire Indonesian ports is desired. In addition to this, detailed regulations should be provided by the Minister of Communication to meet local circumstances.

The said fundamental law should contain the following provisions:

- Object of this law
- Ports and physical limits thereof to which law applies
- Priority of this law in the case of contradictory stipulation of INTERNATIONAL REGULATIONS
- Prescribed channels and rules of sailing including; following the channels, keeping clear of vessels proceeding the channels, restriction on anchoring/overtaking/parallel heading in the channels
- Keeping starboard side of the channel in possible meeting situation
- Priority of departing vessel to entering vessel in possible meeting at the channel entrances
- Keeping such a speed as not to endanger other vessels
- Miscellaneous vessels'(launches, lighters, small boats) obligation of giving way to vessels other than miscellaneous vessels
- Preservation of the environment of the port area
- Commission Minister of Communications to prescribe additional regulations by Ministerial Decree concerning the navigation of vessels in certain stipulated ports.

While the additional regulations should include:

- The maximum size of vessel(GRT/length/draft) to the designated port
- Compulsory or non-compulsory pilotage/tugboats
- Specified signals at the port
- Any restricted time zone of in-coming and out-going the port

- Necessary information prior to entering the port
- Other specified sailing regulations at the port.

(2) Revision of the Pilotage System

The existing pilotage system, as already stated in PROGRESS REPORT 8.4, should be reviewed in terms of further establishment of pilotage districts and additional pilots, in particular, to cope with the increasing vessel traffic. In this connection, however, the lowest limit of objective vessel size can be raised from a 150GRT to a 500GRT for foreign vessels and a 3,000GRT for national vessels from the viewpoints of their relatively easy maneuverability, shallow draft in turn, and low rate of accident of smaller vessels.

Some reports concerning pilotage furnish suggestive information on the latest world pilotage system as follows:

1) Objective vessel of compulsory pilotage

Most countries classify vessels into national and foreign, and compulsory pilotage for foreign vessels can be divided into three groups;

(a) Countries regulating for entire foreign vessels

USA, Canada (Atlantic coast), France, Portugal, Australia, and China

(b) Countries regulating by the vessels' GRT

Canada (The Great Lakes)	300GRT
(Pacific coast)	350
Germany	1,000
Italy	500
Spain	50
New Zealand	100
Korea	500
Taiwan	500
Hong Kong	1,000
Singapore	300

(c) Countries regulating by the vessels' length

Australia (Queensland, Torres Strait)	70m	(approx.	600GRT)
Netherlands	65m	(	500)
UK	61m	(	450)
Thailand	50.29m	(	400)

(Source: Japanese Pilots' Association, 1994)

2) Establishment of compulsory pilot district

(a) Countries whose entire pilot districts are compulsory

USA, France, Germany, Italy, the Netherlands, Portugal, Spain, UK, Australia, New Zealand, and Hong Kong

(Source: Japanese Pilots' Association, 1994)

(b) Countries with compulsory and non-compulsory districts

Canada;	Atlantic coast	partial compulsory
	Lawrence district	compulsory except estuary
	The Great Lakes	compulsory except few exception
	Pacific coast	entire compulsory
Belgium		only Scheldt district is compulsory
Korea		8 among 11 districts are compulsory
Thailand		3 among 7 districts are compulsory

(Source: Japanese Pilots' Association, 1994)

3) Further facts about pilotage districts, number of pilots, age, qualifications, employment, relay system, license validity and compulsory pilotage in some maritime countries are summarized in Table 7.5.1.1.

Table 7.5.1.1 Facts about Pilotage in Maritime Countries

	JAPAN	KOREA	HONGKONG	NETHERLANDS	GERMANY	FRANCE	USA		
							ENTIRE	NY/NJ	FRISCO
General									
Districts/Pilots	39 / 705	11 / 102	68	4 / 780	7 / 936	21 / 347	58/1,100	99	59
Average Age Oldest/Youngest	62 72 / 48	56 67 / 48	45 67 / 30	NA	52 65 / 34	47 58 / 30	NA	NA 65-70/30	48 74 / 32
Qualifications	·National ·1st C. Certificate ·3Ys. Capt. Career ·State Examination ·3 Ms. Apprentice	·National ·1st C. Certificate ·7 Ys. Capt. Career ·State Examination ·6 Ms. Apprentice	·National ·1st C. Certificate ·Capt. Career ·State Examination ·6 Ms. Apprentice	·--- ·1st C. Certificate ·--- ·1 Y. Apprentice ·Pilot Examination	·EC Citizen ·1st C. Certificate ·6Ys Capt./Mate C.	·Unrestricted ·1st C. Certificate ·6 Ys Sea career including 4Ys mate ·6 Ms. Apprentice ·Pilot Examination	—	·National ·Special training system for 7.5 Ys	·National ·1st Class. Certificate ·2 Ys Capt. ·1-3 Ys Apprentice ·Pilot Examination
Employment	Independent	Independent	Independent	Independent	Independent	Independent	Independent	Independent	Independent
Relay System	Bay-Port	None	None	River-Dock	Bay-River-Dock	Sea-River-Dock	—	Sea-Dock	None
License Validity	5 years	3 Years	1 Year	No limitation	No limitation	No limitation	—	2 Years	1 Year
Compulsory Pilotage									
Districts	11	8	Entire	Entire	Entire	Entire	Entire	Entire	Entire
Objective Vessel	·Foreign vessels over 300 GRT ·National vessels Ocean going over 300 GRT Coaster over 1,000 GRT ·(Tokyo, Kobe) over 10,000 GRT	· Foreign vessels over 500 GRT ·National Vessel. Ocean going over 500 GRT Coaster over 1,000 GRT	·Vessels over 1,000 GRT ·Vessels over 5,000 GRT bounding anchorage ·Vessels over 1,000 GRT carrying dangerous goods	·Vessels carrying dangerous goods ·Vessels over 65 m in length	·Vessels over 1,000 GRT ·Vessels over 300 GRT carrying dangerous goods	·All vessels	—	·Foreign vessels ·National vessels for overseas service	·Foreign vessels ·National vessels for overseas service and specified coastal service
Exemption	·Coast guard Vs ·Coastwise liners	—	Warship	·Warship ·State owned vessels under 65 m, tugs and dredgers ·Fishing boats ·Pilot boats	Certain level of Capt.'s capability; Experience, German language, Local knowledge and vessel's equip.	—	—	—	Home waters liners

Source: Japan Association for Preventing Marine Accidents, 1996 Report

(3) Reinforcement of tug fleet

Ocean-going vessels that reduce their headway under several knots before berthing normally lose almost all rudder function and in turn their own maneuverability, consequently, the assistance of tugboats is indispensable to control turning/berthing of the vessels. Port authorities, accordingly, should provide capable tugboats to ensure a safe and smooth flow of calling vessels and to promote port productivity.

1) Required number of tugboats

(a) The total required number of tugboats per year (X) would be estimated based on following factors of each port.

X = Objective calling vessels per year x 2(in & out) x required tugs per operation*

* Tugs per operation: 1.5(minor ports) to 1.8(major ports) can be assumed based on actual numbers at similar international ports.

The number to be provided at each port (T) will be derived from following reckoning, respectively.

T = X ÷ (Rate of Actual working days per tug*) ÷ (Average dispatch frequency/tug/day**)

* With exception of 35 repair/docking days: 330/365

** Average dispatch frequency varies from 4 to 10 depending on the geographical features of a district, the working conditions of crew, the tug's performance and others.

(b) Desired output, fleet composition, and propulsion type

It is widely accepted in most developed ports that HP output of a tugboat should be equivalent to 8 – 10% of a mother vessel's DWT, in order to adequately assist a vessel in maneuvering under a normal condition.

The said output of 8 – 10%HP means the total power of tugboats for an objective vessel, and hence in case of a 60,000DWT vessel, two tugboats of 3,000HP each would be perfectly acceptable rather than one 6,000HP tugboat.

Not only large vessels but also some small and medium vessels (3,000 to 10,000DWT) require tugboats, thereby powerful tugboats are not needed at all times. The tug fleet at a port should accordingly be comprised of an appropriate composition of small, medium and large powers to meet the anticipated calling vessels.

Also, it should be noted that a maneuvering tugboat must not only pull/push an objective vessel but must also be able to maneuver quickly and precisely to respond to the ship handler's intentions. Thereby those tugboats known as Z-peller/Duck-peller type equipping with twin-rudder-propellers to enable the thrust to be pointed in any direction throughout a 360° range, and which are being widely used in major ports, are most recommendable.

(c) Other related problems

a) Privatization of tugboat operation

The operation of tugboats should be transferred to the private sector in order to produce effective services for users together with economical results for operators. In most developed ports, the operation has been privatized, e.g. operations have been privatized at over 470 among some 500 Japan's ports accommodating oceangoing vessels.

b) Replacement of aged tugboats

According to collected information on existing tugboats, the number of capable tugboats is generally insufficient with the exception of some major ports. The accepted wisdom is that the life of a tugboat is 25 years, and therefore the replacement of aged ones should be systemacally carried out to prevent accidents from deterioration.

Some examples concerning tugboat operation in Japan's ports are shown in Table 7.5.1.2.

Table 7.5.1.2 Stationed tugboats in Japan's ports

Ports	Calling vessels in 1995					Stationed tugboats		
	Overseas service			Domestic service	Total amount	Amount	Ave. output	Ave. age
	Over 3,000 GRT	Over 6,000 GRT	Over 10,000 GRT	Over 6,000 GRT				
Ishiariwann	29	7	3	4	43	1	2,000	18.4
Kushiro	173	28	200	205	606	4	2,300	12.1
Tomakomai	339	60	453	517	1,369	9	2,928	8.5
Murorann	52	20	246	26	344	7	2,534	17.8
Hakodate	96	12	71	142	321	4	2,250	24.1
Noshiro	21	2	30	3	56	2	3,200	11.3
Sakata	134	1	53	4	192	3	2,900	18.4
Niigata	393	76	307	44	820	7	3,185	4.4
Naoetsu	79	49	79	3	210	1	3,100	4.1
Fushikitoyama	456	60	200	21	737	3	2,900	13.2
Nanao	58	1	49	4	112	1	3,100	7.2
Fukui	13	1	6	2	22	1	1,660	19.7
Tsuruga	152	8	73	3	236	3	2,600	21.3
Hatinoe	88	45	290	194	617	6	3,266	8.7
Miyako	107	5	40	1	153	1	2,100	25.3
Kamaishi	-	-	31	1	32	3	3,000	19.8
Ishinomaki	225	21	200	-	446	2	3,100	9.7
Shiogama	158	3	226	668	1,085	5	3,000	10.9
Souma	10	1	76	-	87	4	3,325	3.3
Onahama	90	32	279	49	450	5	3,000	6.2
Hitachi	37	26	133	173	369	6	2,883	10.8
Oharai	-	-	7	7	14	1	2,400	24.6
Kashima	454	157	813	90	1,514	7	2,665	10.7
Kisarazu	223	22	429	209	883	4	3,700	5.0
Chiba	735	173	1,942	306	3,156	14	3,307	6.8
Tokyo	930	494	2,702	540	4,666	12	3,183	7.0
Kawasaki	383	262	1,256	160	2,061	2	2,500	17.9
Yokohama	2,467	1,967	5,871	340	10,645	37	3,154	5.3
Yokosuka	21	13	202	317	553	10	3,060	7.5
Tagonoura	20	5	137	2	164	1	1,300	11.6
Shimizu	232	114	1,105	95	1,546	7	2,885	6.6
Omaezaki	34	7	15	197	253	1	2,600	11.6
Mikawa	168	42	684	140	1,034	7	3,371	12.2
Kinuura	135	30	259	7	431	2	3,450	10.0
Nagoya	1,507	1,087	4,642	647	7,883	24	2,758	9.0
Yokkaichi	121	95	767	29	1,012	3	3,333	7.6
Wakayama-shimotsu	214	49	416	12	691	8	2,600	12.7
Sakai-sennboku	509	273	725	154	1,661	19	2,946	8.7
Osaka	1,733	1,159	3,002	370	6,264	30	2,564	14.2

