



Office of Transport and Traffic Policy and Planning
Ministry of Transport

Study on Factors and Impact of Modal Shift from Road Transport to Rail and Water Transport

Executive Summary Report



TransConsult Co., Ltd.



Thailand Development Research Institute

with technical support from



EUROPEAN INTERMODAL ASSOCIATION



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EXECUTIVE SUMMARY REPORT

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1. BACKGROUND AND RATIONALE

1.1 TRANSPORTATION AND ECONOMIC DEVELOPMENT

Planning of economic development in the past half-century has shown that transportation is a key factor in supporting development and economic growth since the road network helps spread prosperity to the regions. Meanwhile, rail, water, and air transportation have supported the mobility of freight and passenger that are key requisites for moving factors of production and service, whether it be in industry, agriculture, planning of production base, plants, industrial estates, urban planning, and public travel. Hence, economic growth of the transportation sector is in line with national aggregate economics and urban growth. Consequently, transportation problems impact people's quality of life both directly and indirectly, whether it be in terms of comfort and convenience, economy of time, passenger fares and transportation prices, safety and environmental pollution. Planning management of factors to promote maximum efficiency in transportation is therefore most meaningful to the national economic and social systems.

1.2 IMBALANCE IN THE TRANSPORTATION SECTOR

From the transportation sector, road transportation commands a share more than 85 percent due to economic development focus on the road network to distribute prosperity to various regions of the country. As a result, rail and water transportation networks--both having lower unit costs than road transportation--have not received the development they deserve.

The imbalance in the transportation sector keenly focused on road transportation also impacts the share of energy consumption in the transportation sector, which is greater than 1 out of 3 of the combined national energy consumption.

Statistics from World Resources 2000-2001 of the World Bank indicate that Thailand and the United States of America are two countries whose shares of energy consumption in the transportation sector exceed that of the industrial sector and where the share of energy consumption in the transportation sector is approximately 40 percent compared with total energy consumption.

Another notable quantitative indicator is Thailand's energy consumption in road transportation, which is as high as 33 percent of total energy consumption, while comparably the United States has 31.7 percent. Therefore, surrounding factors affecting high oil prices, thus making expenses in infrastructure and transportation services a key factor enhancing competitiveness and promoting Thailand's socio-economic development. When valued as energy consumption in the transportation sector, it will be as high as 4.4 trillion baht per year, equivalent to 58 percent of energy consumption in Thailand. (Source: Report from the Colloquium on Energy Savings in the Transportation Sector, organized at the Prince Palace Hotel on January 24, 2003.)

1.3 MODE SHIFT AND LOGISTICS MANAGEMENT

Effective logistics management to promote national competitiveness has been prescribed as a key national agenda. Hence, it is the urgent need to develop the logistics infrastructure including transportation network and service. In this respect, development will require a modal shift strategy, a concept recognized by many developed and developing countries that can help reduce costs and provide service advantages. In a situation where oil prices are continuously trending higher, a country with a domestic transportation structure emphasizing passenger and goods transportation by road, such as Thailand, and aiming to reduce logistic cost of transportation business to enhance competitiveness, it may be necessary to shift mode from road having higher energy consumption to other less energy-intensive modes of transportation, especially rail and water modes (inland water and coastal shipping).

2. PROJECT OBJECTIVES

- 2.1** Study and analyze factors affecting the possibility to promote modal shift in Thailand, whose main emphasis today is passenger and goods transportation by road, to rail and water modes. Factors inducing change include those at the macro level, which is supply oriented, and those at micro level, which is demand oriented.
- 2.2** Prescribe policy framework that advances transportation network integration to signal unequivocal support of modal shift at both the regional and national dimensions by underscoring worthwhile utilization of existing infrastructure and investing in appropriate new projects.
- 2.3** Study possibilities of transportation modes prescribed and how they would impact the socio-economic system, business competitiveness, and transportation services.
- 2.4** Study economic and regulatory incentives or enforcement that would promote mode shift.
- 2.5** Study patterns of investment, budgetary appropriations, and administrative bodies for compliance with established framework and promote development of modal shift in accordance with proposed policy framework.

3. SCOPE OF STUDY

To satisfy objectives of this project, the study must at a minimum cover the following key points,

3.1 STRATEGIC PLAN DEVELOPMENT AND GUIDELINES FOR IMPLEMENTATION

For the formulated plan to be a tool for policy determination to identify current strategy and direction, the goal of future development from beginning stage till project evaluation process will result in modal shift that is most appropriate and effective.

The study must at a minimum cover the following dimensions:

- 3.1.1** Study and analyze freight shipment demand, and water and rail transportation routes, including surveying and analyzing demand and distributing routes of 20 major cargoes which can drive the whole economy.
- 3.1.2** Study and analyze shipment conditions of at least 5 top-priority cargoes, for both export and domestic consumption, in the routes appropriate for modal shift.
- 3.1.3** Study and collect economic data and relevant variables, commodity flow, and demand forecast of rail and water freight shipment, and problem/obstacle conditions, and solution guidelines related to inconvenience or inaccessibility to rail and water transportation.
- 3.1.4** Study, analyze, and forecast modal split, category, type, mode, market, and user demand, including facilitator capacity.
- 3.1.5** Study and analyze performance of existing transportation system of Thailand and future development plans.
- 3.1.6** Study and analyze success factors in modal shift.
- 3.1.7** Study and analyze to assess expected benefits to be derived from strategic plan development of modal shift.
- 3.1.8** Study, analyze, and recommend guidelines for identifying strategic goals, products, outcomes, and key performance indicators related to modal shift strategies.

3.2 DEVELOPMENT AND SELECTION OF POTENTIAL PROJECT PLAN AREA

The area which are both operational and expected to be operational in the future of agencies--those directly concerned and those driving the modal shift strategy--under the Ministry of Transport to achieve targets and key performance indicators at acceptable levels.

- 3.2.1** Study and analyze to plan area development and/or plans/projects that have opportunities and possibilities to support and promote freight rail and water shipment.
- 3.2.2** Study and analyze guidelines for administering intermodal facilities, freight distribution center, regulations, incentive measures and other relevant factors that support, promote, induce greater shift to rail and water modes.
- 3.2.3** Study and analyze to select plans/pilot projects that promote modal shift of freight shipment from road to rail and water or multimodal transportation, including formulation of business plan together with other factors that respond to the possibility for plan implementation by concerned sectors based on suitable, worthwhile investment, and not placing undue burden on the public sector.

4. ANALYSIS OF FREIGHT SHIPMENT DEMAND

4.1 IMPORTS AND EXPORTS

Most international cargoes, both imports and exports of Thailand are made by sea (about 90%), land, and air, respectively. Quantities of goods transported in each mode in 2003 – 2007 of imports and exports of Thailand are shown in Tables 4.1-1 and 4.1-2.

Table 4.1-1: Quantities of Export Freight Shipment

Unit: thousand tons

Mode of Transport	Year				
	2003	2004	2005	2006	2007
By sea	69,185	78,422	75,622	80,959	109,238
By land	6,072	7,096	8,608	8,170	8,877
By air	353	401	444	963	460
By parcel post	0	0	0	0	0
Total	75,609	85,919	84,674	90,091	118,575

Source: Ministry of Transport

Table 4.1-2: Quantities of import freight shipment

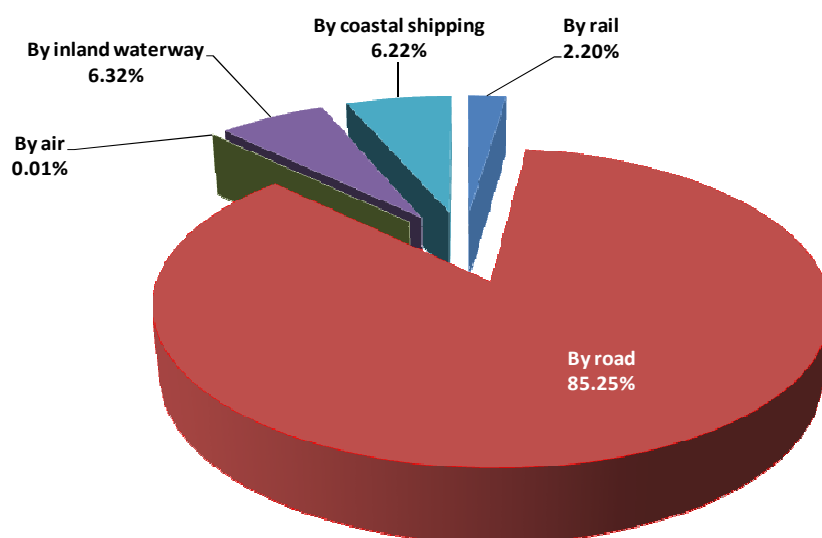
Unit: thousand tons

Mode of Transport	Year				
	2003	2004	2005	2006	2007
By sea	80,624	89,476	107,905	100,136	101,822
By land	3,136	3,261	3,428	3,218	3,548
By air	473	490	914	744	253
By parcel post	1	1	1	1	0
Total	84,234	93,228	112,247	104,098	105,624

Source: Ministry of Transport

4.2 DOMESTIC FREIGHT SHIPMENT

Domestic freight shipment volume is approximately 502 million tons in 2007. Regards to this volume, the shipment made by road, water, coastal and rail accounts for 428.1, 31.8, 31.2 and 11.2 million tons, respectively, which represents 85.25%, 6.32%, 6.22% and 2.20% of total volume, respectively. While, the airshipment is very small portion as shown in Figure 4.2-1.



Source: Ministry of Transport

Figure 4.2-1: Share of Domestic Freight Shipment In 2007

■ By Road



The volume of national road freight shipment is shrunk from 440.0 million tons in 2003 to 427.6 million tons in 2006 and increased to 428.1 million tons in 2007. High volume goods are sugar cane (13.97% of road shipment in 2007), soil, rock, and sand (12.28%), minerals (8.55%), fuel (7.22%) and mineral fuels (7.02%) etc as shown in Figure 4.2-2.

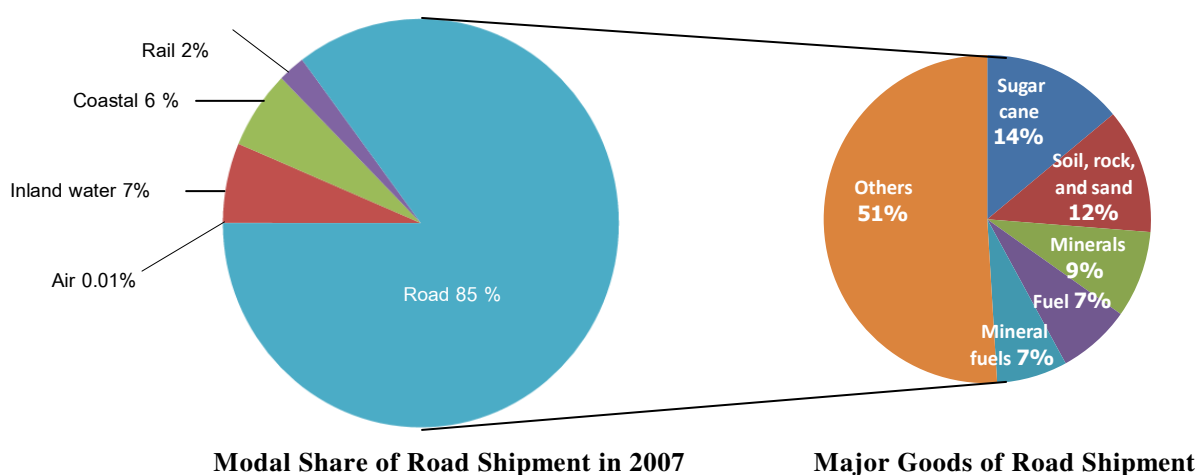
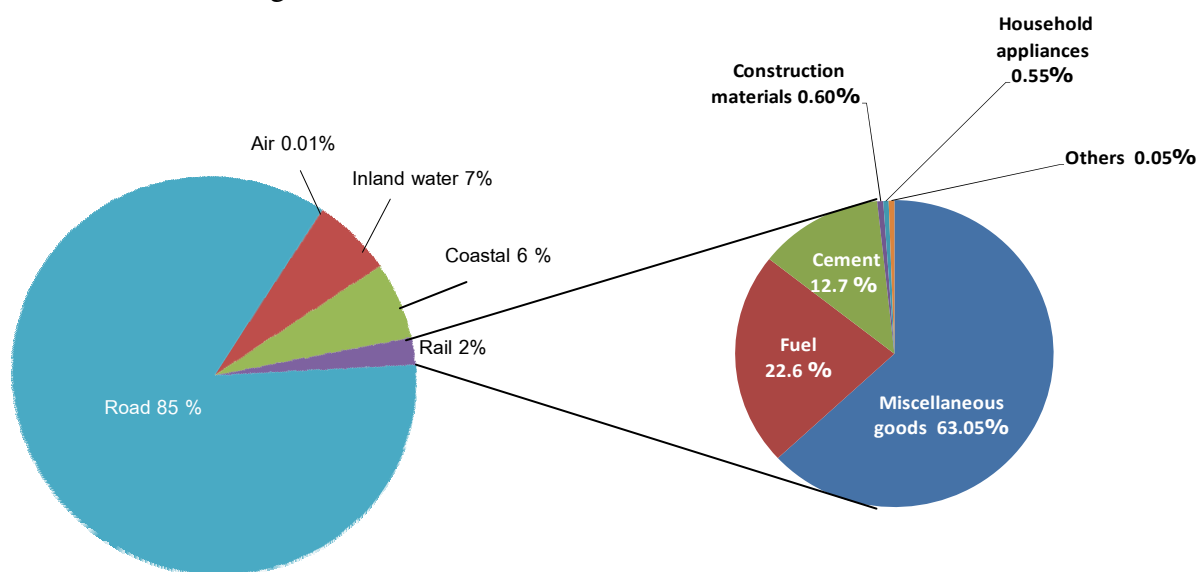


Figure 4.2-2: Modal Share of Rail Shipment and Its Major Goods

■ By Rail



The volume of rail freight shipment has fluctuated of which the highest volume is in 2004 (12.9 million tons). After that, the volume continuously drops. In 2007, large volumes of goods are miscellaneous goods (63.05% of the rail freight shipment in 2007), fuel (22.6%), cement (12.7%), construction materials (0.60 %), and household appliances (0.55%) as shown in Figure 4.2-3.