(continued)

Ports	Calling vessels					Stationed tugboats		
	Overseas service			Domestic service	Total amount	Amount	Ave. output	Ave. age
	Over 3,000	Over 6,000	Over 10,000	Over 6,000				
Kobe	1,480	1,121	2,785	153	5,539	35	2,307	11.3
Higasiharima	187	69	216	-	472	1	3,600	4.3
Himeji	264	53	360	36	713	6	3,300	9.1
Uno	39	18	109	20	186	2	2,800	17.9
Mizushima	386	76	994	63	1,519	20	3,280	9.5
Fukuyama	284	44	382	-	710	6	2,533	15.3
Onomichi-Itozaki	62	15	71	58	206	3	2,533	19.7
Kure	9	1	139	6	155	4	3,300	6.8
Hiroshima	203	60	500	74	837	8	3,025	16.2
Iwakuni	79	38	258	35	410	2	3,300	16.5
Tokuyama	183	109	391	222	905	9	3,000	11.5
Ube	146	37	291	283	757	2	2,900	16.7
Sakaide	64	24	333	43	464	5	3,540	5.4
Imabari	64	12	72	1	149	8	2,293	14.2
Matsuyama	48	63	103	7	221	3	2,866	19.9
Komatsujima	142	42	129	4	317	2	3,100	10.8
Shimonoseki	42	17	101	9	169	1	2,000	28
Kitakyusyu	912	657	1,123	41	2,733	19	2,797	16.9
Hakata	234	448	658	384	1,724	8	3,350	6.5
Imari	127	59	46	-	232	3	3,033	9.6
Sasebo	3	6	24	163	196	10	2,076	21.0
Nagasaki	52	8	71	5	136	7	2,828	13.8
Yatsushiro	43	6	71	1	121	2	2,900	22.5
Kanda	137	64	383	389	973	5	3,040	9.1
Ooita	148	40	519	17	724	10	3,310	11.8
Saeki	24	13	103	8	148	1	2,400	25.3
Hosojima	15	16	82	5	118	1	2,600	15.8
Shibushi	71	6	120	3	200	3	3,366	15.2
Kagoshima	40	12	110	110	272	4	3,165	13.5
Kiire	-	-	183	228	411	1	3,200	14.7
Naha	41	39	118	499	697	3	2,833	17.4
Nakagusuku-wan	32	8	116	19	175	3	3,200	14.4
Kin-wan	101	2	126	25	254	9	1,995	12.9
Total	2,595	1,668	4,482	2,052	10,797	473	2,878	11.0

Source: Japan Tugboat Owners Association, 1997

(4) Additional installation/upkeep of navigational aids

As stated in Progress Report 8.3, the captioned service has been carried out by DGSC since 1985 in accordance with the phased schedule, which was originally furnished by a JICA study team.

However, present situation requires additional installations and comprehensive maintenance in order to accommodate the growing vessel traffic and also to prepare for the establishment of new international sea-lanes.

The additional installation is reaching to the entire Indonesian waters thereby the detailed planning should be carried out for this purpose in particular. In connection with this, all the lighted-buoys should be equipped with solar batteries to promote reliability and maintenance efficiency.

However, it should be noted that even the life of a solar battery system is not permanent. Typical service lives are as follows:

- Lantern 5 – 10 years
- Electric bulb 500 h
- Battery 3 – 5 years
- Solar battery 5 – 10 years
- Buoy chain 2 – 4 years
- Painting 2 – 4 years

(5) Additional DGSC duties concerning the control of safety

1) The implementation of The International Safety Management Code (ISM Code)

With the amendments to the International Convention for the Safety of Life at Sea (SOLAS), 1994, which introduced a new chapter IX into the Convention, and will become effective 1 July 1998, the International Safety Management (ISM) Code has been made mandatory.

The objectives of the Code are to ensure safety at sea, prevent human injury or loss of life, and avoid damage to the environment, in particular to the marine environment and property.

The chapter applies to ships, regardless of the date of construction, as follows:

- passenger ships including passenger high-speed craft, not later than 1 July 1998;
- oil tankers, chemical tankers, gas carriers, bulk carriers and cargo high-speed craft

of 500GT and upwards, not later than 1 July 1998; and

- other cargo ships and mobile offshore drilling units of 500GT and upwards, not later than 1 July 2002.

Previously, vessels and the captains had been forced to comply with the existing conventions in every way, e.g. **SOLAS** regarding the structure/equipment of vessels, **STCW** on the training/certification/watch-keeping of seafarers and **MARPOL** concerning the prevention of pollution from ships respectively. However, the new Code requires not only the ship but also the company (owner, manager or bare-boat charterer who has assumed the responsibility for operation of the ship) to be responsible for the prevention of marine disasters.

Consequently, the Administration (MOC) should carry out the certification/verification and oversee a safety management system of the companies/vessels, which are detailed in the Code. The concrete jobs concerning the matter are handling, probably, by the Port State Control Officers, and training/stationing of capable officers should thus be commenced as soon as possible.

2) Collecting information on navigation safety

DGSC has many different sections, which are responsible for the various aspects of navigation safety (see PROGRESS REPORT 8.2).

The great number of sections makes its difficult to collect/exchange information and form a coherent and updated policy. Therefore, an appropriate organization or committee should be established to perform such tasks.

(6) Removal of wrecks

It can be presumed that some of the submerged wrecks lying in close proximity to the access channels and within ports have been dispersed. However, the position and state of remaining obstructions need to be identified.

Removal of such obstructions should be planned/carried out by the Administration as an important project. According to the latest UK chart, examples of existing obstructions are shown in Table 7.5.1.3.

Table 7.5.1.3 Examples of Existing Wrecks and Obstructions

Objects	Position		Nav. aid	Reference chart (UK)
	Latitude	Longitude		
Belawan				
Wreck	3° - 55.1 ´ S	98° - 43.9 E	None	3584
Wreck	3° - 54.1 ´ S	98° - 45.1 E	None	3584
Wreck	3° - 46.9 ´ S	98° - 40.6 E	Light buoy	3584
Pontianak				
Wreck	0° - 05.3 ´ S	109° - 06.1 E	None	3721
Wreck	0° - 05.3 ´ S	109° - 06.1 E	None	3721
Cirebon				
Wreck	6° - 40.1 ´ S	108° - 35.8 E	None	918
Wreck	6° - 40.6 ´ S	108° - 34.8 E	None	918
Palembang				
Wreck	2° - 11.5 ´ S	104° - 57.1 E	None	3476
Wreck	2° - 11.8 ´ S	104° - 57.1 E	None	3476
Wreck	2° - 12.3 ´ S	104° - 56.4 E	None	3476
Wreck	2° - 12.7 ´ S	104° - 56.1 E	None	3476
Wreck	2° - 12.7 ´ S	104° - 55.1 E	None	3476
Wreck	2° - 18.3 ´ S	104° - 55.1 E	Light buoy	3476
Wreck	2° - 25.7 ´ S	104° - 55.8 E	None	3476
Obstruction	2° - 34.6 ´ S	104° - 56.4 E	None	3476
Obstruction	2° - 48.7 ´ S	104° - 54.6 E	None	3476
Obstruction	2° - 53.6 ´ S	104° - 53.7 E	None	3476
Tanjungpriok				
Wreck	6° - 03.2 ´ S	106° - 52.2 E	Light buoy	932
Wreck	6° - 03.5 ´ S	106° - 52.4 E	None	932
Wreck	6° - 04.2 ´ S	106° - 52.3 E	Light buoy	932
Wreck	6° - 05.4 ´ S	106° - 53.1 E	None	932

(Continued)

Objects	Position		Nav. aid	Reference chart (UK)
	Latitude	Longitude		
Banjarmasin				
Wreck	3° - 37.4 ´ S	114° - 26.8 E	None	3015
Wreck	3° - 20.5 ´ S	114° - 34.7 E	None	3015
Wreck	3° - 20.0 ´ S	114° - 33.1 E	None	3015
Wreck	3° - 20.1 ´ S	114° - 35.3 E	None	3015
Tanjungperak				
Wreck	6° - 52.6 ´ S	112° - 44.2 E	Light buoy	921
Wreck	6° - 52.8 ´ S	112° - 44.2 E	None	921
Obstruction	6° - 53.8 ´ S	112° - 43.8 E	None	921
Obstruction	6° - 54.0 ´ S	112° - 43.6 E	Light buoy	921
2 Obstructions	6° - 54.2 ´ S	112° - 44.0 E	None	921
Wreck	6° - 54.4 ´ S	112° - 43.5 E	None	921
Wreck	6° - 56.0 ´ S	112° - 43.0 E	None	921
Wreck	6° - 58.2 ´ S	112° - 42.1 E	None	921
Obstruction	7° - 01.6 ´ S	112° - 40.3 E	None	921
Wreck	7° - 06.8 ´ S	112° - 39.3 E	None	921
2 Wrecks	7° - 11.0 ´ S	112° - 43.2 E	None	921
4 Wrecks	7° - 11.3 ´ S	112° - 43.3 E	None	921
Wreck	7° - 11.4 ´ S	112° - 43.4 E	None	921
Wreck	7° - 11.5 ´ S	112° - 43.6 E	None	921
Wreck	7° - 11.2 ´ S	112° - 43.7 E	None	921
Wreck	7° - 11.2 ´ S	112° - 43.9 E	None	921
Wreck	7° - 11.0 ´ S	112° - 43.6 E	None	921
2 Wrecks	7° - 11.5 ´ S	112° - 44.1 E	None	921
Wreck	7° - 11.7 ´ S	112° - 43.9 E	None	921
Obstruction	7° - 11.5 ´ S	112° - 43.8 E	None	921
Obstruction	7° - 11.6 ´ S	112° - 43.3 E	None	921
Obstruction	7° - 11.9 ´ S	112° - 43.8 E	None	921
Obstruction	7° - 12.0 ´ S	112° - 43.7 E	None	921
Wreck	7° - 10.8 ´ S	112° - 44.1 E	None	921
Wreck	7° - 10.7 ´ S	112° - 44.2 E	None	921
Wreck	7° - 10.6 ´ S	112° - 44.2 E	None	921
Wreck	7° - 10.5 ´ S	112° - 45.0 E	None	921
Obstruction	7° - 10.2 ´ S	112° - 47.0 E	None	921
Wreck	7° - 10.4 ´ S	112° - 45.8 E	None	921
Wreck	7° - 11.4 ´ S	112° - 45.9 E	Buoy	921
Wreck	7° - 19.0 ´ S	112° - 53.0 E	Castor	921
2 Wrecks	7° - 14.1 ´ S	112° - 50.8 E	Lateral buoy	921

(7) Expanding the System of Vessels Inspection

The Government has ratified almost all of the International Maritime Conventions on Ships and Navigation Safety (see Progress Report 8.1). Therefore, as far as the foreign going Indonesian vessels are concerned, which are being forced to comply with the various codes of the Conventions, there have been no problems on seaworthiness to date.