Modal Share of Rail Shipment in 2007

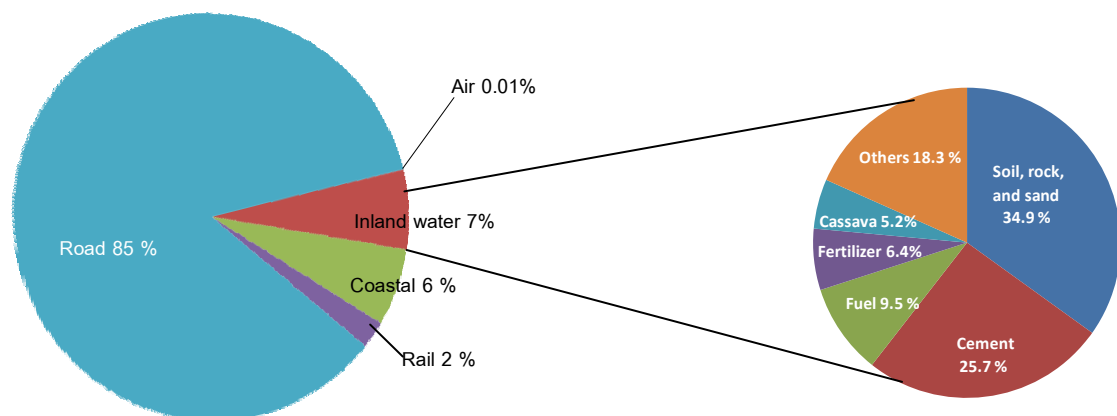
Major Goods of Rail Shipment

Figure 4.2-3: Modal Share of Rail Shipment and Its Major Goods

■ By Inland water



Freight volumes shipped by inland water are likely to increase from 29.0 million tons in 2003 to 31.8 million tons in 2007. Large volumes of freight are soil, rock, and sand (34.9% of water freight shipment in 2007), cement (25.7%), fuel (9.5%), fertilizer (6.4%), cassava (5.2%), etc. as shown in Figure 4.2-4.



Modal Share of Inland Water Shipment in 2007

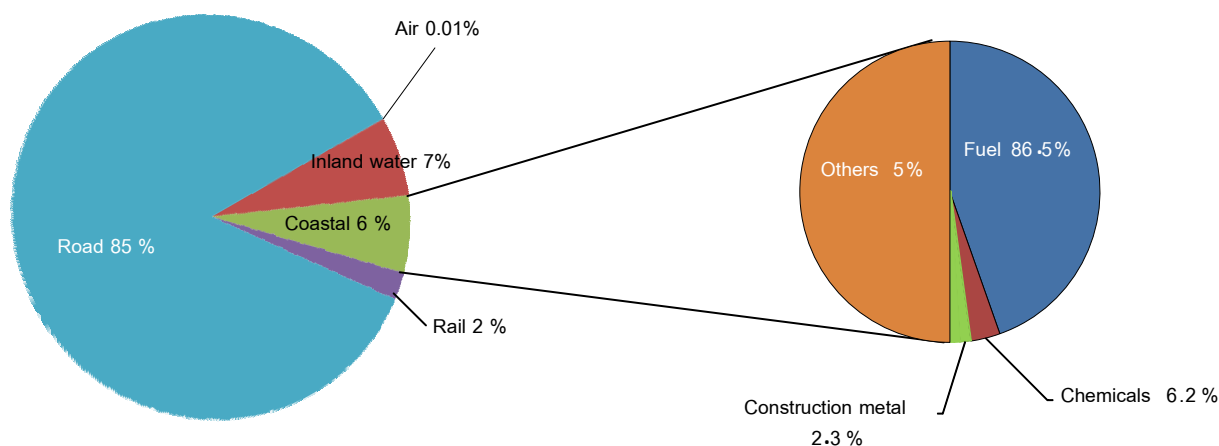
Major Goods of Inland Water Shipment

Figure 4.2-4: Modal Share of Inland Water Shipment and Its Major Goods

■ By Coastal Shipping



The volume of coastal freight shipment in 2004 (29.8 million tons per year) was increased from 2003 (24.6 million tons per year) to 20.8%. During 2003 to 2007, volumes of coastal freight shipment increased from 24.6 million tons in 2003 to 31.2 million tons in 2007. Large volumes of freight are fuel (86.5% of coastal freight shipment in 2007), chemicals (6.2%), and construction metal (2.3%), etc. as shown in Figure 4.2-5.



Modal Share of Coastal Shipment in 2007

Major Goods of Coastal Shipment

Figure 4.2-5: Modal Share of Coastal Shipment and Its Major Goods

4.3 RAIL AND WATER FREIGHT SHIPMENT DEMAND

■ Rail Freight Demand

In 2007, the volume of domestic rail freight shipment of Thailand was approximately 11.9 million tons classified into 8 categories, which are LPG, crude oil, oil products, cement, containers in the eastern line, domestic containers and international containers (land bridge), and other goods. Freight shipped by train having high load at the top three are containers in the eastern line, cement, and crude oil; the load shipped are approximately 6.3 million tons, 1.4 million tons, and 1.3 million tons, respectively, as shown in Figure 4.3-1.

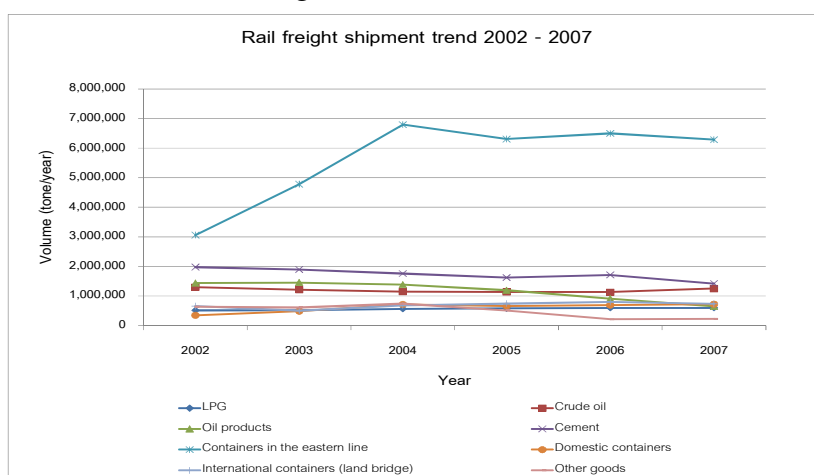


Figure 4.3-1: Rail Freight Shipment Trend 2002 - 2007

■ Water Freight Demand

In 2007, the top three freight shipped by water are soil, rock, and sand (approximately 15.3 million tons, 33.7%), cement (approximately 12.2 million tons, 26.8%), and mineral fuel (approximately 5.1 million tons, 11.2%), respectively. Inland water transportation is made via major rivers, especially Chao Phraya River and Pasak River, which have high volumes. The origins of downstream transport are in Angthong, Ayutthaya, and Nonthaburi and their destinations are Samut Prakarn, Pathum Thani, Surat Thani, Nonthaburi, Bangkok, and Chonburi. For upstream transport, the origins are Chonburi and Samut Prakarn and the destinations are Ayutthaya, Pathum Thani, and Nonthaburi.

■ Coastal Freight Demand

The coastal freight shipment is approximately 31.2 million tons in 2007. The most shipped freight is fuel (approximately 27.0 million tons or 86.5%) and second is chemicals (approximately 1.9 million tons). Export shipments are greater than imports. In 2007, the amount of coastal export shipment is approximately 22.65 millions tons (61.22%) and import shipment is approximately 14.35 millions tons (37.78%) of the total volume of coastline shipment, respectively.

For maritime coastal directions, the origins or destinations are at the coast of Central part, Eastern part, and Southern part, and the main directions are between Songkhla Port/Surat Thani Port/Prachuap Khirikhan Port, and Laem Chabang Port.

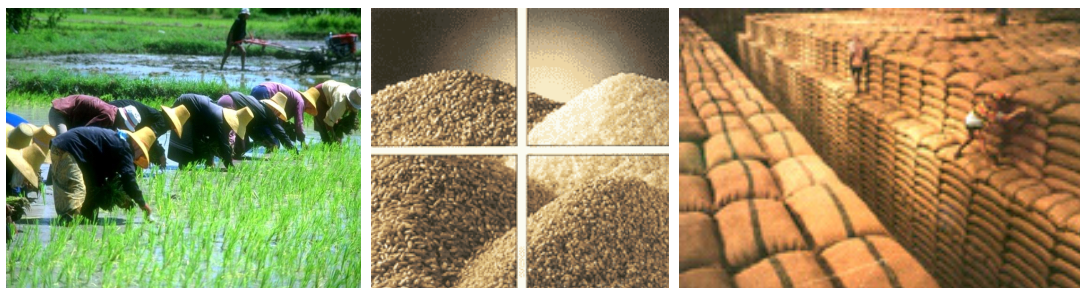
5. STUDY AND SELECTION OF SUITABLE GOODS FOR MODAL SHIFT

5.1 CASE STUDY GOODS

The Consultant has selected goods that are important to the economy, 20 items that are suitable for modal shift from road to rail and water modes. They are as follows: (1) Rice, (2) Fuel, (3) Cement, (4) Coal, (5) Soil-rock-sand, (6) Corn, (7) Cassava, (8) Construction Materials, (9) Wood and Furniture, (10) Sugar, (11) Feed, (12) Fertilizer, (13) Rubber, (14) Hot rolled steel, (15) Cars, (16) Plastic pills, (17) Gypsum, (18) Beverages, (19) Rubber products, and (20) Paper.

5.2 TARGETED GOODS

To induce modal shift that can save transport costs as a whole, the Consultant selected the following 5 target goods: (1) rice, (2) cassava, (3) sugar, (4) rubber, and (5) fertilizer, whose shipment state and logistics have been thoroughly analyzed including conditions for success in shifting mode to save freight shipment costs as a whole. The key features can be summarized as follows:



Rice: Rice is a key economic crop of Thailand. Thailand is the number one global rice-exporting nation and stands ready, in both product volume and stock inventory. The greatest volume rice production and export is in the northeast region at 45 percent of the nation, followed by the north region, at 28 percent, and the central region, at 24 percent, respectively.

Cultivation of rice is distributed throughout all provinces in Thailand. In this regard, most key rice production source and mills are located in the lower northeast region provinces of Surin, Ubon Ratchathani, Nakhon Ratchasima, Roi Et, Buriram, and lower north region provinces of Nakhon Sawan, Phichit, Phitsanuloke, Phetchabun, Kamphaengphet, for instance.



Sugar: The growing area for sugarcane is around 6.2 million rais; total output is around 60 million tons. Cultivation area is mostly in the central and northeast region. The top-5 provinces growing sugarcane are Kanchanaburi, Nakhon Sawan, Suphanburi, Nakhon Ratchasima, and Khon Kaen. Most sugar produced in the country, around 67 percent, is for domestic consumption, and around 33 percent is for export. In this regard, the northeast region produces and exports sugar at most compared with the whole country, about 39 percent, and demand for shipment of sugar to Laem Chabang and Bangkok Ports is year round because part of supply has been kept in stock. Most shipment is made by truck.



Cassava: Thailand is the world's 3rd largest cassava exporter. Cassava and processed flours are exported combined totally up to 2.2 million tons annually. Cassava is thus the heavy freight. In 2007, the growing area for cassava was around 7.5 million rais; total output was around 26.4 million tons. Cultivation is mostly in the northeast region. The top-5 provinces area-wise cultivating cassava are: Nakhon Ratchasima, Kampaengphet, Chaiyaphum, Sa Kaew, and Chachoengsao.



Rubber: Thailand is the world's number one rubber exporter. By 2011, newly planted rubber will begin to yield in the upper northeast region, which is a new market and exporting channel through Laem Chabang Port or through ports in Vietnam. Domestic shipments are more likely to shift to water transport, especially coastal shipments. Moreover, rubber can be shipped by rail. The south region has 86 percent of national output, the central and east regions have a 10-percent share, and the northeast region has a 4-percent share, while the north region has a very small share of only 0.1 percent. In this regard, Surat Thani, Songkhla, Trang, Nakhon Si Thammarat, Narathiwat, and Yala have high output.



Fertilizer: Thailand relies mostly on the agricultural sector. Fertilizer is an industry that directly affects output in the agriculture sector, which depends mostly on imports as Thailand itself still cannot produce fertilizer germs. Today, shipment is made by barge via Chao Phraya River towards ports in Ayutthaya and linking with trucks to various provinces; however, a lot of fertilizer is still shipped by truck.

5.3 FORECAST OF TARGETED GOODS DEMAND

1. Rice (Domestic transport)

It is estimated that the exported volume of rice is 8.1 million tons per year during the years 2006 – 2017.

2. Sugar (Domestic transport)

It is estimated that the average exported volume of sugar in the next 5-10 years is 3.9 million tons per year.

3. Cassava products (Domestic transport)

It is estimated that the exported volume of cassava products will be 7.40 million tons in 2012 and will be increased to 9.45 million tons in 2017.

4. Rubber (Domestic transport)

It is estimated that in the next 5-10 years, the exported volume of rubber will be increased to 2 percent per year, as 3.27 million tons and 3.62 million tons in 2012 and 2017 respectively.

5. Fertilizer

It is estimated that the exported volume of fertilizer will be increased by 4.5 percent per year, which will be 4.10 million tons in 2012 and will be increased to 5.10 million tons in 2017.

6. PERFORMANCE OF THAILAND'S TRANSPORTATION SYSTEM

6.1 INTERNATIONAL PORTS

International ports are important gateways for international trade and economy. They are the transshipment station for the variety and high quantities goods; therefore they cause much more economic activities. The important international ports are Bangkok Port, Laem Chabang Port, Map Ta Phut Port, Songkhla Port, and Phuket Port. The important private ports are Sriracha Harbour and Siam Seaport. Moreover, international inland water ports are Chiang Saen and Chiang Khong Ports as shown in Figure 6.1-1.