The domestic trade vessels, however, are not under the laws/regulations and being applied only corresponding the international codes, therefore most of the domestic vessels remain in substandard conditions in terms of the structure, equipment and operation.

Consequently, it could be pointed out that the state of the above would be one of the causes of primarily preventable sea accidents. For example, many ill-maintained aged vessels, which have insufficient stability or are poorly equipped have been operating in service. The recent capsizing of a ferryboat in Lombok Strait (resulting in loss of 60 lives) and the fact that traditional motorized sailing boats, which are not subject to Governmental inspection, reportedly account for 30% of the total sea accidents should be kept in mind.

The maritime authority should take the following steps:

1) Formulating the remaining technical provisions related to the ratified International Conventions, Shipping Law 21(1992), regardless foreign/domestic trade, e.g. ship's stability, ship's inspection, plying limit, maximum passengers, load line, life-saving/fire-fighting apparatus in particular.

2) The traditional motorized sailing vessels, which are exempt from registering in Indonesian Ship Classification Society, total about 3,000, and carry 20% of domestic seaborne cargoes.

   Considering their important role in shipping activities together with the high rate of sea accidents, it is no longer appropriate to exempt them from being treated as maritime legal objects. Regulating them from the viewpoint of safety, as soon as practicable, is most desired.

3) In all, 250 harbormasters qualified as ship inspectors, 200 marine inspectors, 12 radio inspectors, 30 MARPOL inspectors and 75 measuring inspectors are stationed at Indonesian ports. However, there are few A class inspectors who are capable of ensuring compliance with International Conventions, and therefore additional inspectors with better qualifications are urgently required.

(8) Expanding the System of Search and Rescue

The National Search and Rescue Agency, which is one of the organizations under the Ministry of Communications controls this system. The Agency acts as an information center concerning sea accidents and also regulates search and rescue activities.

The central body responsible for the implementation of search and rescue is the Directorate of Coastguard and Rescue under the Directorate General of Sea Communications, MOC. Entire Indonesian waters are divided into nine sections, which are supervised by the nine Maritime District Offices (KANWIL), and are sub-divided into 45 sections, in which bases of Coastguard (KPLP) are stationed respectively.

It is anticipated that sea accidents will naturally increase with the increase of vessel traffic, therefore it is necessary to expand the System as follows.

1) Reinforcement of rescue fleet

JICA has furnished an appropriate scale of rescue fleet to cope with anticipated sea accidents, which would occur in a random way, using Poisson's ratio as follows:

Item / Size	Required V. (a)	Existing V. (b)	Net Additional (a) – (b)	Aged Boats to be Replaced(c)	Required New V. (a)-(b)+(c)
I - A	6	0	6	0	6
I - B	5	0	5	0	5
II	21	9	12	0	12
III	33	14	19	5	24
IV	37	38	- 1	3	2
V	62	66	- 4	3	-1
Total	164	127	37	11	48

Source: JICA Report on Search &Rescue System, 1988, with partly revised by OCDI based on 1998 data
Remark:I - A; 1,000GRT Class, 74 m L, 10 m B, 5 m D, 1,500 ps x 2, 15 kn, a 5,000 M continual running
I - B; 500GRT Class, 59 m L, 8 m B, 4.5 m D, 1,300 ps x 2, 15 kn, a 3,000 M continual running
II ; 100GRT Class, 35 m L, 6.3 m B, 3.4 m D, 2,400 ps x 2, 26 kn, a 520 M continual running
III ; 93GRT Class, 24 m L, 6.0 m B, 2.85 m D, 540 ps x 2, 16 kn, a 350 M continual running
IV ; 37GRT Class, 18 m L, 4.3 m B, 2.3 m D, 450 ps x 2, 21kn, a 200 M continual running

Although the above table was made in 1988, there is no change in the situation in general, and it remains instructive.

2) Updating the system of information/communications

Sea accidents involving Indonesian domestic trade vessels account for 80% of the total,

resulting in serious damage to lives and properties. However, there is no legal obligation to equip radio apparatus on domestic vessels, and consequently, a prompt rescue operation can not be conducted when an accident occurs.

Considering that there are many small ship owners in domestic trade circle, and the difficulties of installing a power source in these vessels, owners should be forced instead to installing the cheap and dry cell type signal buoy known as EPIRB (Emergency Position Indicating Radio Buoy).

Furthermore, to keep pace with continually evolving tele-communication age, up-dating the following systems are required:

1) Provision of service for Global Maritime Distress and Safety System (GMDSS)

The service will be required from November 1999 to comply with SOLAS Convention. Coastal radio stations will have to commence the service, and foreign going vessels over 300GRT also have to equip the apparatus.

2) Replacement of deteriorated/damaged equipment

3) Reinforcement of equipment at the Fourth class coastal stations

4) Retraining officials concerned and up-dating training facilities

7.5.2 Maintenance of Navigational Channels

(1) The Current Situation of Maintenance Activities on Major Navigational Channels

Among the major Indonesian ports, channel maintenance requirements are considered critical mostly at the six ports of Belawan, Palembang, Banjarmasin, Pontianak, Samarinda, and Jambi. The navigational channels of the above six ports are located at the estuaries of the rivers which carry the large amount of sedimentation materials. As a consequence, the total annual maintenance dredging volume and cost of the six ports are recorded 9,900,000 m^3 and 29,884 million Rp in the year of 1997, of which percentage in those of all Indonesian ports (except for dredging for some special ports and for minor dredging in small river ports, if any) are 74.1% in dredging volume and 70.9% in dredging cost. Table 7.5.2.1 shows Dredged volume at the six ports in 1997. For detailed figures on respective ports, see Table A.7.5.2.1. The total maintenance dredging cost of all Indonesian ports is 15.5 % of total national budget allocated to all port sector activities including port development, maritime safety and pioneer shipping and 43.3% of total maritime safety budget of the government. This implies that the dredging requirements and its cost of Indonesia is considerably higher than other major countries of the world (Few percent in Japan).

The DGSC responsible for port dredging affairs in Indonesia supervises all surveys including echo-sounding conducted by IPCs, necessary for initial and maintenance dredging and compiling of vertical profile of sea/river bed made on the basis of survey results, and dredging works particularly by the national budget for maintenance dredging of access channels.

Table 7.5.2.1 Dredged volume at six ports in 1997

Name of Port	Annual Dredged Volume ('000m^3)	Share of Dredged Volume(%)	Dredging Cost (Million RP.)	Share of Dredging Cost (%)
Belawan	1,800.00	13.47	5,236.60	12.43
Palembang	2,300.00	17.22	6,683.92	15.87
Jambi	350.00	2.62	1,026.22	2.44
Pontianak	1,700.00	12.73	4,943.11	11.74
Banjarmasin	2,400.00	17.97	8,025.40	19.05
Samarinda	1,350.00	10.11	3,928.91	9.33
Total of Others	3,458.20	25.89	12,275.24	29.14

Source: DGSC

The PT. RUKINDO conducts actual dredging works with a fleet of twenty seven dredgers consists of fourteen trailing suction hopper dredgers, four cutter suction dredgers, two sand pump dredgers and seven grab/clamshell dredgers on the contract base with the DGSC. The fleet of dredgers dredged total volume of 23,600,000m^3 per year in Indonesia and other countries in 1997. Detail specifications of dredging vessels are indicated in Table A7.5.2.2, Table A7.5.2.3, Table A7.5.2.4 and Table A7.5.2.5 in Appendices.

(2) Preliminary Suggestions for Improving Dredging Administration

General performance of DGSC's dredging administration is generally well and capacity of dredging fleet is evaluated enough. Because the dredging fleet of PT. RUKINDO dredges 23,600,000m^3 in Indonesia and other countries in 1997, while domestic dredging volume was 13,358,200m^3 in 1997. Under severe budget constraints, however, the initial and maintenance dredging requirements of Indonesian ports are not fully satisfied, and maintenance of sound performance of the ports become difficult and crucial even in the most important ports in Indonesia. Therefore how to use the limited budget effectively is the most important point in this regard.

In order to cope with the current difficulty on the dredging affairs, the following suggestions may be helpful. While the most of current difficulties on dredging affairs in this country come from general shortage of available budget which can not be expected to increase instantly, following suggestions are mainly focused on those for basic or long term policy oriented measures.

1) From cost and benefit point of view, critical examination is necessary to select priority dredging projects and their scopes. In order to achieve the target, it may be necessary to strengthen DGSC capability in collecting good enough engineering data and information, and in conducting economic analyses on the data as well as in developing effective coordinating procedure.

2) More accurate engineering surveys and assessment on the results of dredging works is required for the channels which are utilized under very critical or limited conditions in particular. This requires substantial upgrading of total engineering survey system of the DGSC.

3) Since it is not easy to reduce annual maintenance volume simply by improving current dredging technology or method in particular on the site where heavy and irregular sedimentation is observed. A long term engineering survey on the sites need to be conducted

as a base of development of advanced method so that more effective way of dredging could be realized on long term basis.

4) Alternatively, it is recommended to conduct a comprehensive study on development of entirely deferent solution for the issues, for instance, to the port of Banjarmasin. More concretely, it may be interesting to conduct a study on development of a new water transport system using the shallow draft container vessels which is able to navigate both in the river channel and open sea areas instead of trying to keep constant maintenance dredging for the entrance channel of the port.

5) As for the current engineering standard for dredging works, it is still necessary to upgrade them in accordance with the overall port engineering standards to be improved and adopted in the DGSC port and dredging administration. Authorizing of technical justification of technical standards of dredging is normally effective and useful in getting necessary budget successfully from the agencies concerned.

6) Environment consideration is another important field of dredging affairs. While environmental disaster caused by dredging and disposal of dredged materials seems not to be serious under the current situation in Indonesia, the issue has become quite crucial in most countries of the world. In order to avoid possible future environment problems, careful preparation of institutional counter measures on this subject is essential. This kind of action is considered one of the most appropriate targets to be started during the current economic difficulty of the country when some able staffs of the DGSC are available due to reduced assignment for actual dredging works under the situation.

7) It is very important for the DGSC to understand that the higher authorities of the government may not fully understand the real importance of port dredging and economic implication of inadequate dredging activities in this country. More active and reasonable explanations or appeals from the DGSC on nation wide significance of port dredging to the higher responsible agencies are strongly expected. Considering that overall port development can not promoted only by DGSC efforts, positive understanding and support from other various port sector entities need to be invited accordingly.

8) To cope with shortage of budget for dredging, beneficiary-payment principle should be employed according to degree of their benefit such as number, size and draught of vessels entered, and cargo volume transported through the channel. Section 6.1.2.4 describes details of cost sharing system with beneficiary in Japan.

(3) Siltation

Economizing of the construction of auxiliary facilities such as training wall and submerged dyke should be considered, in addition to economizing of maintenance dredging in channels and basins which suffer from siltation. However, these countermeasures against the siltation are not sufficient enough to overcome the siltation problem. Because, location of port, arrangement of port facilities such as breakwater, channel and basin, size of entering vessels should be also considered at the port planning stage. Figure 7.5.2.1 shows the relation between cost and benefit of port construction with siltation problem.

Total cost of facilities C_T is sum of the construction cost of facilities C_1 (includes all maintenance cost of facilities exclude maintenance dredging), construction cost of auxiliary facilities against siltation C_2 and cost of maintenance dredging C_3. On the other hand, benefit B_T associated with development of a port is sum of benefit B_1 which is the reduction of total transportation cost by expansion of port facilities, benefit B_2 which is increase of safety and B_3 which is indirect effect of port development. The economical appropriateness of a port investment is evaluated by the comparison between total cost of facilities C_T and total amount of benefit B_T.

The problem is very small, if B_T is very large comparing with C_T, even if the cost of countermeasures against siltation (C_2+C_3) is considerable sum of money. In other words, even if there is a little volume of sedimentation. However, in the case of a port which has small B_T and large amount of cost for countermeasures against siltation (C_2+C_3), and developed by national policy, the siltation problem is serious. In these ports, it is demanded to decrease the cost for maintenance dredging C_3 and decrease volume of sedimentation with minimum investment for auxiliary facilities against siltation C_2. The factors influencing the cost for port facilities C_1 are location and scale of ports, size of entering vessels and arrangement of port facilities. These factors are related closely to siltation problem and influence to cost of countermeasures against siltation (C_2+C_3). To decrease siltation volume as much as possible, some increase of cost for port facilities is allowable. To cope with siltation problem, overall technical countermeasures in port planning, design of port facilities, construction works and maintenance of port facilities are indispensable. However, main ports adjacent to comparatively large cities are old and gradually had been expanded according to the economic activities. Expansion of facilities according to enlargement of entering vessels may make the siltation problem more severe. To move the ports suffering from siltation to other place, large amount of cost for construction of port facilities and auxiliary facilities such as an access road is necessary. In this case, C_1 exceeds B_T largely. To cope with most of siltation problem that have occurred actually, value of (C_2+C_3) should be minimized directly when the port planning of port facilities can not be changed. Countermeasures to decrease C_3 are discussed widely about improvements in dredging technology. On the other hand, appropriate arrangement of

training wall and submerged dyke are necessary to decrease C_2. In order to realize appropriate arrangement of port facilities, clarification of siltation mechanism and development of advanced technology for countermeasures against siltation are expected.

To conduct the most appropriate channel maintenance, study on economical comparison between costs and benefits should be conducted, and the most effective countermeasures against siltation at the individual ports should be developed.

Specific gravity is a main characteristic of mud for consideration of the siltation. When mud that has more than 1.2 t/m3 (11.8 kN/m3) in specific gravity, accumulates in a channel and a basin obstructing navigation of vessels.

It is extremely important to know from where sediment come and accumulates in a channel and a basin, in study on countermeasure against siltation. In the case of siltation in a channel dug at flat of estuary, the river, which supplied the mud that forms this flat, is the source of supply of sedimentation. Mud transported by flow will accumulate at the estuary of the river because of reduction in flow velocity caused by urgent expansion of the width of the river and flocculation of suspended particles. The countermeasures will differ by whether the sediment comes from the river directly or move from shoal where mud once accumulated as fluid mud.

At every stage of port development, above economical and technological investigation should be done carefully.

(4) Recent Technical Trend in Dredging in Japan

Trailing suction hopper dredgers are frequently used in dredging of navigational channels, because they have advantages that they can dredge without obstructing ship's navigation in the channels, and they can dredge in the site far from the disposal site without long piping. Many technical developments are conducted recently in automation, labor saving and high dredging efficiency.

Other recent technical development is dredged material transport system using compressed air. This system was developed to transport dredged material in high density causing reduction of disposal area. To make the dredging works more efficient and avoid any environmental problem included in dredging work, following techniques should be adopted after careful investigations on mechanism of siltation and dredging cost.

1) Bottom Profile Sonar System

Bottom profile sonar system was developed to enhance the operation control of the trailing suction hopper dredger. Water depth and dredger position can be displayed on a single screen in real time by installing positioning system. This display permits monitoring of completed work quality by mapping all or part of the sea bottom as necessary. Accordingly, bottom profile sonar system permits dredging work management, which improves dredging

efficiency and reduces cost for depth measurement. Figure 7.5.2.2 shows bottom profile sonar ststem installed the dredger. Figure 7.5.2.3 shows a diagram displayed in the bottom profile sonar system on XY plotter.

2) Recycling System

A trailing suction hopper dredger pumps up soil with much seawater from sea bottom. The seawater, or effluent, is generally discharged from the hopper to increase loading capacity of the hopper causing contamination of the sea. In this system, instead of taking in seawater from the inlet of drag head, effluent in the hopper is returned to the drag head for making dredged material fluidity. Accordingly, this system permits increase of soil load capacity without effluent discharge and realizes more efficient dredging without contamination of the sea. Figure 7.5.2.4 shows the recycle system.

3) Bed Leveling Equipment

During dredge by a trailing suction hopper dredger, grooves are formed on a sea bed. Therefore, a special working vessel equipped with a leveling blade is used for leveling the sea bed. The bed leveling equipment is designed to level the sea bed with blades installed to the drag heads, instead of using a special working vessel. Dredging using the equipment makes the sea bet flat, in other word makes no grooves, minimizing dredging volume. Figure 7.5.2.5 shows bed leveling equipment.

4) GPS

To realize efficient dredging, real time positioning system for a trailing suction hopper dredger is indispensable. The Global Positioning System (GPS) has developed to achieve real time accurate positioning for vehicles. Real time kinematic GPS has been developed for a trailing suction hopper dredger and other vessels realizing real time precise vessel positioning using a reference station. The system employs unique method, or carrier phase double differential method, to get the precise positioning data from artificial satellite. Figure 7.5.2.6 shows the principle of the real time kinematic GPS.

5) Fuzzy Dredging Control System

The automated operation system for the trailing suction hopper dredger has been developed mainly for labor saving. The system is based on a sequence control, using predetermined procedure, and can not follow changes in dredging conditions, soil characteristics and other factors. An automated system using fuzzy control is developed to make an operation of the trailing suction hopper dredger as good as the operation by experienced human operators. The system includes subsystem, light water mixture control, optimal control of jet water, optimal control of dredge pump rotation speed, optimal control of drag head grounding pressure,

optimal control of dredger speed, automatic selection control of dredging factors. Figure 7.5.2.7 shows configuration of AI dredging works.

6) Compressed Air Transport Method

In Japan, dredged material is transported to a disposal site and used for land reclamation, though in other country it is mostly dumped into the ocean. To reduce contaminated effluent discharge from reclamation site and volume of reclamation site, make the reclamation site firm for early use and reduce dredging and reclamation cost, density of the dredged should be high. The compressed air transportation method has developed to transport dredged material keeping its concentration at a high level. Compressed air transport system are divided into four types, screw and inpeller type dredging and transport system, bucket hood type dredging and transport system, screw feeder type discharge equipment and tank type discharge equipment. Figure 7.5.2.8 shows high-density air compressed transport process.