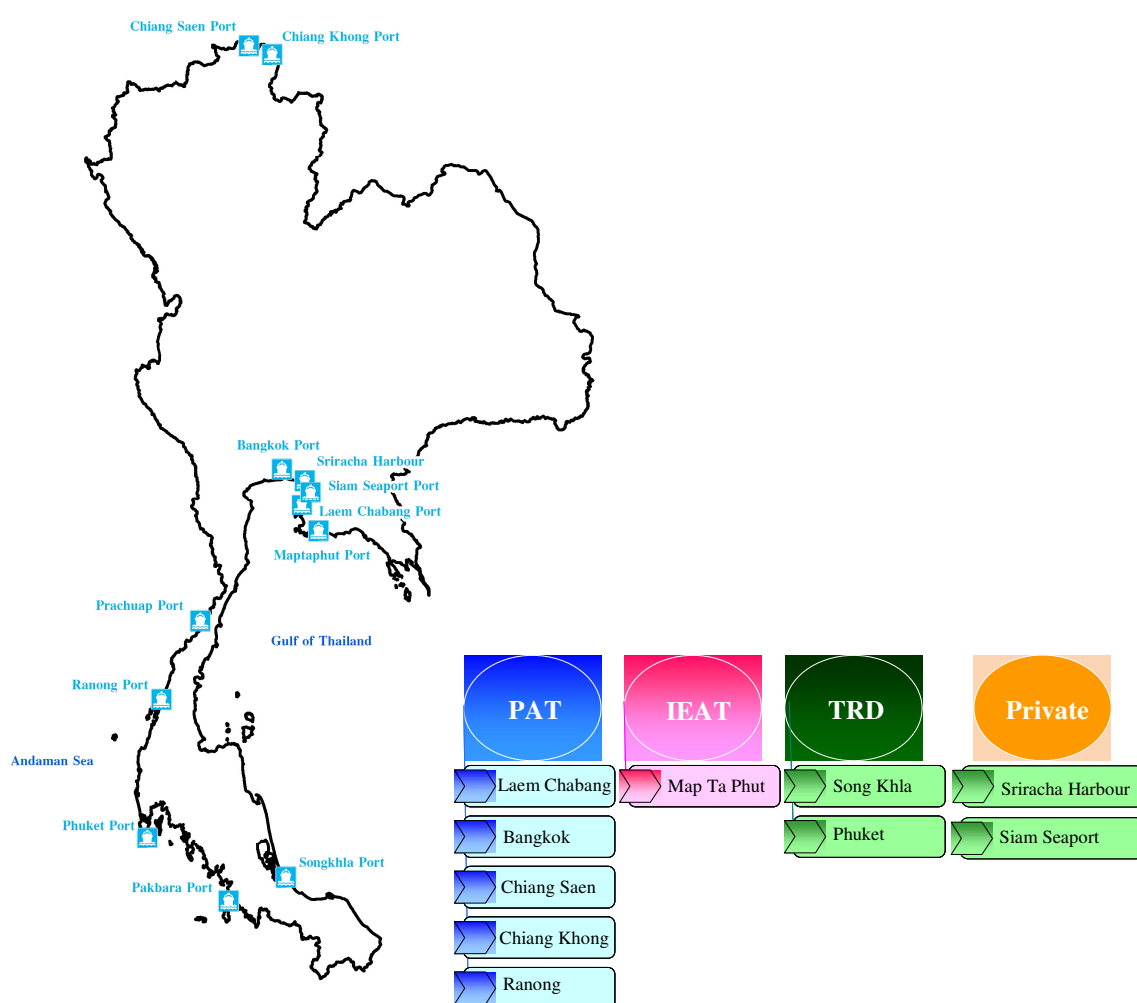


Figure 6.1-1: International Ports

The future development plan of the international ports is Pakbara Port and Songkhla Port 2. The international inland water port is Chiang Saen Port 2 project in Chiang Rai.

Once Chiang Saen Port 2 is opened, however, Chiang Saen Port 1 will be changed to a tourist port because the transportation area in Chiang Saen Port 1 is congested and harmful to the historic area by truck traffic.

6.2 DOMESTIC TRANSPORTATION SYSTEM

The current infrastructure and transportation system are classified by road, rail, inland water, coast, air, and pipeline, as shown in Figure 6.2-1.

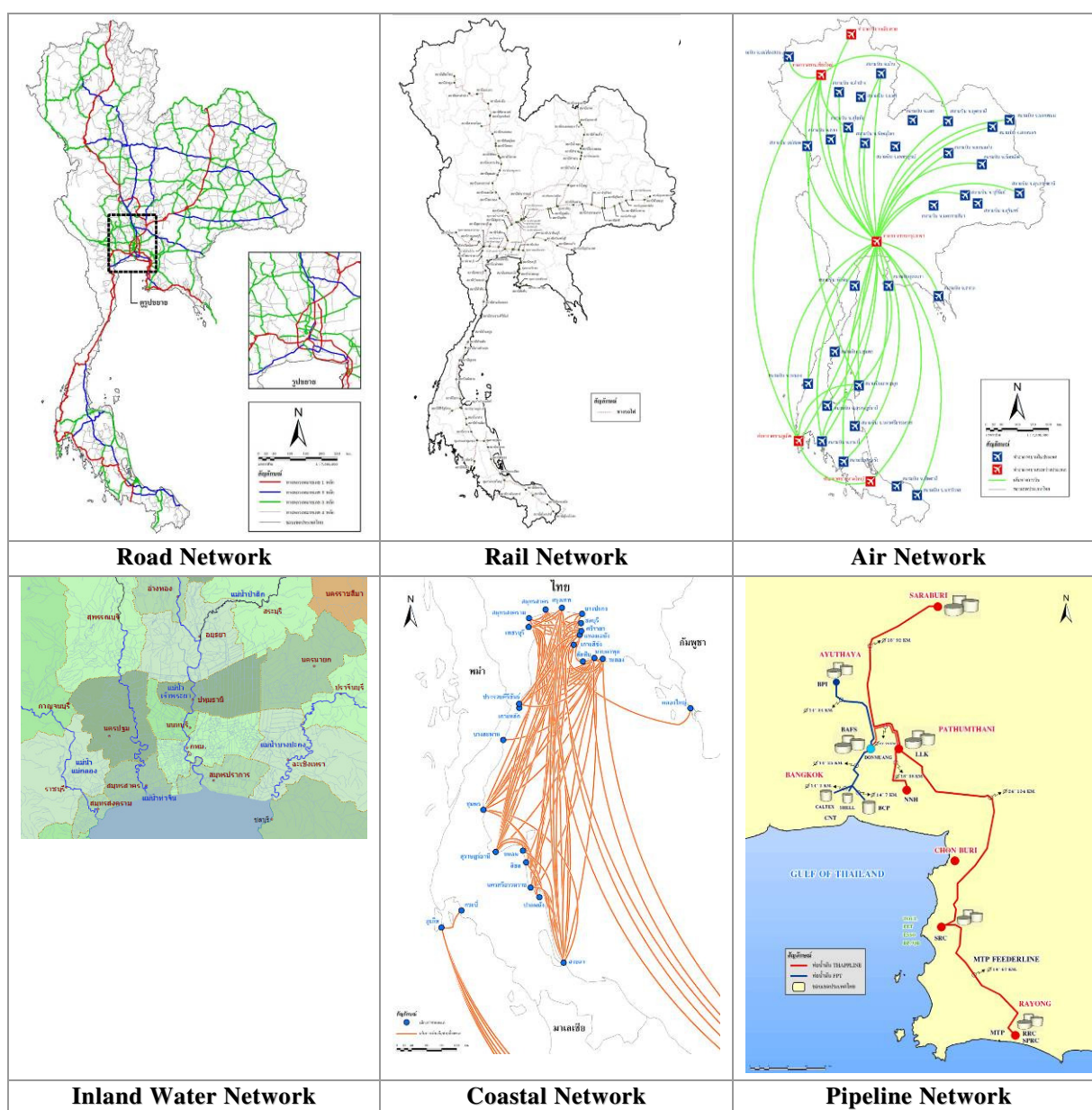
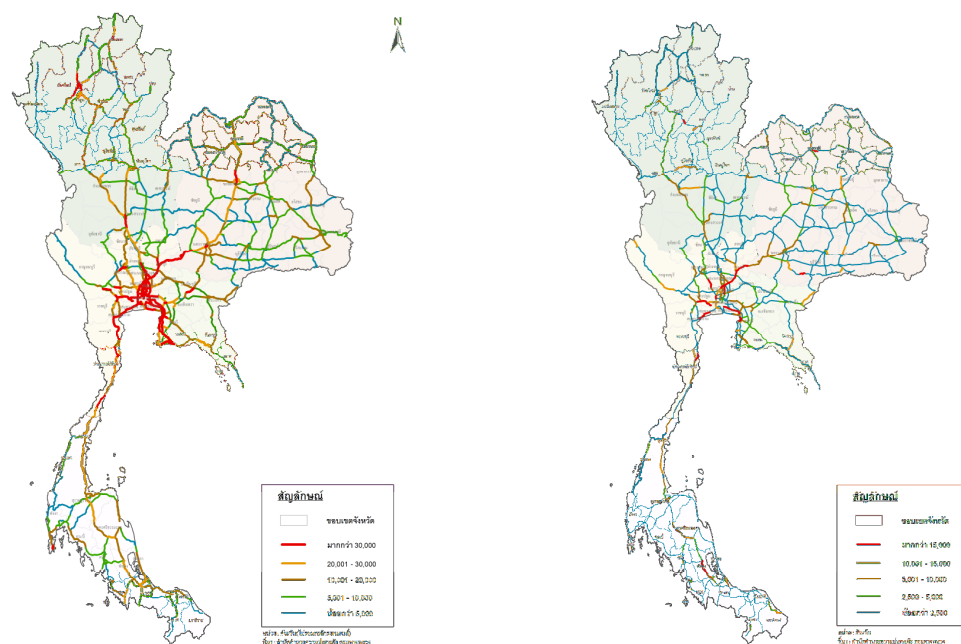


Figure 6.2-1: Major Domestic and International Transport Network of Thailand

6.2.1 Road Transportation

Road transportation has been very popular because the road is the basic rapid transport service and has the ability to access directly the sources of production and consumption (door-to-door) with no change or transfer between vehicles. It has the highest efficiency in short transport. Moreover, road network covers all area of the country. It also has a high standard road, surface of asphaltic or reinforced concrete and easy to provide a vehicle.

The Consultant compiled nationwide highway network traffic volume data from Bureau of Highway Safety, Department of Highways, as current as 2007, showing combined traffic conditions of all vehicle types and only truck volumes in the same year in Figure 6.2-2. Result of road transport-efficiency analysis in 2007 can show the proportion of traffic volume to capacity on highways nationwide, as shown in Figure 6.2-3.



Traffic volume of all modes on the highway network

Truck volume on the highway network

Figure 6.2-2: Traffic Volume on Highway in 2007

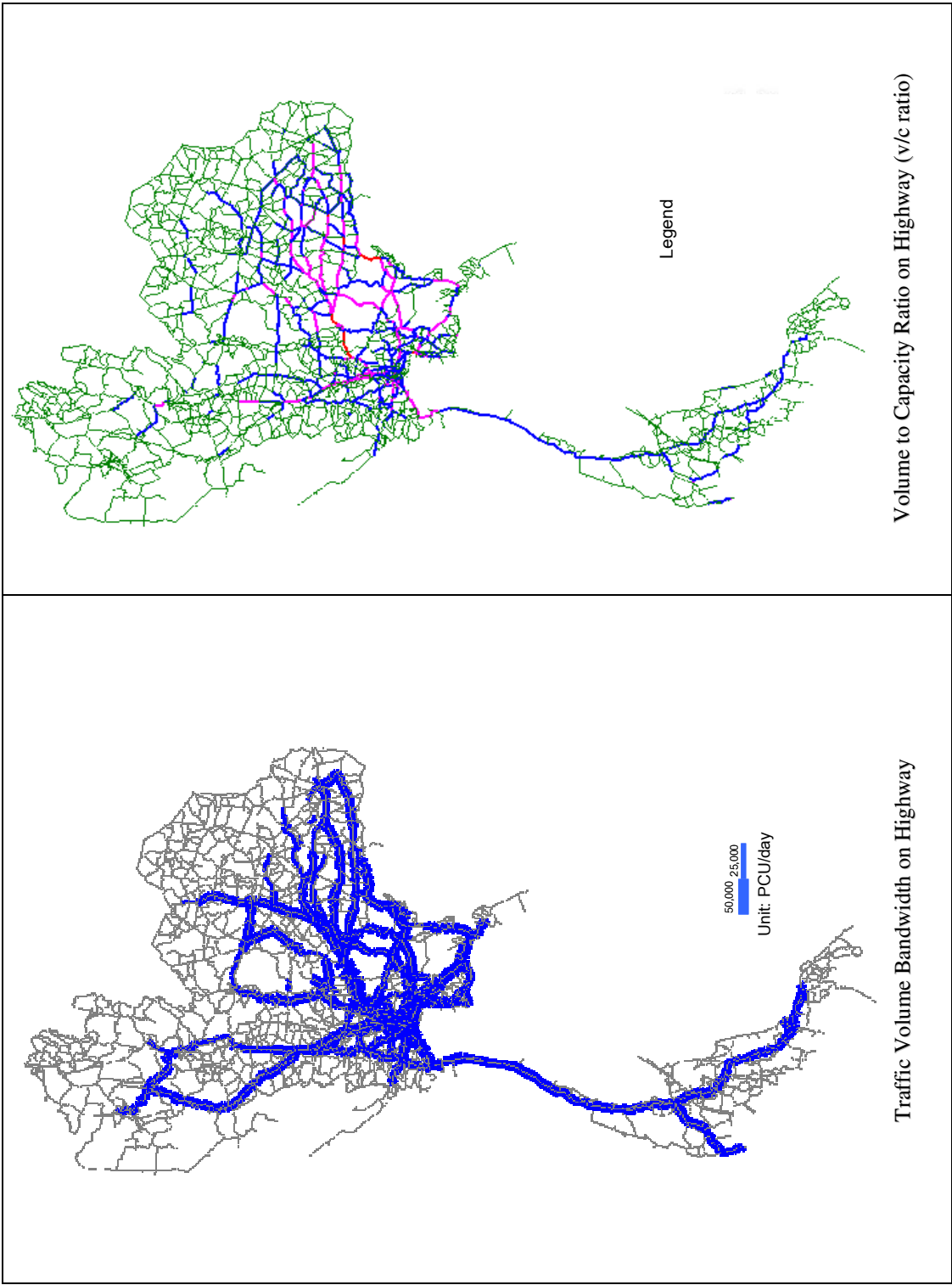


Figure 6.2-3: Highway Performance in 2007

6.2.2 Rail Transportation

Today rail transportation comprises passenger and freight. In this regard, passenger transportation is most concentrated from suburbs surrounding Bangkok and adjoining provinces, to inner areas of Bangkok. The next congested route is the intercity travel from Bangkok to the north, northeast, and south. Subsequently, the east region has negligible passenger travel as most passengers choose to travel by bus, which is faster and more convenient. While, the most dense section for freight shipment is between Ladkrabang ICD and Laem Chabang, as shown in Figure 6.2-4.

To promote the modal shift from road to rail transport, rail capacity must be analysed especially in terms of both passenger and freight demand. Results of rail performance analysis in 2007 in terms of volume to capacity ratio are shown in Figure 6.2-5.

Presently, State Railway of Thailand (SRT) has implemented various infrastructure development projects to support increased passenger and freight volumes and to maintain rail tracks. Capacity expansion projects comprise nationwide double-track segment development, eastern seaboard rail line double-track construction, phases 5 and 6 of track rehabilitation, second Ladkrabang ICD construction, and locomotive and freight container bogeys (FCBs) provision.

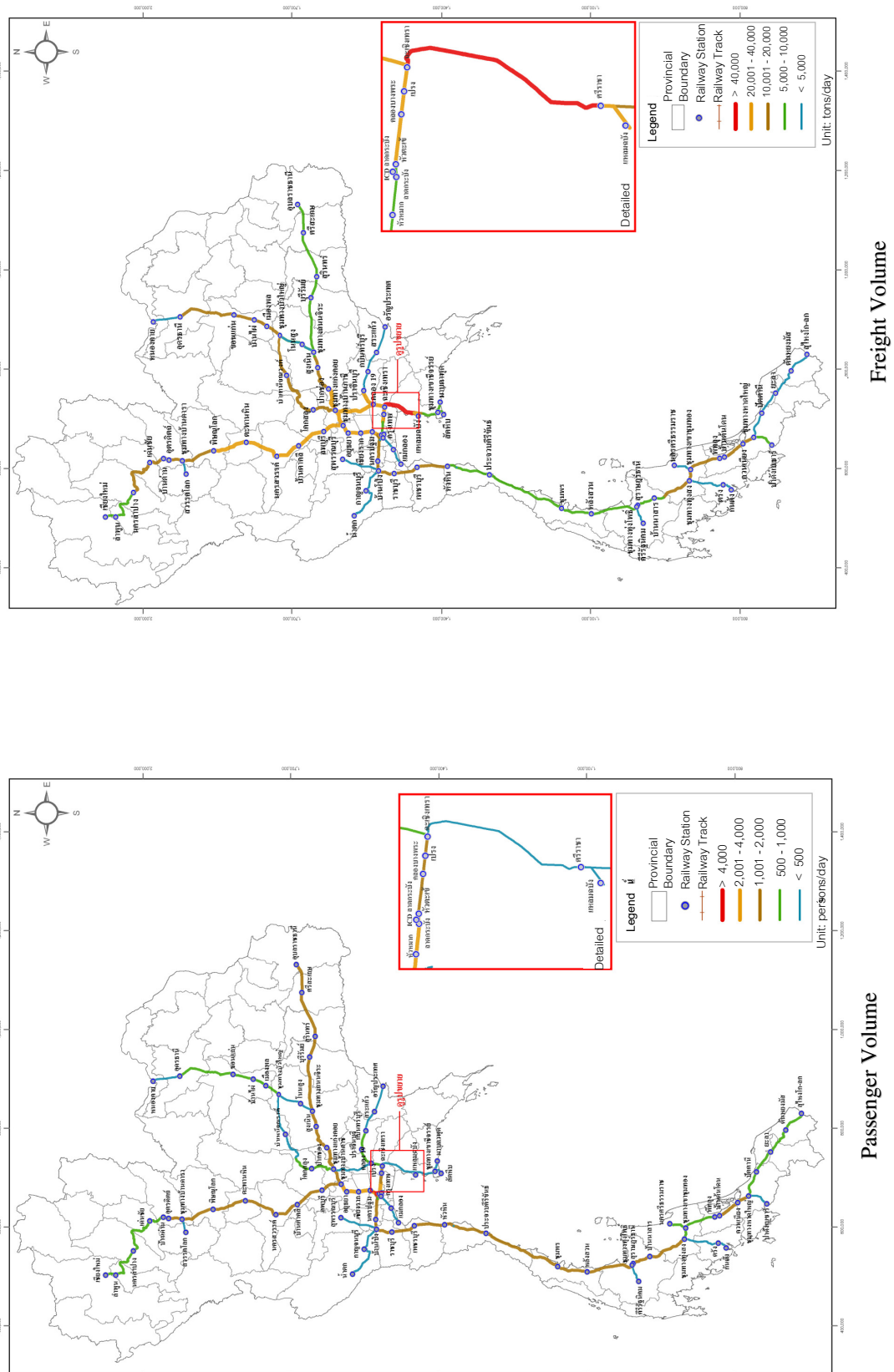


Figure 6.2-4: Traffic Volume on Rail in 2007

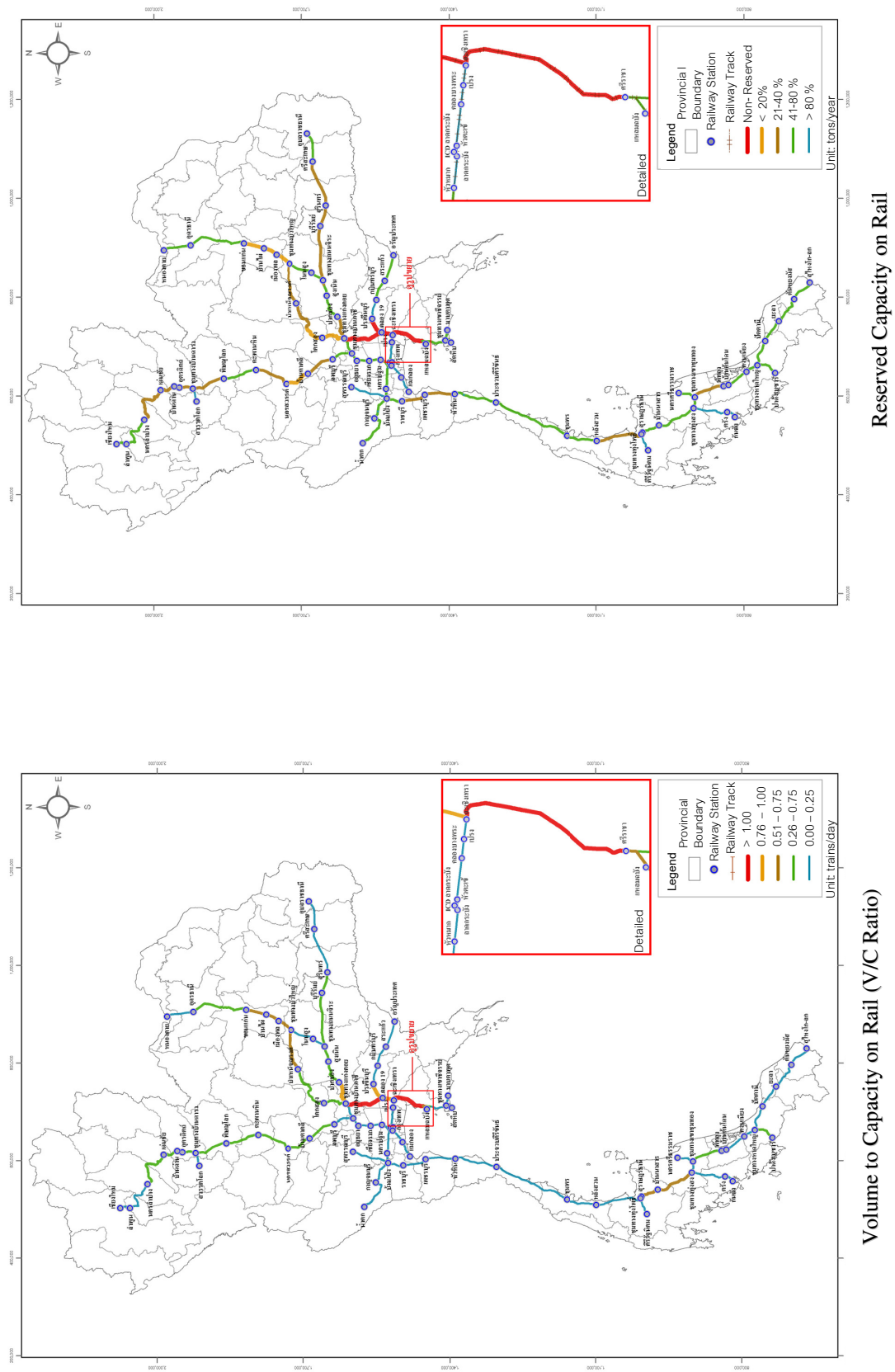


Figure 6.2-5: Rail Performance in 2007

6.2.3 Inland Water Transport

Important waterway is made in Chao Phraya River, Pa Sak River, Bang Pakong River, Mae Klong River and Tha Chin River and the navigable range of those rivers is shown in Table 6.2-1.

Table 6.2-1: Major Inland Water Transportation of Thailand

River	Navigable Range
Chao Phraya River	From estuary (Samut Prakarn) to Amphoe Mueang (Angthong) with distance of 170 km
Pa Sak River	From converging point with Chao Phraya River (Ayutthaya) to Amphoe Tha Rua (Ayutthaya) with distance of 47 km
Bang Pakong River	10 km from estuary (Chachoengsao)
Mae Klong River	Estuary area (Samut Songkhram)
Tha Chin River	From estuary (Samutsakhon) to Amphoe Nakhonchaisri (Nakhon Pathom) with distance of 78 km

Source: The development plan of inland water transport center to promote coastal transport system and international transport, Marine Department.

In 2007, approximately 14,000 ships navigated the waters; they comprised around 10,000 self-propelled ships and around 4,000 non self-propelled ships. Of this number, 7,000 are freighters, or 50 % of all ships, most of them are 500-ton ships used for shipping sand, and 1,000-ton ships are used to ship coal. Presently, navigation on Chao Phraya River from the estuary to about 45 km inland can accommodate international vessels, thereafter, only barges can access. Due to limitations related to water size, height clearance, and distance between foundation support beams, ship navigation on the Pa Sak River is limited to barges only. Due to limitation related to watercourse, vertical clearance, and spacing between the piers, ship navigation in Bang Pakong, Mae Klong, and The Chin River can accommodate coastal ships on the first section, thereafter, only barges can access, as shown in Figure 6.2-6.

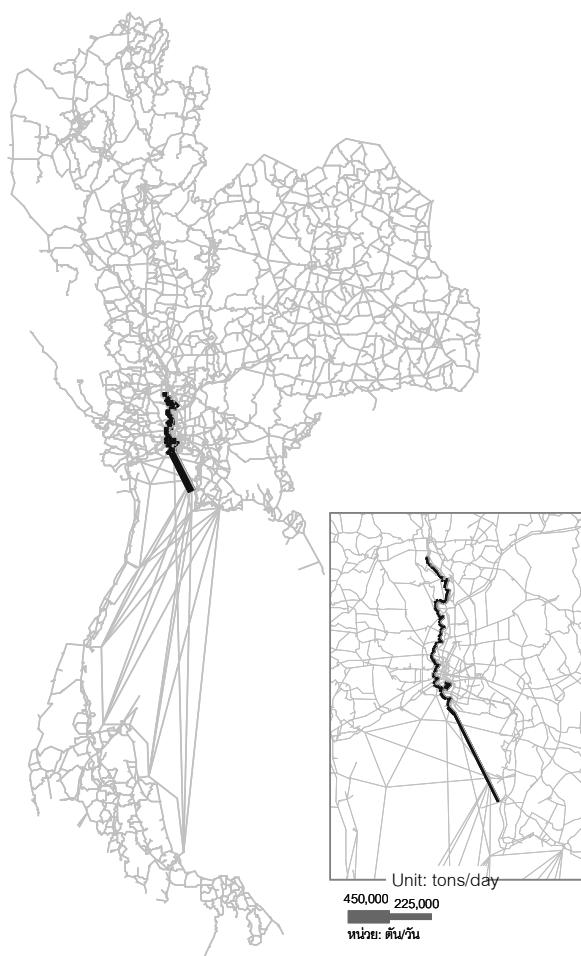


Figure 6.2-6: Inland Water Freight Volume in 2007

6.2.4 Coastal Transport

In 2007, about 39,000 coastal ships were available. They comprised about 36,000 self-propelled ships and about 3,000 non self-propelled ships. Of these, 6,000 are freighters, or 15.4 % of all ships. Most domestic routes of these freighters originate from or destine to the central, eastern, and southern coast of the Gulf of Thailand. Key coastal ports are Laem Chabang Port, Klong Toey Coastal Berth, BMT Port, Saha Thai Port, Prachuab Port, and Surat Thani Port.

Marine Department has important projects which are development of Phuket Port, Songkhla Deep-Sea Port No. II, Kantang Port, Chumporn Port; construction of Donsak Multipurpose Port in Surat Thani and Klong Yai Multipurpose Port in Trat; and the support of roll-on and roll-off ships for Laem Chabang - Surat Thani line or Laem Chabang - Surat Thani - Songkhla line or Laem Chabang - Songkhla line.

6.2.5 Air Transport

Most of domestic and international cargoes originate from and destined to the airports that have cargo warehouse support. Suvarnabhumi is the major airport of Thailand that has established one stop service to reduce service time, arranged all international cargo warehouses in a tax-free zone, and is the airport that has a cargo warehouse-service area and 24-hour customs free zone service having with the capacity of 3 million tons per year.

Thai Airways International Public Company Limited has conducted various projects to support the strategy of logistics development, comprising the expansion of cargo shipping areas in the important cities around the world, cargo charter aircraft project, freighter service project, and express logistics center project.

6.2.6 Pipeline Transport

Currently, there are two companies that provide oil pipeline service. The first company is Thailand Petroleum Pipeline Company, Limited (THAPPLINE). It provides oil pipeline service in 5 sections (Map Ta Phut-Si Racha, Si Racha-Lum Lukka, Lum Lukka-Don Mueang, Lum Lukka-Suvarnabhumi and Lum Lukka-Saraburi). However, average usage is only 32% of its capacity. In this regard, the most utilized section is Lum Lukka-Don Mueang at 56%, followed by Lum Lukka-Saraburi at 30%.

The second company is the Fuel Pipeline Transport Company, Limited (FPT), operational since 1994. It provides pipeline service in 4 sections. Currently, the utilization is still below its capacity. The pipeline capacity is 9,600 million liters per year; however, it is actually utilized only 3,400 million liters per year, or 36%, which is similar to the operational rate of Thappline. Hence, it is obvious that the current pipeline transportation of both THAPPLINE and FPT is utilized below its service capacity.

7. THE STUDY AND ANALYSIS OF RAIL AND WATER ACCESSIBILITY

7.1 PROBLEMS AND OBSTRUCTIONS

7.1.1 Problems and Obstructions of Rail Transport

Transportation needs are increasing while the proportion domestic rail transport is far less than that of road transport. Problems and obstructions are as follows:

- Infrastructure, locomotives, and wheels are in disrepair.
- Lack of locomotives, wheels, and handling equipments.
- Public service obligation.
- Lack of financial strength.
- Lack of specialized knowledgeable people.
- Lack of good management.

7.1.2 Problems and Obstructions of Inland Water Transport

The problems and objections of domestic water transportation can be divided into inland water transport and coastal transport, but their problems are linked and interrelated as a whole. Important problems are infrastructure problems, regulatory problems, and limitation of physical problems.