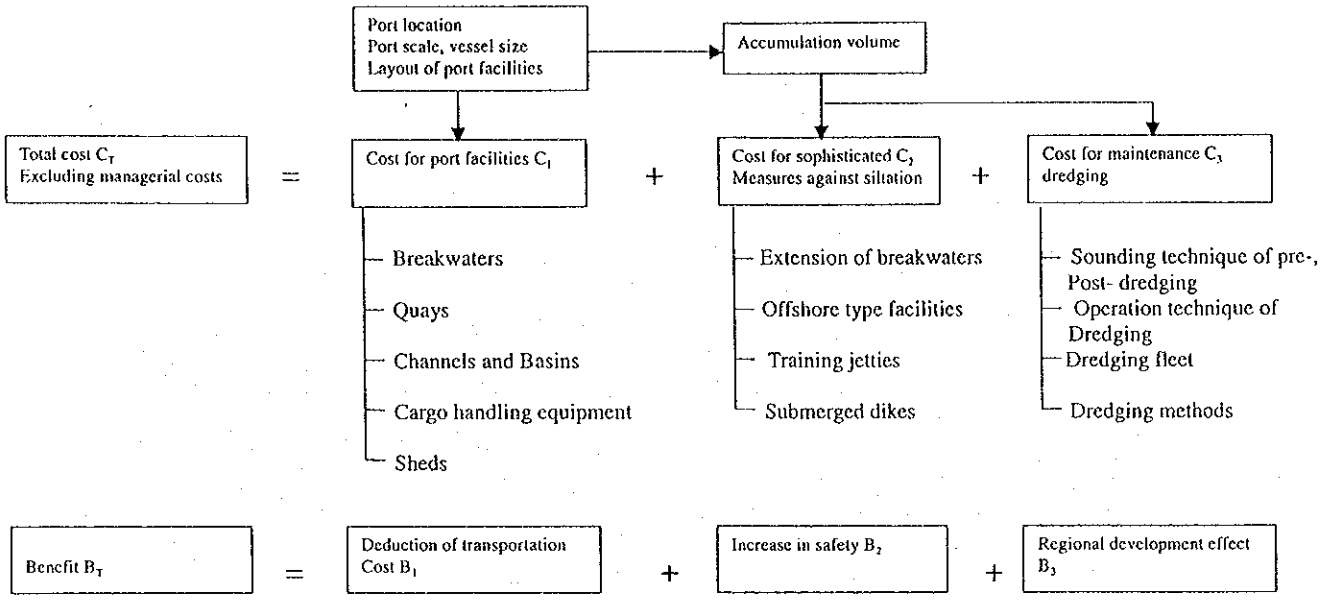


Figure 7.5.2.1 Economical and technical investigation

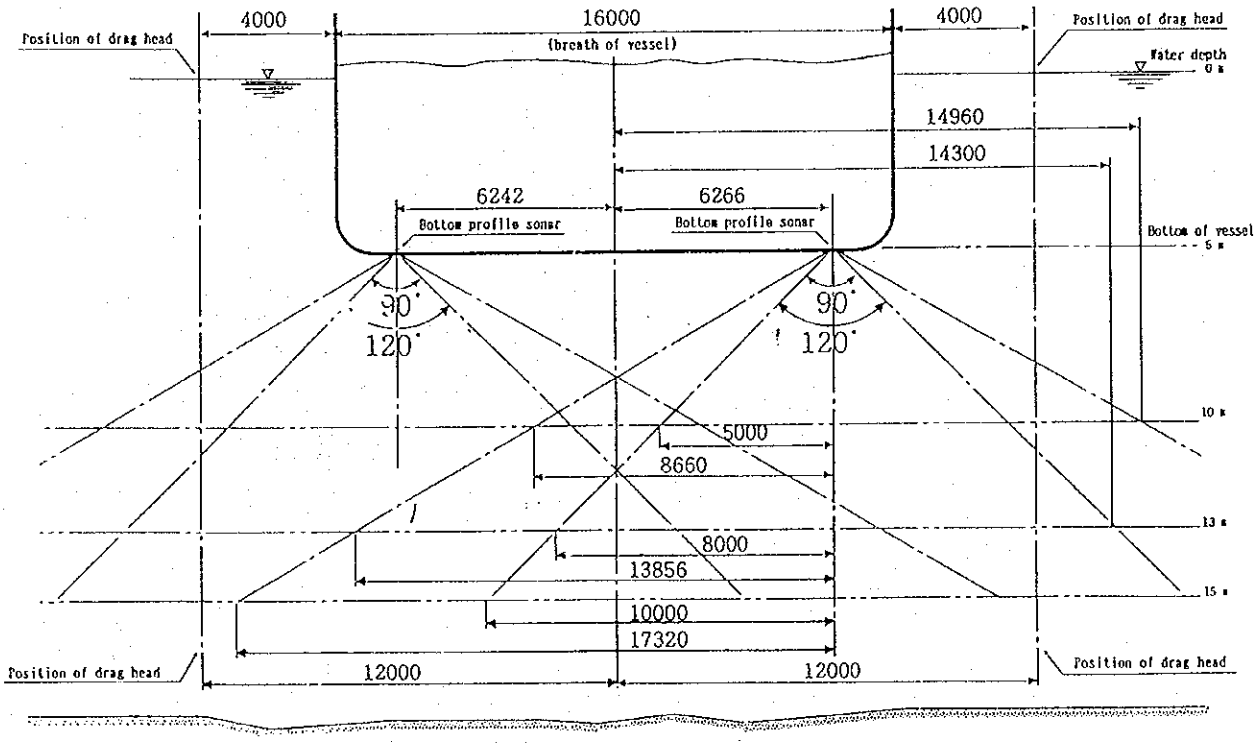


Figure 7.5.2.2 Profile sonar sensor installation

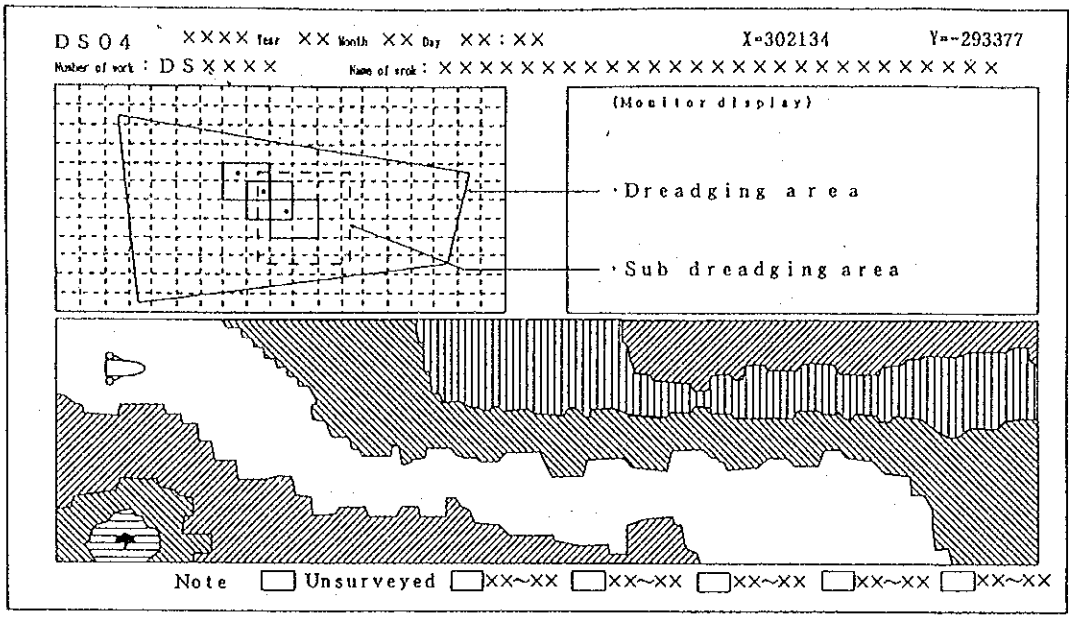


Figure 7.5.2.3 Indication of water depth and dredged area

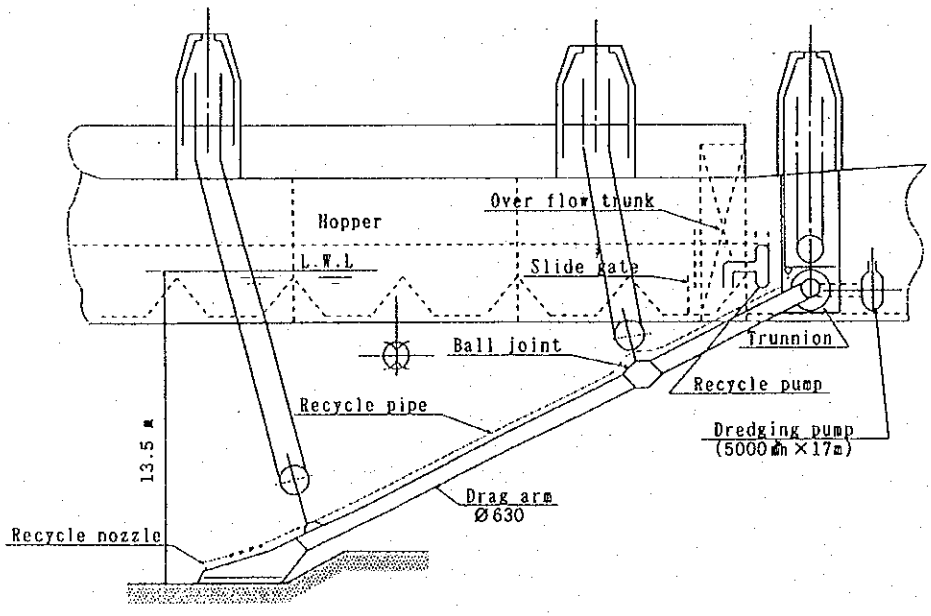


Figure 7.5.2.4 Recycle system

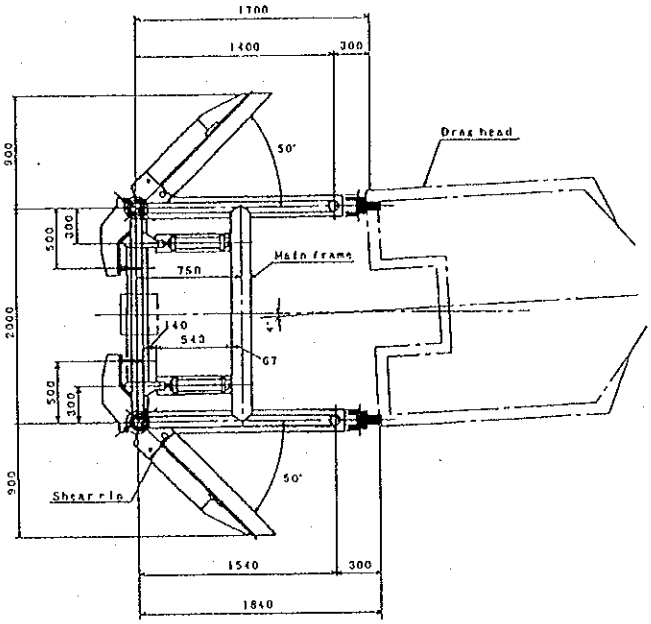


Figure 7.5.2.5 Bed levelling equipment

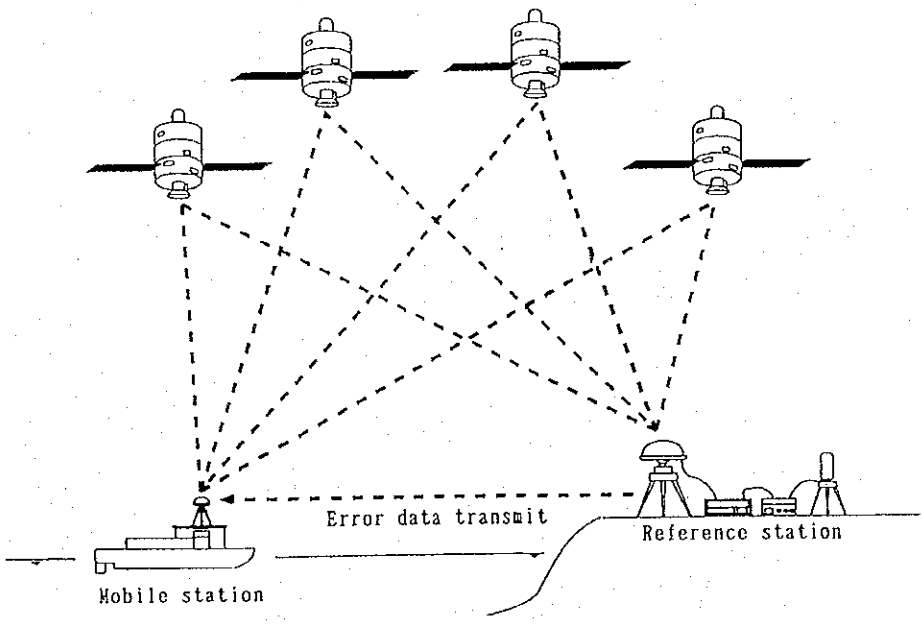
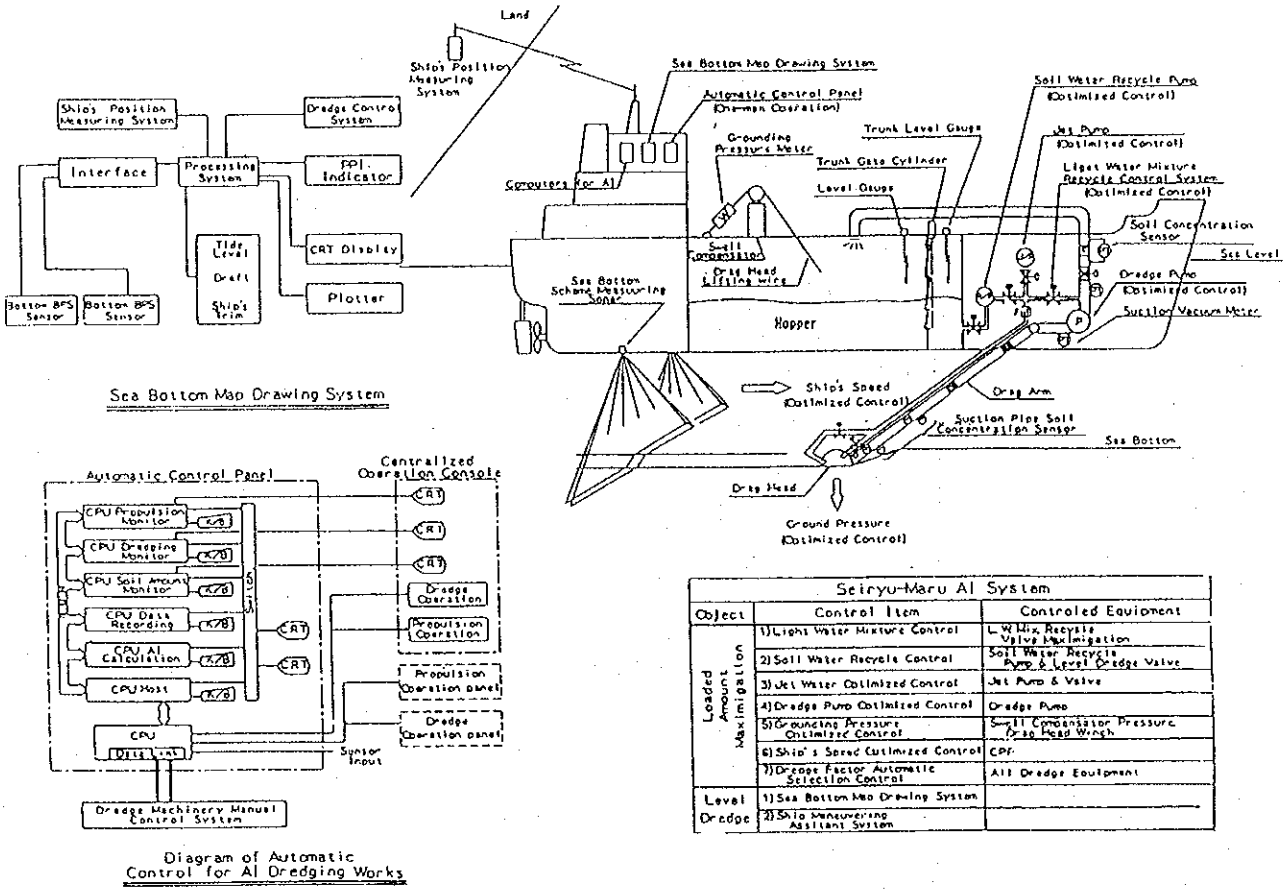