Problems and obstructions of inland water transport

- Thailand has no public river ports or inland water station in Chao Phraya River serving as linkage between land and water transport.
- The linkage of berth area and hinterland is not efficient.
- The port charge criteria for the private are not clearly specified.
- Lack of inland container barges.
- Flooding problem due to release water from Chainat dam causes higher cost resulting from additional few tug boats.
- Watercourse, e.g., shallow channel, river bend, insufficient width of channel.
- The out of date of some registered ship regulations.

Problems and obstructions of domestic coastal transportation

- New port at Laem Chabang (A0) is the semi-international port, so the coastal ship is inconvenient to use the port and has high costs.
- Coastal port has no suitable handling equipment.
- Some goods at Klong Toei Port which are unable to be transported to Laem Chabang Port must be notified and new documents made. But, Klong Toei Port still uses manual system so the cost is increased.
- Many restrictions from public regulation and control.
- Towed ship cannot maintain the quality and delivery throughout the year due to rough wave problem during stormy season so they could not determine the exact travel time.

7.2 CONNECTION POINT BETWEEN RAIL AND WATER TRANSPORTATION

The transport linkage plays a vital role for the modal shift from road to rail and water transport because they are the connecting point between production sources and gateways. The basic information of the current connection points between road/rail and road/water as well as future development can be described as follows:

7.2.1 Current connection points between rail and water transport

SRT establishes Ladkrabang inland container depot (LICD) to support the imports and exports of Thailand as well as growing throughputs at Laem Chabang Port. The linkage between LICD and Laem Chabang Port can be made by road and rail, as shown in Figure 7.2-1.



Figure 7.2-1: Ladkrabang Inland Container Depot (LICD)

Presently, SRT has invested the container yards (CY) in some regions serving as public consolidation and distribution area for operators and supporting railway transport. The major CYs are:

Kudjik Station Nakhon Ratchasima Province; Area: 15,010 sq m; Construction cost: 11.8 million baht; opened for service: 9 October 2006.

Tha Pra Station Khon Kaen Province; Area: 14,840 sq m; Construction cost: 18.4 million baht; opened for service: 1 September 2005.

Sila Art Station Uttaradit Province; Area: 17,716 sq m; Construction cost: 8.5 million baht; opened for service: 1 December 2005.

Ban Tung Po Junction Station Surat Thani Province; Area: 25,260 sq m; Construction cost: 18.8 million baht; opened for service: 1 October 2005.

However, some manufacturers are inconvenient to use those public container yards due to additional door-to-door transport costs. So, the private sector has developed new container yards in Northeast line: Non Payom Station; Khon Kaen, Thanon Jira Junction Station, Ban Kor Station, Bua Yai Station; Nakhon Ratchasima, and South line: Tha Maung; Kanchanaburi, Thung Song Junction Station; Nakhon Si Thammarat.

7.2.2 Development Plan of Rail and Water Transport Connection Points

7.2.2.1 Development of Container distribution centers between road and rail transport

In addition to current CYs invested by SRT and private sectors, the potential container yards are: 1) Wisai Station in Chumphon Province, and 2) Tha Khao Kamnan Song Station in Nakhon Sawan Province.

Meanwhile, SRT has studied more consolidation area in the region, e.g., new ICD in Khon Kaen, the second LICD, etc.

7.2.2.2 Development of container distribution centers between road and water transport

The Marine Department (MD) has proposed the development of consolidation area for the inland water transport in Ayutthaya and Angthong Province in order to support agricultural products from central, lower north and northeast region, i.e., rice, cassava, sugar etc. In Ayutthaya, there are two busy ports, i.e., in Amphoe Tha Rua and Nakorn Luang. Both of them are in Pasak River. Meanwhile, river port in Angthong should be developed in Amphoe Champalor. Moreover, Surat Thani Province has high potential for establishing the consolidation center supporting coastal transport because its location can serve as a transfer point from road to coastal transport which can reduce the transport cost. Presently, the manufacturers who are interested in coastal transportation are, e.g., rubber operators, auto parts operators, cement operators, etc.

7.2.2.3 Development of Borderline Truck Terminal

In the future, border freight along economic corridors will increase so the truck terminal will be established for consolidation and distribution purpose. Moreover, they will serve as the rest area, maintenance and the customs checkpoint. The high potential points are Amphoe Mueang in Nong Khai Province, Amphoe Mueang in Mukdahan Province and Amphoe Chiang Khong in Chiang Rai Province. In the future, truck terminal may become borderline ICD.

8. GUIDELINES AND MEASURES PROMOTING MODAL SHIFT

The study of guidelines driving modal shift will comprise:

- 1) The study of guidelines and measures promoting modal shift
- 2) The analysis of guidelines developing connection points
- 3) The study of regulations and laws related to the transportation field

8.1 THE STUDY OF GUIDELINES AND MEASURES PROMOTING MODAL SHIFT

8.1.1 Policy Tools to Promote Modal Shift

Study of guidelines and measures promoting mode shift are based on the report by TransConsult Co., Ltd. and others cited from Schwaab and Thielmann (2001). They have studied about transportation policy tools, which can be divided into 4 main sections, as follows:

- 1) **Legal and planning tools.** Legislation is designed to act according to policy emphasizing command action and control.
- 2) **Voluntary cooperation tools.** Voluntary cooperation between people and government for making consistent policies and measures.
- 3) **Economic tools.** Use economic principles as a motivational tool for achieving policy objectives.
- 4) **Data tools.** Offer information to users and service providers to choose transport mode.

8.1.2 Measures for Promoting Modal Shift

- ***Modal shift from road to rail***

If SRT can provide better rail service than that of road transport, the modal shift will occur. Key measures include law and regulation, institutional measures, organizational measures, and infrastructure measures. Necessary guidelines for rail mode are:

- Expanding the goals of rail in logistics strategy.
- Improving operation based on logistics strategy and supporting establishment of logistics subsidiaries.
- Improving law and regulation in concert with logistics management of SRT.
- Infrastructure development of rail multimodal transport.

- ***Modal shift from road to water***

Key guidelines of water transportation are:

- Capacity building of multimodal transport operators.
- Infrastructure development of multimodal transport.

8.1.3 Guidelines for Infrastructure Development of Multimodal Transport

The objectives of multimodal transport strategy development are:

- Rail or coastal transportation between hubs serves as the main line.
- Develop logistics centers that connect between various modes of transport.
- Build regional clusters that correspond with logistics service center area.
- Develop feeder system for transport center to transfer to train or coastal ships.

8.2 THE ANALYSIS OF GUIDELINES DEVELOPING CONNECTION POINTS

Hub is a key to drive modal shift from road to rail and water modes. If hubs are highly efficient and well managed, modal shift will occur. Guidelines to increase the role and efficiency of hubs are as follows:

- Expand ICD services, such as bonded warehouse, freezone. Moreover, it will benefit industries that import raw materials from abroad to manufacture for export and promote Thailand as the hub for international trade.
- Promote development of logistics center at hinterland and important ICD. Logistics centers include customs clearance, consolidation and distribution of containers, packaging and identification of products.
- Upgrade equipment, facilities, and communication, such as the use of RFID (Radio Frequency Identification) system with containers to track transportation route from origin to destination.
- Improve access and connection points to facilitate the flow of goods.
- More activities including procurement and pre-assembly stages for adding value to goods before they depart from port should be provided at the hubs, which will be more cost-effective when compared to transportation.

- International hubs may reduce tax of goods from abroad by importing all sets of goods or a whole car and separate them at the hubs and then exporting them to countries having taxation of parts less than instant goods (one form of supplementary services in new packaging).
- The IT technology and communication to track transportation activities for data connection from origin to consumers overseas should be applied at the hubs.
- The data collection of import and export between regions and overseas should be conducted at the hubs. The data can show the demand and supply of each goods in each country.
- Hubs should function as “consolidation center” for minor exporters or importers so that the containers can be effectively used, resulting in significant cost saving.

8.3 THE STUDY OF REGULATIONS AND LAWS RELATED TO THE TRANSPORTATION FIELD

From the study, guidelines to promote modal shift is promote and drive private sector operations in key public transport affairs, that is provide benefits to businesses based on the Investment Promotion Act of B.E. 2520 (1977) like exemption from Immigration Law, Land Law Code, tax exemption of imported machinery, cost reduction for imported raw materials, tax exclusion, etc. For focused activities specifically announced by the Board of Investment, the rights on benefits and taxation are excluded for imported machinery and exempt corporate income tax is 8-year period including the right to receive other tax benefits in the investment zone¹.

Operations related to maritime activities, including ship transportation² are the service and public utility business and they are under the condition of the account of the announcement of the Board of Investment 2/2543(2000) about the type, size, and condition of the promotion of investment business³ so they

¹ http://www.boi.go.th/thai/about/investment_policies_criteria.asp#priority1

² For ship transport, The Notification of the Board of Investment of S 5 / 2542 on the Amendment Type 7.9, Ship transport means the Coastal maritime operations, International maritime including ship operation that support the petroleum exploration and production in the sea by imposing conditions that must be a boat that has been classified with the reliable Marine Institute. In the case of maritime coast, boat size must have at least 500 date weight ton and drive by engine that if ship is used in transporting oil and hazardous goods must have liability insurance (P & I Clubs).

³ As issued by virtue of Section 16 paragraph two of the Investment Promotion Act 2520, the announcement has set the minimum investment size to not less than one million. (Excluding land costs and working capital) and define activities to promote investment by the end of accounting announcements.

are defined as special business⁴ and receive benefits under the Investment Promotion Act of B.E. 2520 (1977).

For rail transportation, because now it is a monopoly provider by the State Rail of Thailand, so it is not under the investment announcement. However, when the Draft Transport Administration Act of B.E.... will be enabled and private sector will take part in the operations, the Consultant found that private operators should be given benefits under the investment announcement in the same way with water transport. Therefore, the Department of Land Transport may need to coordinate action to the Board of Investment to announce that rail business is the promoting investment.

Moreover, the Consultant found that rail transport has no state agency that is directly responsible and promotes operations. For example, air transport is under the responsibility of the Department of Civil Aviation, water transport is under the responsibility of the Marine Department and land transport especially road transport is under the responsibility of the Department of Land Transport. Therefore, rail transport should have the state agency act more as well. It may be named "Department of Railway" or "Department of Railway Transport". Establishment of this department, the state will have to determine the annual government and official rates, including management within the department, so it is necessary to draft an act to improve the Department, Ministry (No. ...) Year ... to establish a "Department of Railway" or "Department of Railway Transport" and prepare a Draft Ministerial Regulation to divide the "Department of Railway Transport" (or the Department of Railway) in order to define and divide agencies within the department.

⁴ Businesses under conditions must be approved by relevant government agencies.

9. THE STUDY OF MODAL SHIFT ALONG PILOT CORRIDORS

9.1 SELECTION OF PILOT CORRIDORS AND PROPOSED MEASURES

The pilot corridors will be selected as most likely possibility of modal shift with supporting criterion as follows:

- Major production area of the country
- The rail and water is located in parallel to road network with high traffic volume
- The consolidation points are conveniently accessible by rail and water transport

As a result, the pilot corridors comprise 4 routes as follows:



Corridor 1: Northeast Region-Laem Chabang Port

The northeast region is an important national production source of rice, sugar, and cassava and lot of exports using container trucks originate from the northeast region to Laem Chabang Port. While, a number of exporters have turned to use rail transport to lower the costs by using Tha Phra Station in Khon Kaen Province, Bua Yai Station, Ban Jira Station and Ban Koh Station in Nakhon Ratchasima Province. In Fiscal Year 2007, the major goods, i.e., tapioca flour, rice and sugar are shipped by rail from CY in the northeast region to Laem Chabang Port about 284,000 tons, or equivalent to about 14,600 TEUs.



Corridor 2: North Region-Laem Chabang Port

Presently, a large number of trucks from Nakhon Sawan Province and nearby provinces have moved towards Laem Chabang Port. While, a number of exporters have turned to use rail transport to Laem Chabang Port to lower the costs by using Tha Khao Kamnan Song Station in Nakhon Sawan as freight consolidation from road to rail. However, it is still utilized at very minimal level despite the rail link has been established since 2005. In addition, there is also

a CY at Sila-art Station surrounded by several factories and production sources. This includes Thai Ekalux Sugar Plant which has sugar production and shipping capacity of about 200,000 tons per year, most of them are currently shipped by truck. Potential goods are rice, kaolin, and sugar.



Corridor 3: South Region-Laem Chabang Port

Today, lot of rubbers is shipped by trucks from Surat Thani Province and nearby provinces up towards Laem Chabang Port. While, a number of exporters have turned to use rail towards Laem Chabang Port to cut down the costs by using Ban Thung Pho Station in Surat Thani as freight consolidation from road to rail. Similarly, another group of operators uses coastal transport from Surat Thani Port to Laem Chabang Port to lower shipment costs as well.



Corridor 4: Central Region-Laem Chabang Port / Si Chang Port

Currently, a large number of rice and sugar are shipped by truck from the central region to Laem Chabang Port. In the meantime, a number of exporters have turned to use inland water transport via barges towards Si Chang Port to reduce the costs by using river ports in Amphoe Pa Mok in Angthong and Amphoe Nakhon Luang in Phra Nakhon Si Ayutthaya as freight consolidation from road to water. Furthermore, for inbound trips, fertilizer is imported from abroad, unloaded at Si Chang Port, and shipped up to river ports in Phra Nakhon Si Ayutthaya.

The proposed measures which help promoting the modal shift in each corridors are as follows:

- **Measure 1** Management of locomotives.
- **Measure 2** Provision of locomotives and carriages with private participation (measures 1 and 2 should be implemented simultaneously). In addition, the imposition of proposed measures 1 and 2 must correspond with double track construction and rail maintenance program plan of SRT.

- **Measure 3** Development of current container yards and new potential container yards
- **Measure 4** Implementation of new container port at Nakhon Luang, Ayutthaya
- **Measure 5** Improvement of service charge rate at A0 berth within Laem Chabang Port

The summary of proposed measures and their impacts can be shown in Table 9.1-1.