Figure 7.5.2.6 Principle of real time kinematic GPS



Seiryu-Maru AI System

Object		Control Item	Controled Equipment
Loaded Amount Maximigation	1)	Light Water Mixture Control	L.W Mix. Recycle Valve Maximigation
	2)	Soil Water Recycle Control	Soil Water Recycle Pump & Level Dredge Valve
	3)	Jet Water Optimized Control	Jet Pump & Valve
	4)	Dredge Pump Optimized Control	Dredge Pump
	5)	Grounding Pressure Optimized Control	Small Compensator Pressure Drag Head Winch
	6)	Ship's Speed Optimized Control	CPP
	7)	Dredge Factor Automatic Selection Control	All Dredge Equipment
Level Dredge	1)	Sea Bottom Map Drawing System	
	2)	Ship Maneuvering Assistant System	

Figure 7.5.2.7 Configuration of AI Dredging Works

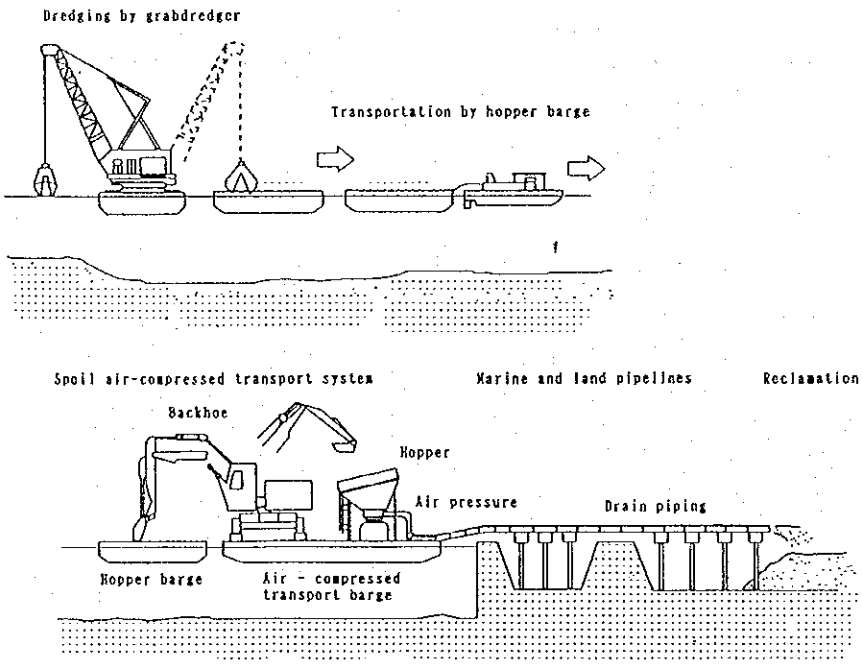


Figure 7.5.2.8 High-density air compressed transport process

7.6 Staff Training System for Port Sector

7.6.1 General

The port sector is composed of various sub-sectors including the government organizations, public corporations or government owned companies, private business entities and many other port related organizations or associations which play their own roles to achieve their original assignment or business target. Although the required roles or functions of each sub-sector are different and diversified, overall capability or performance of the port sector of a country is largely controlled by quality of manpower which may be evaluated by level of moral, knowledge, skill, experience and mental/physical soundness of each individual staff of the organizations of the sector.

In this sense, staff training system for port sector should be designed and developed with comprehensive training program structure covering across various training demands of all relevant sub-sectors so that effective improvement of total power or capability of port sector could be expected. In other words, staff training for each port sub-sector needs to be conducted under well coordinated programs with constant exchange of relevant information, for instant, on new technologies for port operation or development, and recent trend of administrative or legal requirements.

While to develop and apply such a comprehensive training system instantly to the port sector of most developing countries is considered not easy, it is recommended that DGSC as a center of port sector of Indonesia should always pay its attention on above basic training concept when designing or conducting its own staff training program and advising the matter to other port sub-sectors.

7.6.2 Staff Training Program of DGSC and IPC

The staff training programs currently executed by DGSC and IPC are generally well designed and practically adequate considering the back ground of the organizations and nature of training demands (see Table A.7.6.1.1, Table A.7.6.1.2 and Table A.7.6.1.3 in Appendices). However, there are some room for improvement in basic training patterns and programs, which are mostly common to both organizations as indicated as follows.

(1) Strengthening exact knowledge and deep understanding on other sub-sectors' business.

This is particularly important in making better coordination with relevant agencies or entities for effective adjustment of contradictory interests.

(2) Active introduction of information on new technology.

This includes the fields of port planning, designing, operation and construction method of facilities. Through this kind of training, positive incentive and interest of trainees could be developed for every aspect of port administration.

(3) Promotion of On-the-Job- Training (OJT).

This can become more effective by strengthening understanding on significance of OJT of all senior staff and by developing OJT methods and manuals applicable to actual training stage. It is commonly understood that OJT is quite effective, if appropriately conducted, for young staff in particular not only to strengthen their practical knowledge but also to improve their coordinating and cooperating capability with their superiors or colleagues. Periodical staff rotation among the relevant internal sections is also effective in carrier development of the staff as an alternative pattern of OJT.

(4) Establishment of effective personnel exchanging system.

This should be executed among the port sub-sector entities including MOC, DGLT, DGSC, IPCs, ADPELs and other semi-governmental organizations. In order to obtain wider knowledge and broad sense of administration, temporary transference of MOC or DGSC personnel to other central/local government authorities such as BAPENAS, MOF or BPPT, and relevant section of the local government may be effective if possible and appropriate. Dispatching personnel to the international agencies or even private sector entities is also recommended.

(5) Strengthening evaluation of effects of training.

This is another requirement for improving the system, which need to be executed on various view points including direct on the job or paper testing of the staff, overall evaluation of performance of a certain section and training course or method wise evaluation of effectiveness.

7.6.3 Outlines of Port Staff Training in Singapore and Japan

For further improvement of the details of staff training programs of DGSC and IPCs, it is helpful to refer the advanced cases of training system in other countries. As a matter of course, these cases could not be applied directly to the in-house training courses in Indonesia, some

useful ideas may be taken from the details of the cases.

(1) Training Program in Singapore

1) The Marine and Port Authority

The Marine and Port Authority (MPA) has the National Maritime Academy (NMA) for training maritime and port personnel. The NMA provides quality training to ensure that there is a ready pool of highly skilled maritime and port personnel to meet the needs of the port industries. The NMA conducts courses for officers and ratings at pre-sea and post-sea upgrading level, including various supplementary safety course to meet the need of the shipping industry. The training division of the MPA also organizes workshops/seminars/lectures on topical issues of interest for the maritime/port community.

2) The PSA Corporation Limited

The PSA Corporation Limited (PSA) provides training for personnel from the local and regional maritime industries since 1970. The PSA trained 107,000 personnel from the local shipping industries and 4,600 personnel from ports and shipping organizations from 67 countries. The PSA has also customized training programs for ports in Indonesia, Philippines, Oman, Sri Lanka, Italy, Vietnam and Republic of China.

The PSA invests some S$14 million in 2 quay/yard crane simulators and 1 full-mission ship handling simulator to cope with the advancement in technology and to support the training of equipment operations and marine personnel.

The PSA also maintains a maritime library with a collection of over 13,000 books.

(2) Training Program in Japan

1) The Port and harbor bureau of MOC in Japan

The port sector in the Ministry of Transport in Japan conducts several kinds of stuff training to raise the level of ability, expertise and knowledge necessary to cope with new system and technologies.

Training for newly recruited staff, training for each category of staff, special training on specialized category such as accounting and port statistics are conducted. In addition to stuff training, the MOC has the on the job training and job rotation between local government, port authorities, agencies, and foreign government to raise ability and knowledge of their stuff.

2) The Port of Yokohama

(a) Yokohama Harbor Polytechnic College

Yokohama city has operated the Yokohama Harbor Polytechnic College to bring up talents

who can meet various needs of the harbor industry as well as the distribution industry practically and efficiently. Many distribution management engineers graduate from this junior college every year.

(b) Harbor Training College of Yokohama

The purpose of Harbor Training College of Yokohama is to develop the ability of workers in the Port of Yokohama trough seminars and various training courses such as practical training for operating large cargo handling equipment and driving transportation vehicles.

7.6.4 Evaluation of Training Effect and Re-training

Every port sector has its own training systems. In addition to comprehensive training courses, the port sector should evaluate the effect of the training courses, in order to achieve more effective training system in Indonesia.

The participants of training courses have improved their knowledge and ability. But after few years, the knowledge tend to be forgotten unless they engage in the job related to the knowledge. So, it is necessary that the port sector provide with re-training courses, in order to make the training effective.

Training course is not effective unless contents of the training courses are understood easily by the trainees. So, the port sector should have several kinds of equipment for stuff training such as audio-visual system, computer system, simulators, in order to make the training course easier to be understood by the trainees.

7.7 Policy on Port Statistics

7.7.1 General

It is one of the most significant assignments of any government in the modern world to compile and publish reliable and responsible statistics on every sector of the country including natural and socio-economic conditions and situation of national assets and activities. Without a firm base of statistics, accountable policies and plans of the country can not be formed. It is commonly understood that the level (quantitative and qualitative grade) of a country's statistics exactly represents the overall national power of the country.

As far as a census of the population is concerned, most countries in the world have fairly reliable statistics under positive UN requirement and assistance. However, the actual policy and practice for compiling the statistics in various other fields are generally insufficient and substandard, especially in most developing countries.

While the government of Indonesia has a well developed system for compiling various kinds of statistics including the field of port affairs, there may be still some room for improvement in taking more reliable and useful statistics for policy making.

7.7.2 Overall Statistics System

The official statistics of a country are normally divided into two categories: nation wide statistics designated by laws and regulations, and official statistics to be compiled for administrative purposes of the central/ regional government organizations.

Port statistics should be edited in a unified style so that they can be easily accessed and understood by all of the nation and concerned parties. In advanced countries, port management bodies acting as port administrators are obligated to compile port statistics according to stipulated methods. And, a special statistics agency comprehensively performs the tasks related to the designated statistics including port statistics as well as population census, commercial census, labor force survey and price survey, etc.