Table 9.1-1: The Effect of Each Measure to Modal Shift Factors

Measures	Budget (Million baht)	The effect of measures to factors		Time Implementation Year	Responsible agency
		Travel Time (hr)	Reliability of transport (percent)		
Measure in each corridor					
Corridor 1 : Northeast – Laem Chabang Port					
(1) Management of locomotives	-	Reduced 2 hr. *	Increased 2.5%*	2007	State Railway of Thailand (SRT)
(1.1) Make new train schedule.	-	Reduced 2 hr. *	Increased 2.5%*		
(1.2) Increase engine drivers to correspond with number of circulated trains.	-	-	Increased 2.0%		
(1.3) Priority new freight trains.	-	-	Increased 2.5%		
(1.4) Separate locomotives for freight and passengers.	-	-	Increased 2.5%		
(2) Provision of locomotives and carriages.	113	Reduced 2 hr. *	Increased 2.5%*	2007	SRT
(2.1) Allocate bogies for loading containers.	3		Increased 2.5%		
(2.2) Increase diesel locomotives.	110	Reduced 2 hr. *	Increased 2.5%*		
(3) Development of current container yards and new potential container yards	34	Reduced 3 hr.	Increased 2.5%	Construction: 2010 Start: 2011	SRT and private sector
(3.1) Container yards that should be developed currently.					
(3.1.1) Expand the container yard at Tha Phra Station.	2	-	Increased 1%		
(3.1.2) Develop legislation and regulation for land lease, and construction of container yard at Bua Yai Station	-	-	Increased 2.5%		
(3.2) Potential Container Yards					
(3.2.1) Develop container yard in Northeast corridor (Upper) on Udon Thani Rail Station.	15	-	Increased 1.5%		
(3.2.2) Develop the Depot near Siracha Rail Station.	2	Reduced 3 hr.	Increased 2.5%		
(3.2.3) Develop container yard in Northeast corridor (Lower) on Bu Rue Si Station.	15	-	Increased 1.5%		

Table 9.1-1: The Effect of Each Measure to Modal Shift Factors (Continued)

Measures	Budget (Million baht)	The effect of measures to factors		Time	Responsible agency
		Travel Time (hr)	Reliability of transport (percent)	Implementation Year	
Corridor 2 : North – Laem Chabang Port					
(1) Measures to tow freight train and passenger train.					
Corridor 3 : South – Laem Chabang Port					
(1) Management of locomotives.	-	Reduced 2 hr. *	Increased 2.5%*	2007	SRT
(1.1) Make new train schedule.	-	Reduced 2 hr. *	Increased 2.5%*		
(1.2) Increase engine drivers to correspond with the number of circulated trains.	-	-	Increased 2.0%		
(1.3) Prioritize new cargo trains.	-	-	Increased 2.5%		
(1.4) Separate locomotives for freight and passengers.	-	-	Increased 2.5%		
(2) Provision of locomotives and carriages.	113	Reduced 2 hr. *	Increased 2.5%*	2007	SRT
(2.1) Allocate bogies for loading containers.	3		Increased 2.5%		
(2.2) Increase diesel locomotives.	110	Reduced 2 hr. *	Increased 2.5%*		
(3) Container yard development		Reduced 3 hr.	Increased 2.5%	2011	SRT and private sector
(3.1) Develop container yard in Southern corridor at Lak Chang Station.	15	-	Increased 1.5%		
(3.2) Develop container yard in Southern corridor at Kan Tang Station.	15	-	Increased 1.5%		

Table 9.1-1: The Effect of Each Measure to Modal Shift Factors (Continued)

Measures	Budget (Million baht)	The effect of measures to factors		Time	Responsible agency
		Travel Time (hr)	Reliability of transport (percent)	Implementation Year	
Corridor 4 : Central – Laem Chabang Port/Si Chang Island					
(1) Implementation of new container port at Nakhon Luang, Ayutthaya					
Nakhon Luang container port.					
General measures					
(1) Measures to determine transport service price.					
(1.1) Adjust SRT management to correspond with market needs (Shipping fee)					
(1.2) Freight charge at A0 berth within Laem Chabang Port.					
(2) Persuaded measures on tax.					
(3) Promote rail transport service for minor goods owner.				2012	SRT and private sector
Establish business units to coordinate with private transport service providers.	-	-	Increased 1.5%		
(4) Promote e-Freight and ICT application	10**	-	Increased 2.5%	2012	SRT and private sector

Note: * Measures 1 to 3 are the main measures and measures 4 to 5 are the minor measures

** The budget is estimated from e-Business software development company in Thailand. The basic e-freight software comprises management of international shipment, document, reservation of sea and air freight, query of shipping routes and schedules, etc. The reservations on airplane in ship and air transport, Searching and corridor and schedules.

9.2 ESTIMATION OF MODAL SHIFT FREIGHT DEMAND

A summary of freight demand of all routes can be shown in Table 9.2-1. While, the detailed figures in each pilot corridor, i.e., northeast, north, south, and central, separated by various transport modes: rail, water, coastal are shown in Table 9.2-2. In this regard, road transport serves a feeder system.

Table 9.2-1: Estimates of Total Freight Demand in All Routes in Future Years

Unit: tons/year

Measure	2011	2014	2017
Existing case	2,326,358	2,680,214	3,063,461
Measure 1+2+5	2,493,671	2,864,160	3,104,963
Measure 1+2+3+5	2,530,477	2,913,614	3,358,532
Measure 1+2+4+5	2,759,065	3,772,785	5,717,310
Measure 1+2+3+4+5	2,795,871	3,822,239	5,790,879

Table 9.2-2: Estimates of Freight Demand by Rail, Water, and Coastal Transport in Each Pilot Route in 2008, 2011, 2014 and 2017

Route	Mode of Transport	Measures	Freight Demand in Future Years (Unit: tons/year)			
			2008	2011	2014	2017
Route no. 1						
- Upper Northeastern Region – Laem Chabang Port (Khon Kaen - Laem Chabang)	Road – Rail	Existing Case	158,189	179,586	203,202	226,832
		Measure 1+2+5	158,189	259,505	266,609	272,470
		Measure 1+2+3+5	158,189	267,795	275,765	286,648
		Measure 1+2+4+5	158,189	259,505	266,609	272,470
		Measure 1+2+3+4+5	158,189	267,795	275,765	286,648
- Lower Northeastern Region – Laem Chabang Port (Nakhon Ratchasima - Laem Chabang)	Road – Rail	Existing Case	117,798	137,252	160,547	188,515
		Measure 1+2+5	117,798	166,060	192,262	222,488
		Measure 1+2+3+5	117,798	182,726	208,906	238,591
		Measure 1+2+4+5	117,798	166,060	192,262	222,488
		Measure 1+2+3+4+5	117,798	182,726	208,906	238,591
Route no. 2						
- Northern Region – Laem Chabang Port (Nakhon Sawan - Laem Chabang)	Road – Rail	Existing Case	30,873	36,225	42,711	50,676
		Measure 1+2+5	30,873	36,225	42,711	50,676
		Measure 1+2+3+5	30,873	36,225	42,711	50,676
		Measure 1+2+4+5	30,873	31,017	25,411	4,781
		Measure 1+2+3+4+5	30,873	31,017	25,411	4,781

Table 9.2-1: Estimates of Freight Demand by Rail, Water, and Coastal Transport in Each Pilot Route in 2008, 2011, 2014 and 2017 (Continued)

Route	Mode of Transport	Measures	Freight Demand in Future Years (Unit: tons/year)			
			2008	2011	2014	2017
Route no. 3 - Southern Region – Laem Chabang Port (Surat Thani - Laem Chabang) - Southern Region – Laem Chabang Port (Surat Thani - Laem Chabang)	Road – Rail	Existing Case	629,552	701,779	940,025	1,189,320
		Measure 1+2+5	629,552	745,293	1,014,435	1,321,691
		Measure 1+2+3+5	629,552	817,597	1,087,556	1,412,626
		Measure 1+2+4+5	629,552	745,293	1,014,435	1,321,691
		Measure 1+2+3+4+5	629,552	817,597	1,087,556	1,412,626
	Road – Coastal	Existing Case	940,265	1,112,532	1,150,067	1,198,379
		Measure 1+2+5	940,265	1,127,604	1,164,481	1,027,899
		Measure 1+2+3+5	940,265	1,067,150	1,115,014	1,160,252
		Measure 1+2+4+5	940,265	1,127,604	1,164,481	1,207,899
		Measure 1+2+3+4+5	940,265	1,067,150	1,115,014	1,160,252
Route no. 4 - Central Region – Laem Chabang Port (Nakhon Sawan – Phra Nakhon Si Ayuttaya - Laem Chabang)	Road – Water	Existing Case	138,511	158,984	183,662	209,739
		Measure 1+2+5	138,511	158,984	183,662	209,739
		Measure 1+2+3+5	138,511	158,984	183,662	209,739
		Measure 1+2+4+5	138,511	429,586	1,109,587	2,687,981
		Measure 1+2+3+4+5	138,511	429,586	1,109,587	2,687,981

9.3 BENEFITS ACCRUED FROM MODAL SHIFT

9.3.1 Economic Evaluation of Pilot Corridor

Benefits accrued from shifted freight volume comprise cost savings from each transportation mode, energy consumption, and reduced accidents. In this regard, assessment of cost and benefit will consider from freight volume in terms of ton-kilometer compared with without-project and with-project in each corridor. Freight volume in each corridor at target years is shown in Table 9.3-1.

Table 9.3-1: Freight Volume in Each Corridor (Unit: Ton-km/day)

Mode of Transport	In case of government plan	Corridor no. 1 Northeast - Laem Chabang Port	Corridor no. 2 North – Laem Chabang Port	Corridor no. 3 South – Laem Chabang Port	Corridor no. 4 Central – Laem Chabang Port/ Sichang Port
Year : 2012					
Road transport	581,052,470	580,782,124	580,894,103	580,862,682	580,843,268
Rail transport	11,143,518	11,425,932	11,312,198	11,307,617	11,310,461
Water transport	23,087,244	23,100,521	23,094,757	23,116,669	23,144,117
Total	615,283,232	615,308,577	615,301,058	615,286,968	615,297,846
Year : 2017					
Road transport	658,007,337	657,701,188	657,832,930	657,792,414	657,770,429
Rail transport	12,139,094	12,446,740	12,322,844	12,317,854	12,320,952
Water transport	25,875,424	25,890,304	25,883,845	25,913,582	25,939,166
Total	696,021,855	696,038,232	696,039,619	696,023,850	696,030,547

- **Vehicle Operating Costs**

The benefit of vehicle operating costs will be derived from economic cost of freight transport by road, by rail, and by water which are estimated at 1.8850 baht/ton-km, 1.3135 baht/ton-km, and 0.5026 baht/ton-km, respectively. The results of benefit estimation for each mode of transport are shown in Table 9.3-2.

Table 9.3-2: Vehicle Operating Cost and Benefit in Each Corridor

Corridor	Mode of Transport	VOC (million baht/year)		Benefit (million baht/year)	
		Year 2012	Year 2017	Year 2012	Year 2017
Without project	Road	399,779	452,725		
	Rail	5,343	5,820		
	Water	4,235	4,747		
	Total	409,356	463,292		
Corridor no. 1 Northeast - Laem Chabang Port	Road	399,593	452,515	186	211
	Rail	5,478	5,967	-135	-147
	Water	4,238	4,750	-2	-3
	Total	409,308	463,232	48	60
Corridor no. 2 North - Laem Chabang Port	Road	399,670	452,606	109	120
	Rail	5,423	5,908	-81	-88
	Water	4,237	4,748	-1	-2
	Total	409,330	463,262	27	30
Corridor no. 3 South - Laem Chabang Port	Road	399,648	452,578	131	148
	Rail	5,421	5,906	-79	-86
	Water	4,241	4,754	-5	-7
	Total	409,310	463,237	47	55
Corridor no. 4 Central - Laem Chabang Port/ Sichang Port	Road	399,635	452,562	144	163
	Rail	5,423	5,907	-80	-87
	Water	4,246	4,759	-10	-12
	Total	409,303	463,228	53	64

From Table 9.3-2, it can be seen that modal shift from road to rail and water of 5 target goods can save vehicle operating cost (VOC) approximately 27-53 million baht in 2012 and approximately 30-64 million baht in 2017 by using the 4th route: Central Region-Laem Chabang Port/Si Chang Island is the route with the most benefits.

- **Energy Cost**

From the data of the Ministry of Transport that refers to the ESCAP study on energy usage in transportation, they found that energy cost in road transport was higher than rail and water transport which can be concluded that if energy usage is a liter in a kilometer transport, the volume of water transport is 217.6 tons, the volume of rail transport is 85.5 tons, and the volume of land transport is 25.5 tons respectively. The average price of Diesel fuel in 2008 was at 25.6029 baht per liter, which if calculated as economic value, will be at 20.1673 baht per liter (adjustment value is equivalent to 0.7877), as shown in analysis results in Table 9.3-3. Benefits arising from each route are shown in Table 9.3-4.

Table 9.3-3: Energy Consumption by Mode of Transport

Corridor	Mode of Transport	Year 2012		Year 2017	
		million litrs/year	million baht/year	million litrs/year	million baht/year
Without project	Road	8,317	167,732	9,419	189,946
	Rail	48	959	52	1,045
	Water	39	781	43	875
	Total	8,403	169,472	9,514	191,867
Corridor no. 1 Northeast - Laem Chabang Port	Road	8,313	167,654	9,414	189,858
	Rail	49	984	53	1,072
	Water	39	781	43	876
	Total	8,401	169,419	9,511	191,805
Corridor no. 2 North - Laem Chabang Port	Road	8,315	167,686	9,416	189,896
	Rail	48	974	53	1,061
	Water	39	781	43	876
	Total	8,402	169,441	9,512	191,833
Corridor no. 3 South - Laem Chabang Port	Road	8,314	167,677	9,415	189,884
	Rail	48	974	53	1,060
	Water	39	782	43	877
	Total	8,401	169,433	9,512	191,822
Corridor no. 4 Central - Laem Chabang Port/ Sichang Port	Road	8,314	167,672	9,415	189,878
	Rail	48	974	53	1,061
	Water	39	783	44	877
	Total	8,401	169,428	9,511	191,816

Table 9.3-4: Benefits from Energy Consumption Saving of Each Corridor

Corridor	Year 2012		Year 2017	
	litrs/year	million baht/year	litrs/year	million baht/year
Corridor no. 1 Northeast - Laem Chabang Port	2,641,747	53	3,043,842	61
Corridor no. 2 North - Laem Chabang Port	1,534,125	31	1,697,867	34
Corridor no. 3 South - Laem Chabang Port	1,966,667	40	2,249,215	45
Corridor no. 4 Central - Laem Chabang Port/ Sichang Port	2,186,379	44	2,507,774	51

From Tables 9.3-3 and 9.3-4, it was discovered that modal shift from road to rail and water modes of 5 target goods could result in energy conservation of about 1.5-2.6 million liters per year in 2012 and about 1.7-3.0 million liters per year in 2017, valued at about 31-53 million baht per year in 2012 and about 34-61 million baht per year in 2017. Consequently, Corridor 1 (Northeast Region-Laem Chabang Port) contributes most to energy conservation.