Table 7.7.1 shows the Japanese statistics designated in the Statistics Law. There are five statistical categories with port management.

7.7.3 Basic Policy of Improving Port Statistics System

Indonesia has already had the Port Operation Management Information System, the so-called SIMOPPEL. Figure 7.7.1 shows SIMOPPEL system for reference. In that system, statistical data of public ports including information of traffic, port performance and port facilities are collected and edited to Grade III report and then processed to Grade II report

through each branch office responsible for port administration. Grade II report is sent to Board of Director and ADPELs and compiled as Grade I report. This report is sent to DGSC and finally kept there for five years.

However, the SIMOPPEL Report Grade I , as a finally integrated statistical record for public ports, does not cover cargo-wise volume, annual cargo handling trend and so on. Such detailed data, which are indispensable to estimating future cargo demand, can not be grasped unless Grade III report is obtained from each branch office. It makes it very difficult to establish a national port policy comprehensively.

Port statistics should cover all ports including special ports and special wharves based on laws and regulations. It should clarify at least the trend of cargo handling volume by lot and the origin/destination of each kind of commodity and cargo type, as well as number of calling vessels, number of passenger and situation of basin, warehouse and stock yard, etc. Table A 7.7.1 to A 7.7.3 show the examples of questionnaire for port statistical survey.

And, if possible, port statistics should be integrated with statistics system of land transportation, which is closely related to port activities, and also be compatible with international standards. In that case, it will become very important to define the classification of individual cargo by categorizing into a couple of strata and to unify the survey period. These are indispensable matters also for adequately revising the subject items according to the change of times.

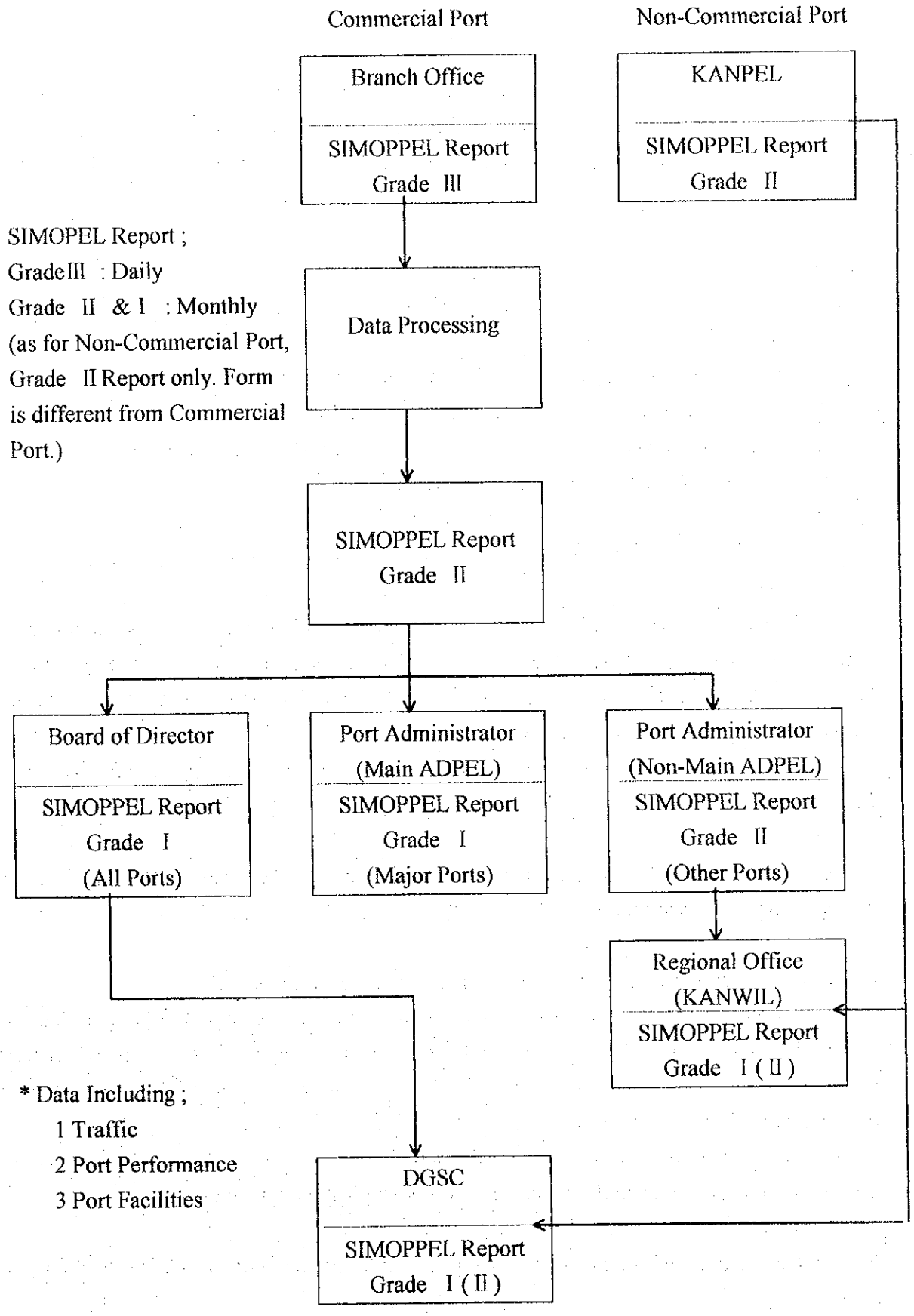
Table 7.7.1 Designated Statistics in Japan

1 Population Census
2 Establishment Census
5 Vital statistics of Japan
6 Survey on Port and Harbor *
7 Monthly Labor Survey
10 Census of Manufactures
11 Current Survey of Production
13 School Basic Survey
14 Housing Survey
15 School Health Survey
19 Survey of Textile Distribution
23 Census of Commerce
26 Census of Agriculture and Forestry
27 Current Survey of Coal Demand and Supply
28 Survey on Vessels and Seaman *
29 Survey on shipbuilding and Engineering *
30 Labor Force Survey
32 Statistics of Building Starts
33 Survey on Milk and Daily Products
35 Retail Price survey
36 survey of Farm Household Economy
37 Crop Survey
38 Survey of Cocoon Production
40 Statistical Survey on Domestic Mineral Deposits
43 Current Production Survey on Gas Utility Industry
46 Survey on Machine Tools Installation
48 Statistical Survey on Pharmaceutical Industry Production Trends
49 Current Survey of Non-Ferrous Metal Supply and Demand
51 Current Survey of Petroleum Products Supply and Demand
53 Outdoor Employees' Wage Survey by Occupation
54 Survey of Marine Production
56 Family Income and Expenditure Survey
57 Unincorporated Enterprise Survey
58 Mode-of-Trade Statistics Survey
61 Survey of Research and Development
62 School Teachers Survey

64 Current Survey of Commerce
65 Survey of Medical Institutions
66 Patient Survey
67 Census of Fisheries
69 Survey of Sawing Products
71 Survey on Current Rolling Stock Production
76 Survey on Wages of Local Government Employees
77 Survey of Wages and Salaries at Private Firms
83 Social Education Survey
84 Statistical Survey on Construction
87 Employment Status Survey
90 Survey on Seaman's Labor *
93 Basic Survey of Manufacturing Structure and Activity
94 Basic Survey Wage Structure
95 Survey of Paper Products Distribution
97 National Survey of Family Income and Expenditure
98 Basic Survey of Commercial Structure and Activity
99 Survey on Motor Vehicle Transport
100 Survey on Production Cost of Rice
101 Statistical Survey on Machinery and Equipment Marketing
103 Survey on Coastwise Vessel Transport *
108 National Survey of Prices
110 Report of Incorporated Enterprises Statistics
113 Survey of Selected Service Industries
114 Survey of Time Use and Leisure Activities
115 Survey of Oil Consumption in Commerce, Mining and Manufacturing
116 Comprehensive Survey of Living Conditions of the People on Health and Welfare
117 Survey on Service Industries
118 Basic Survey of Business Structure and Activity

note * : port related statistics
source : Japan Statistics Bureau

Figure 7.7.1 Procedure of SIMOPPEL (Port Operation Management Information System)



7.8 Port Engineering, Research and Survey

(1) General

In Indonesia investment funds for infrastructure development are limited due to the severe economic situation. In order to utilize the limited investment funds more efficiently, to secure safety of facilities and to envisage earlier materialization of the investment effects, more sophisticated technology shall be introduced in the port development field as well as the port management and operation field.

In formulating a policy for port engineering, research and survey, the following four (4) items should be examined. (See Figure 7.8.1)

1) Arrangement and application of "Technical Standards for Port Facilities"
2) Accumulation and analysis of technical information for port development
3) Introduction of new technology and promotion of technology development
4) Enhancement of total capability of port engineers

(2) Arrangement and application of "Technical Standards for Port Facilities"

In Indonesia, port facilities have been constructed mainly based on previous experience in adjacent areas and knowledge of engineers in charge. Therefore, sometimes port facilities have been damaged by inappropriate prediction of natural forces such as wave, tide and earthquake, in addition to inferior ground condition.

In order to secure safety of facilities and save construction cost, appropriate "Technical Standards for Port Facilities" should be introduced by considering characteristics of respective regions.

Preliminary idea of the process for introducing "Technical Standards for Port Facilities" is shown below. (See Figure 7.8.2)

1) Collecting and analyzing engineering data on port construction sites

Many port development projects have been conducted in various regions all over Indonesia. As the first stage, it is very important to collect and analyze engineering data on construction sites. In particular, data on port facilities damaged by national disasters and other causes, is quite valuable from the engineering aspect.

Considering that the nation spreads out across a wide area, technical data should be collected and analyzed from the areas with different typical natural conditions.

2) Collecting and analyzing engineering data and information which can be utilized for port

construction work

Necessary items, especially from the viewpoints of economy and securing safety, should be collected and analyzed. To identify ways to prevent large damages by natural disasters is especially important for future projects. These analyses should be conducted considering the difference of natural condition by areas.

For example, in some areas of Indonesia, coral reef is predominant at the project sites. Transformation of the wave and tidal wave in these areas should be carefully examined. In other areas of Indonesia, sedimentation problems will be predominant in the project sites. Siltation in the river and sea port and weak soil foundation should be carefully examined.

3) Monitoring conditions of construction sites

By monitoring the various conditions of construction sites from the technical aspect, useful information can be obtained. The natural conditions which were predicted in the planning and designing stage shall be checked with the monitoring results.

4) Formulating the "Technical Standards for Port Facilities"

In formulating "Technical Standards for Port Facilities", it is necessary to pay much attention to the importance of taking flexible measures to deal with different natural conditions and other characteristics of ports located in respective regions.

Technical standards in foreign countries will serve as good references in formulating Indonesian technical standards. However it is necessary to recognize the fact that these standards cannot be introduced in Indonesia directly, because of the differences in natural conditions in respective countries.

(3) Accumulation and analysis of technical information for port development

As mentioned above, accumulation and analysis of technical information for port development is very important for effective, efficient and safe project implementation.

Several ideas for strengthening accumulation and analysis of technical information for port development are as follows.

1) Establishment of the port related information system

- Strengthening the function of R&D Center in the field of data collection and analysis

2) Accumulation and utilization of technical information

- Continuing the measurement of the natural conditions such as wind, wave and tide before and after completion of projects

3) Promotion of technological exchange

- Promotion of international technological cooperation by utilizing technical cooperation schemes of foreign countries

(4) Introduction of new technology and promotion of technology development

Introduction of new technology and promotion of technology development are quite useful for dealing with various kinds of demand and request from port users. For example, environmental consideration, cost reduction and modernized shipping system/port operation are key items.

In Japan, the Ministry of Transport published a policy report "Towards the Realization of Human and Nature Friendly Ports and Harbors --- Long-term Policy for Technological Development for Ports and Harbors ---" in June 1992. This report specifies 10 priority items for technology development for ports and harbors. (See Appendix 7.8.1) Identification of the prioritized items among port related technology is important and this example in Japan can be utilized as a reference.

Several examples of new technologies are as follows.

1) Modernized shipping system

(a) Techno Super Liner (TSL)

TSL is a high speed modernized vessel which is now under development in Japan. (See Appendix 7.8.2)

This vessel is expected to play an important role in transporting a large amount of cargo including container cargo by high speed over a long distance. At present it can transport a cargo volume of about 1,000 tons at a speed of 50 knots across a distance of about 1,000 km under relatively high wave height.

In Indonesia, this vessel can be introduced in the future to the inter-island shipping route between main islands which will play an important role in the transportation of a large volume of cargo over a long distance.

(b) Shallow Draft Container Vessels

In Indonesia, due to the siltation problems, have resulted in increased maintenance dredging costs and the inability to introduce deep draft cargo vessels. As one of the countermeasures for these problems, introduction of the shallow draft container vessels suitable for container transportation in river and sea areas shall be examined.

An idea of a new transportation system by using a shallow draft container vessel connecting ports along Yangtze River in China and Kobe Port in Japan can be utilized as a

useful reference for establishing future transportation system in river and sea areas in Indonesia. The outline of this plan made by MOT of Japan is shown in Appendix 7.8.3.

2) Environmental aspects

Indonesia, which is the largest archipelago country in the world, has a clean and beautiful sea, white sand beaches and precious coral reefs. In planning and implementing port development projects, maintaining the above mentioned precious natural environment in the adjacent sea and land areas is of vital importance.

As one of the examples, in Japan water purification by utilizing biological oxidization function of beaches, gently-sloped seawalls and seabed has been done. This technology can also be applied in Indonesia for maintaining the sea environment in good condition (See Appendix 7.8.4).

(5) Enhancement of total capability of port engineers

In order to promote efficient and effective port development, it is vital to enhance the total capability of port engineers. Especially considering the variety of natural conditions such as soil and sea conditions in Indonesia, ability of the engineers to judge the natural conditions and decide design of the port facilities should be improved.

Several ideas for enhancing engineer's capacity are as follows.

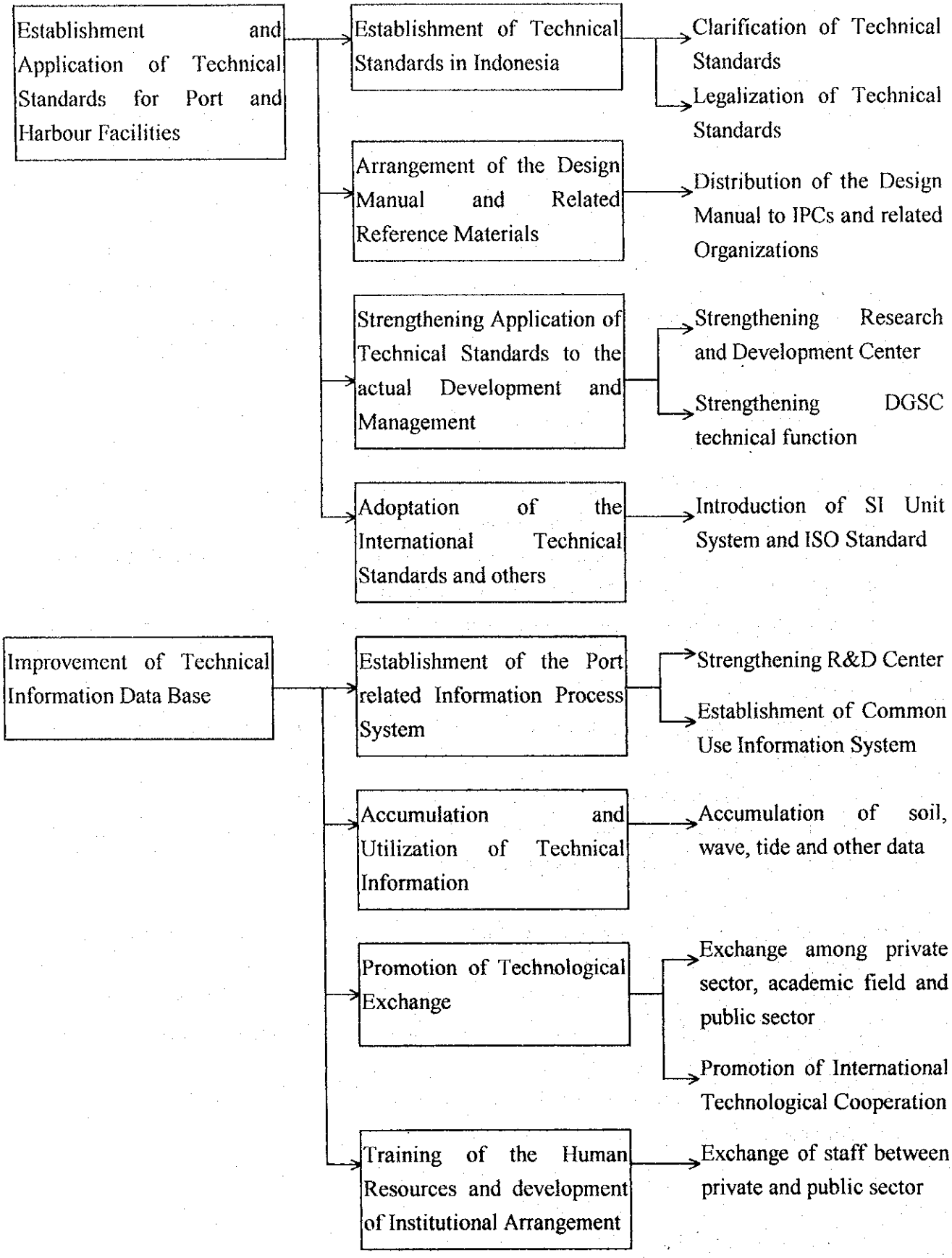
1) To train human resources

- Promotion of training of human resources by utilizing technical cooperation scheme of foreign countries
- Promotion of human exchange between public sector and private sector
- Fostering in-house engineers in governmental organizations in order to promote the consistent improvement of total technical capacity

2) To improve and strengthen an education system in the field of civil engineering and other related engineering fields related to the port

- Inviting instructors from foreign countries to universities and other schools to train instructors and teachers in the fields of civil engineering and other engineering fields related to the port
- Dispatching students to developed countries in order to obtain the latest technical information

Figure 7.8.1 Technical Policy System for Port Development



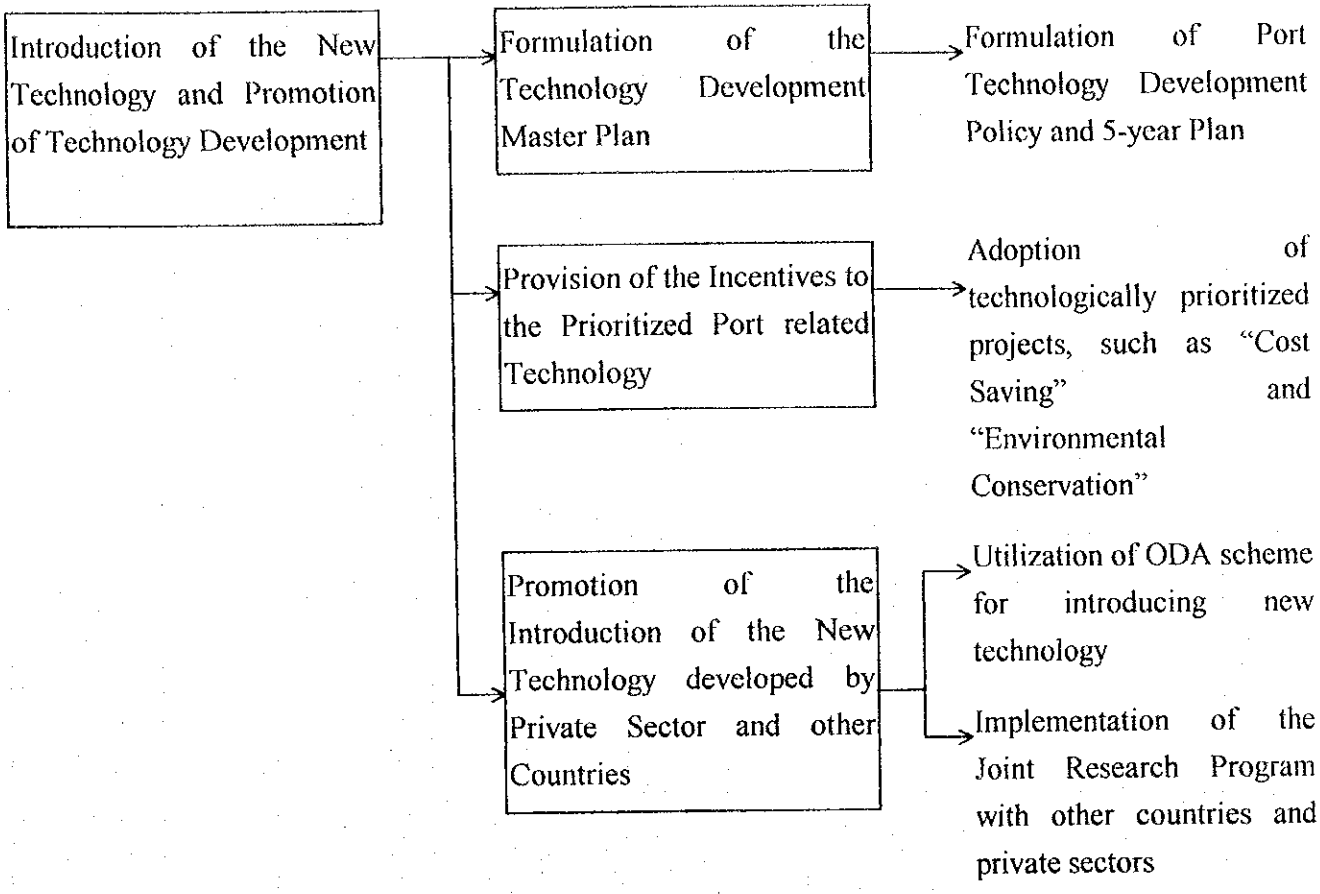

Introduction of the New Technology and Promotion of Technology Development
Formulation of the Technology Development Master Plan
Formulation of Port Technology Development Policy and 5-year Plan
Provision of the Incentives to the Prioritized Port related Technology
Adoption of technologically prioritized projects, such as "Cost Saving" and "Environmental Conservation"
Promotion of the Introduction of the New Technology developed by Private Sector and other Countries
Utilization of ODA scheme for introducing new technology
Implementation of the Joint Research Program with other countries and private sectors

Figure 7.8.2 Flow Chart for Establishing and Improving Port Development Technology