- **Accident Cost**

Assessment of benefits accrued accounting for cost expense of accident incidents of various modes of transportation discovered that water mode accounts for the least accident cost, followed by rail mode, while topping the list is road mode. In this regard, road transport cost is estimated at 95,143 baht/million ton-kilometer, rail transport cost is estimated at 22,513 baht/million ton-kilometer, and water transport cost is estimated at 17,441 baht/million ton-kilometer.

The unit cost of accident classified by mode of transport will be used together with freight volume (ton-kilometer) in the calculation of accident costs and benefits due to accident reduction in each corridor, as shown in Tables 9.3-5 and 9.3-6.

Table 9.3-5: Accident Cost by Mode of Transport

Unit: million baht/year

Corridor	Mode of Transport	Year 2012	Year 2017
Without project	Road	20,178	22,851
	Rail	92	100
	Water	147	165
	Total	20,417	23,115
Corridor no. 1 Northeast - Laem Chabang Port	Road	20,169	22,840
	Rail	94	102
	Water	147	165
	Total	20,410	23,107
Corridor no. 2 North - Laem Chabang Port	Road	20,173	22,845
	Rail	93	101
	Water	147	165
	Total	20,413	23,111
Corridor no. 3 South - Laem Chabang Port	Road	20,172	22,843
	Rail	93	101
	Water	147	165
	Total	20,412	23,109
Corridor no. 4 Central - Laem Chabang Port/ Sichang Port	Road	20,171	22,843
	Rail	93	101
	Water	147	165
	Total	20,411	23,109

Table 9.3-6: Benefits from Accident Saving of Each Corridor**Unit: baht/year**

Corridor	Year 2012	Year 2017
Corridor no. 1 Northeast - Laem Chabang Port	6,983,139	8,008,995
Corridor no. 2 North - Laem Chabang Port	4,065,731	4,493,161
Corridor no. 3 South - Laem Chabang Port	5,055,022	5,751,846
Corridor no. 4 Central - Laem Chabang Port/ Sichang Port	5,531,130	6,327,026

From Tables 9.3-5 and 9.3-6, it was discovered that modal shift from road to rail and water modes of 5 target goods could reduce accident cost by about 4-7 million baht per year in 2012 and about 4-8 million baht per year in 2017. In this regard, Corridor No. 1 (Northeast Region-Laem Chabang Port) contributes most to accident cost reduction.

- **Environment Cost**

According to the study conducted by the Texas Transportation Institute, Center for Ports & Waters, Texas A&M University, entitled “a Modal Comparison of Freight Transportation effects on General Public”, the comparative study on pollutant emission by mode of transport is shown in Figure 9.3-1.

Inland waterways transport generates fewer emissions than rail or truck per ton-mile.

Barge transportation generates the lowest emissions as measured in grams per ton-miles in four standards tracked by the EPA:

- Particulate matter (PM)
- Carbon monoxide (CO)
- Hydrocarbons (HC)
- Nitrogen oxides (NO_x)

**Unit: grams/ton-miles**

No.	emissions	Truck	Train	Ship
1	Particulate matter (PM)	0.018	0.00021	0.011164
2	Hydrocabons (HC)	0.020	0.02423	0.01737
3	Carbon Monoxide (CO)	0.136	0.06445	0.04021
4	Nitrogen Oxides (No _x)	0.732	0.65423	0.46907

Source: A Modal Comparison of Freight Transportation effects on General Public, the Texas Transportation Institute, Center for Ports & Waters, Texas A&M University, USA

Figure 9.3-1: Pollutant Emission by Mode of Transport

The amount of pollutant emission by mode of transport (kilogram/year) can be summarized in Tables 9.3-7 and 9.3-8. It can be noticed that total amount of emission will be reduced due to modal shift from road to rail and water.

Table 9.3-7: Amount of Pollutant Emission by Mode of Transport in 2012

Corridor	Mode of Transport	Amount of Pollutant Emission (kilogram/year)			
		Particulate matter (PM)	Hydrocarbons (HC)	Carbon Monoxide (CO)	Nitrogen Oxides (Nox)
Without project	Road	2,385,947	2,651,052	18,027,153	97,028,499
	Rail	534	61,595	163,839	1,663,128
	Water	58,798	91,484	211,777	2,470,487
	Total	2,445,279	2,804,131	18,402,769	101,162,114
Corridor no. 1 Northeast - Laem Chabang Port	Road	2,384,837	2,649,818	18,018,765	96,983,355
	Rail	547	63,156	167,992	1,705,277
	Water	58,832	91,537	211,899	2,471,908
	Total	2,444,216	2,804,511	18,398,656	101,160,540
Corridor no. 2 North - Laem Chabang Port	Road	2,385,296	2,650,329	18,022,240	97,002,054
	Rail	542	62,528	166,319	1,688,303
	Water	58,817	91,514	211,846	2,471,291
	Total	2,444,656	2,804,371	18,400,405	101,161,648
Corridor no. 3 South - Laem Chabang Port	Road	2,385,167	2,650,186	18,021,265	96,996,807
	Rail	542	62,503	166,252	1,687,619
	Water	58,873	91,601	212,047	2,473,636
	Total	2,444,582	2,804,289	18,399,564	101,158,062
Corridor no. 4 Central - Laem Chabang Port/ Sichang Port	Road	2,385,088	2,650,097	18,020,662	96,993,565
	Rail	542	62,518	166,294	1,688,044
	Water	58,943	91,709	212,299	2,476,573
	Total	2,444,573	2,804,325	18,399,255	101,158,182

Table 9.3-8: Amount of Pollutant Emission by Mode of Transport in 2017

Corridor	Mode of Transport	Amount of Pollutant Emission (kilogram/year)			
		Particulate matter (PM)	Particulate matter (PM)	Particulate matter (PM)	Particulate matter (PM)
Without project	Road	2,701,943	3,002,158	20,414,678	109,879,000
	Rail	582	67,098	178,477	1,811,714
	Water	65,899	102,532	237,353	2,768,841
	Total	2,768,423	3,171,789	20,830,507	114,459,555
Corridor no. 1 Northeast - Laem Chabang Port	Road	2,700,686	3,000,762	20,405,179	109,827,877
	Rail	596	68,799	183,000	1,857,629
	Water	65,937	102,591	237,489	2,770,433
	Total	2,767,219	3,172,152	20,825,669	114,455,939
Corridor no. 2 North - Laem Chabang Port	Road	2,701,226	3,001,363	20,409,267	109,849,876
	Rail	590	68,114	181,179	1,839,138
	Water	65,921	102,566	237,430	2,769,742
	Total	2,767,737	3,172,042	20,827,875	114,458,756
Corridor no. 3 South - Laem Chabang Port	Road	2,701,060	3,001,178	20,408,010	109,843,111
	Rail	590	68,087	181,105	1,838,393
	Water	65,996	102,683	237,703	2,772,924
	Total	2,767,647	3,171,948	20,826,818	114,454,428
Corridor no. 4 Central - Laem Chabang Port/ Sichang Port	Road	2,700,970	3,001,078	20,407,328	109,839,439
	Rail	590	68,104	181,151	1,838,856
	Water	66,062	102,785	237,938	2,775,662
	Total	2,767,622	3,171,966	20,826,416	114,453,957

In this regard, pollutant emissions reduced in each corridor is summarized in Table 9.3-9. It was discovered that carbon monoxide and nitrogen oxide gases are pollutants that could be reduced in greater amounts than other noxious emissions if modal shift occurs. In the case of hydrocarbons, it could be seen that the slight increase is observed since road and other modes have similarly greater hydrocarbon emissions. Consequently, when rail and water transportation modes increase greater than the converse reduction of road transportation, hence the increase in hydrocarbons is observed.

Table 9.3-9: Reduced Amount of Pollutant Emission by Each Corridor

Pollutant	Year	Corridor no. 1	Corridor no. 2	Corridor no. 3	Corridor no. 4
		Northeast – Laem Chabang Port	North – Laem Chabang Port	South – Laem Chabang Port	Central – Laem Chabang Port/ Sichang Port
Particulate matter (PM)	2012	1,063	623	697	706
	2017	1,204	686	883	802
Hydro Carbons (HC)	2012	-380	-240	-158	-194
	2017	-363	-253	-159	-177
Carbon Monoxide (CO)	2012	4,113	2,364	3,206	3,514
	2017	4,839	2,632	3,690	4,092
Nitrogen Oxides (Nox)	2012	1,574	467	4,052	3,933
	2017	3,616	799	5,127	5,598

9.4 STUDY OF INPUT AND OUTPUT FACTOR MODEL

The economic effect at the macro-level is analyzed by using the study of economic system, social and the competitive ability in business and transport services when the transportation change from road to rail and water modes. The study is analyzed by the Input-output Model and Computable General Equilibrium Model.

• Input-output Model

Logistic cost in goods transfer from manufacturer to the export point and value of 5 kinds of main goods are considered and found that when the transport cost is decreased by changing modes of transport, the logistic cost of rice export is reduced at the highest rate. If the transport cost is decreasing 10%, the logistic cost of rice export will decrease from 5,577.3 million baht to 5,304.2 million baht, or 4.9%. If the transport cost is reduced 20%, the logistic cost of rice exports will decrease from 5,577.3 million baht to 5,301.2 million baht, or 4.97%. This is shown in Tables 9.4-1 and 9.4-2.

Table 9.4-1: Logistic Cost in Goods Transfer from Manufacturer to the Export Point and Value of 5 Kinds of the Main Goods when the Transport Cost is Reduced Due to Modal Shift

(Unit: million baht)

Cost	Fertilizer	Rice	Cassava products	Sugar	Rubber Products
Total logistic cost					
- Original	439.1	5,577.3	1,218.0	1,714.8	16,611.2
- Transport cost is reduced for 10%	431.9	5,304.2	1,199.4	1,636.8	16,313.6
- Transport cost is reduced for 20%	424.6	5,031.2	1,180.7	1,558.8	16,015.9
Total exported value					
- Original	2,244.7	60,138.7	7,488.5	25,734.3	62,724.4
- Transport cost is reduced for 10%	2,237.5	59,865.6	7,469.9	25,656.3	62,426.8
- Transport cost is reduced for 20%	2,223.0	59,319.4	7,432.6	25,500.4	61,831.5

Source: From calculations

Table 9.4-2: The Change Rate of Logistic Cost and Exported Value of 5 Kinds of Main Goods when the Transport Cost is Reduced Due to Modal Shift

(Unit: percent)

Cost	Fertilizer	Rice	Cassava products	Sugar	Rubber Products
Total logistic cost					
- Transport cost is reduced for 10%	-1.65	-4.90	-1.53	-4.55	-1.79
- Transport cost is reduced for 20%	-3.30	-9.79	-3.06	-9.09	-3.58
Total exported value					
- Transport cost is reduced for 10%	-0.32	-0.45	-0.25	-0.30	-0.47
- Transport cost is reduced for 20%	-0.97	-1.36	-0.75	-0.91	-1.42

Source: From calculations

The Input-output Model analysis results are not clear in the impact on price. The results are only estimates with constant production volume. But if the production volume is changed, estimation of production value and exported value will not correspond consistently with reality. This is to explain that mode shift makes transport cost change impact to goods cost, goods volume, including overall economic system. It is thus advised to take the computable general equilibrium model into consideration.

- **Computable General Equilibrium Model**

Computable General Equilibrium Model is established to explain the relationship between variables in the economic system, which consist of variables on price and volume.

When the transport mode is changed from road to rail, rail efficiency will be increased, which means transport service of rail transport in the same resource can respond more to the needs of customer service. The indirect result is the service price or the transport cost will be decreased. Moreover, the logistic cost and the total production cost will be reduced too. When the production cost is decreased, the price trend will be reduced. For exported goods, the business ability in the world market will increase and Thailand will export goods in higher volumes. Therefore, the exported income will increase, exports will grow and domestic production, including employment, will increase too. In addition, the modal shift can reduce the fuel consumption since rail and water transport requires less energy than that of road transport. This will lessen quantity of fuel import.

Based on the analysis result from computable general equilibrium model with the assumption that rail performance increases by 10%, water performance increases by 5%, modal shift of all goods and road congestion reduces by 10% (case 4) as shown in Figure 9.4-1, it is found that

- the goods price will be reduced by 0.05%
- the export value will increase by 2.20%
- the employment will rise by 0.80%
- the gross national product will grow by 32,000 million baht

Moreover, the modal shift will

- reduce fuel consumption by 2.1%
- lessen fuel import by 1.3% with total import value at 12,000 million baht as of 2006 oil price

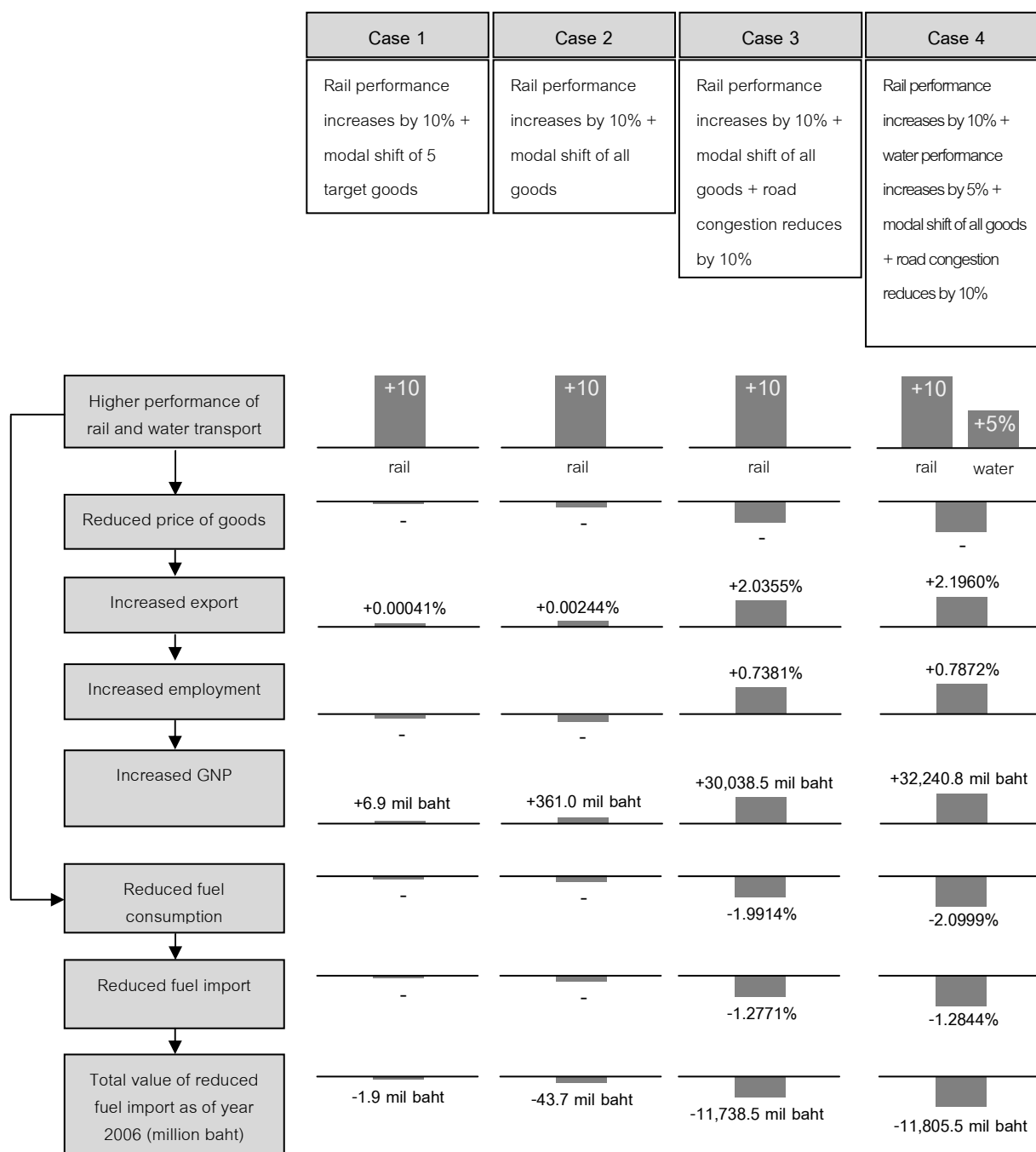


Figure 9.4-1: Impact of Modal Shift from Road to Rail and Water Transport

10. DEVELOPMENT OF BUSINESS PLAN TO PROMOTE MODAL SHIFT FROM ROAD TO RAIL AND WATER TRANSPORT

10.1 ANALYSIS OF COST STRUCTURE FOR MODAL SHIFT: CASE STUDY OF NEW CONTAINER PORT IN NAKHON LUANG, AYUTTHAYA

The water shipment from Ayutthaya to Laem Chabang Port is one of the proposed modal shift corridors whereas the port development at Nakhon Luang will be one of the proposed measures which can stimulate the modal shift in related corridors.

Presently, Ayutthaya Port and ICD Co., Ltd. which is the subsidiary company of Charoen Pokphand Groups Co., Ltd. has invested the ports with container yard at 135 Mae La, Nakorn Laung, Ayutthaya, as shown in Figure 10.1-1.



Source: Ayutthaya Port and ICD, Co., Ltd.

Figure 10.1-1: Location of Proposed Container Port of Ayutthaya Port and ICD, Co., Ltd.

In this regard, facilities comprise:

- Container yard; area: 22,400 sq m
- Inland container depot (ICD) and rice enhancement factory; 1-million ton capacity; total combined area: 339,200 sq m
- Reserve area for development in the next phase: 139,200 sq m
- 3 Gantry Cranes

As shown in Figure 10.1-2

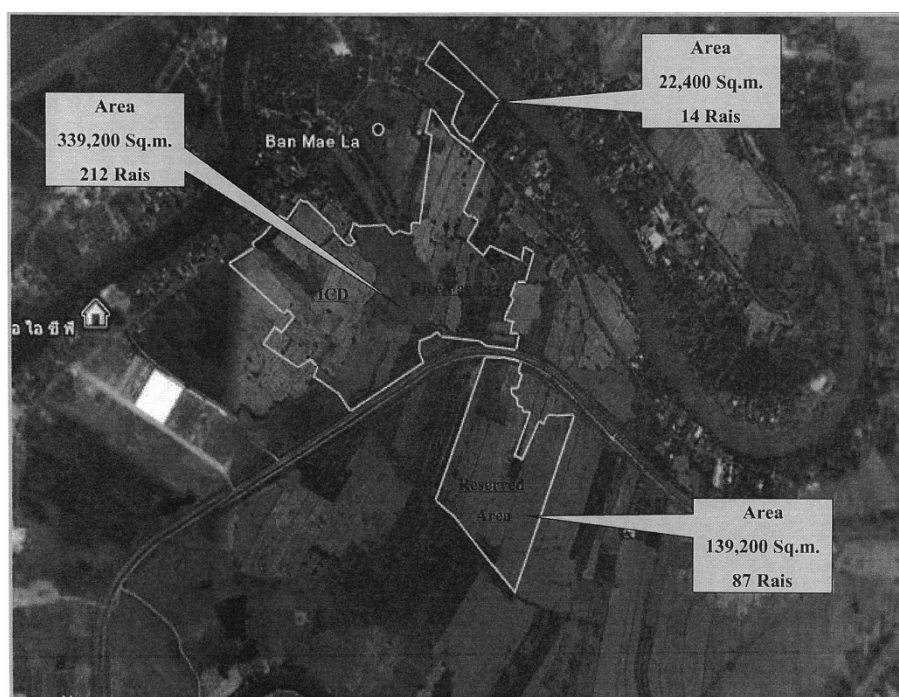
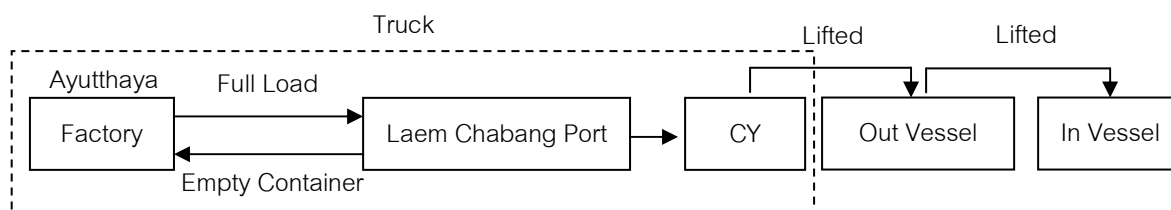


Figure 10.1-2: Area Management within Freight Container Shipping Berth of Ayutthaya Port and ICD Co., Ltd.

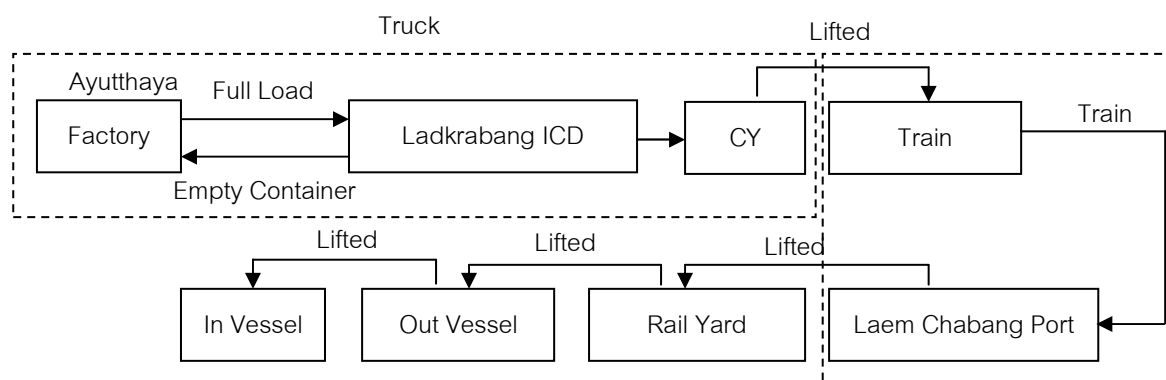
In this regard, SC Management Co., Ltd. will provide freight container shipment service to Laem Chabang Port by using 40-TEU freight container ships, which could be increased to 60 TEUs if not limited by bridge height clearance.

Analyzing cost structure of freight shipment service considered different modes of transportation in 3 cases, as follows,

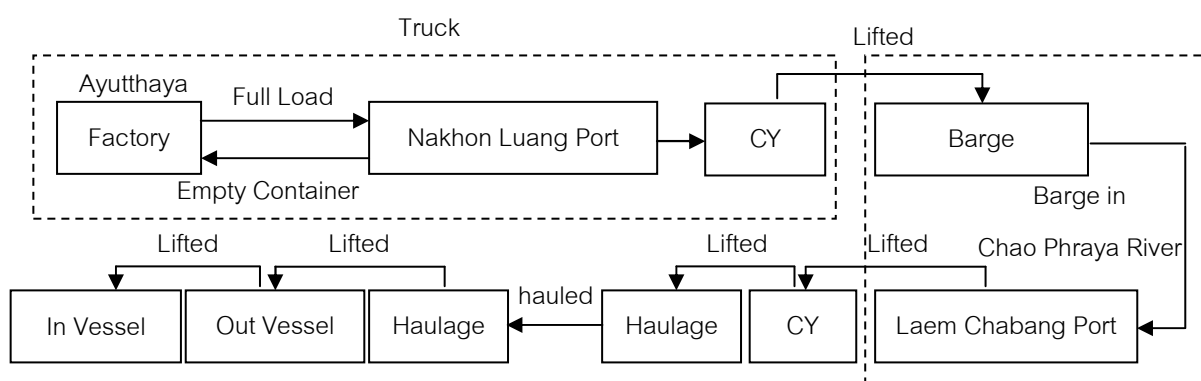
- **Case 1: Transporting freight containers by truck from Ayutthaya to Laem Chabang Port**



- **Case 2: Transporting freight containers by rail from Ayutthaya to Ladkrabang ICD and further shipping freight containers by rail to Laem Chabang Port**



- **Case 3: Transporting freight containers by barge from Ayutthaya via Chao Phraya River to Laem Chabang Port**



Results of analysis discovered that shipment both by rail and water modes, freight shippers would benefit from cost savings of up to 5,500 baht in Case 3, while shipping lines would shoulder the burden of expenses in lifting freight containers within Laem Chabang Port that has a service rate that is as high as 5,055 baht in the same case, as shown in Table 10.1-1.

Table 10.1-1: Benefit from Freight Transport compared among Transport Modes Case: Pilot Project Study on Container Port at Amphoe Nakhon Luang, Ayuttaya

Cost / Benefit	1 st Case: Ayuttaya- Laem Chabang (By Truck)	2 nd Case: Ayuttaya – ICD Lad Krabang – Laem Chabang (By Rail)	3 rd Case: Nakhon Luang Port – Laem Chabang (By Water)
Transport cost (Baht)	10,345	10,396	10,110
Cost paid by exporter (Baht)	11,830	9,330	6,330
Shipping lines gain profit / loss (Baht)	+1,485	-856	-3,570
Exporter's Benefit (Baht)	-	+2,500	+5,500
Shipping Lines' Benefit (Baht)	-	-2,341	-5,055
Overall Benefit (Baht)		+159	+445

Conclusion

1. In the case of freight container shipment both by train and by barge, shipping lines have to shoulder the burden of loss, which does not attract cooperation from shipping lines in carrying out shipping operations.
2. Due to lack of active support from shipping lines, it is difficult that the activities can be realized in practice. Due to the nature of international freight shipping operations, shipping lines usually has the key authority in determining various shipping modes that link with shipment from their own seaborne vessels (both before loading and unloading freight from the vessels). In this regard, shipping lines have executed transshipment on behalf of goods owners under terminal Handling Charge (THC) expense.

Recommendation

1. Supporting measures concerning Factors Condition

- Promote domestic public port construction at Laem Chabang Port. In this regard, the handling charge at this domestic berth should be lower than that of international berths. In addition, it should have specific regulation and lack of customs procedures.
- Promote additional public river ports to develop capabilities of barge operators through competition and pressure in order that the service charge can be reduced. Moreover, it will be an alternative for goods' owners and barge operators.
- Invest more facilities, such as dredging channels, enhancing environment of ship navigation, managing water traffic to facilitate maximum efficiency, upgrading main highways accessing ports, etc.
- The government might provide subsidies to shipping lines participating in the modal shift project to cover actual losses. In this regard, a time frame might be specified within a period of 3-5 years. After the specified grace period, participants in modal shift development project could try to eliminate losses and operate using their own funds.
- The government might provide indirect subsidies to barge operators through sales projects of low-cost fuels or gas for barges, similar to green fuel project that supports fishing industry. Nonetheless, the government needs supplementary measures in pushing barges receiving this low-cost energy to lower freight charge for service users participating in the project also.

2. Supporting measures concerning Demand condition

- The government should have a role in disseminating news and information of modal shift from land to water by pointing out benefits to be gained by freight owners from using water shipment mode.

3. Supporting measures concerning Related and Supporting Industry Condition

- The government should urge operators related to modal shift from land to water to have the opportunity to gain profit from supplementary services at other ports, such as container repair and cleaning services, etc.

- Support these river ports in participating in ICD management outside the port and freight distribution services between ports so that profits from those linking activities could be compensated with lowered charges in the ports.

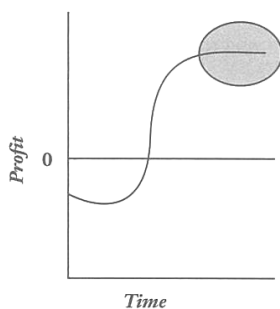
4. Supporting measures concerning Firm Strategy Condition

- Urge freight forwarders to join with barges and shipping lines in the form of a mutual alliance having allocation of benefits. This is another way that will ensure the survival of freight container shipment via water.
- The government needs to develop other efficient modes of transportation as a means for pressuring agencies relevant to water transport to enhance efficiency continuously.

10.2 PROFIT PATTERNS SUITABLE FOR MODAL SHIFT BUSINESS

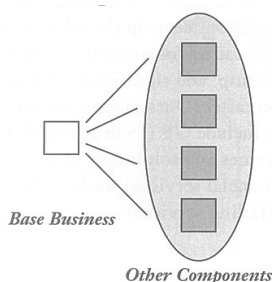
From the analysis of profit nature of various businesses, it was discovered that suitable patterns of profit for modal shift business are:

1. Getting loss at the start and gaining profit at the end (Customer Solutions Profit)



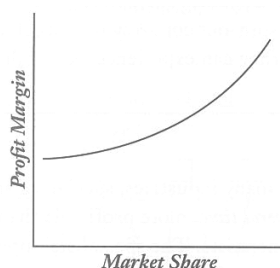
At the start of the project, it might have to compensate expenses to shippers and freight owners in inducing mode change from road to rail and water. When enough people start to shift mode to rail and water, shipment costs of freight owners and shippers can be lowered. Moreover, this will create profits to rail and water users at the beginning until there is no further need for financial assistance in urging use of these facilities furthermore.

2. Gaining profit from other components within the base business (Multicomponent Profit)



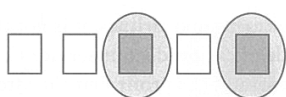
Based on this pattern, the base business might not create as much profit as the component business, such as handling operation at the river port may gain less profit than supplementary service at other ports.

3. Gaining profit from promoting multiple users (De Facto Standard Profit)



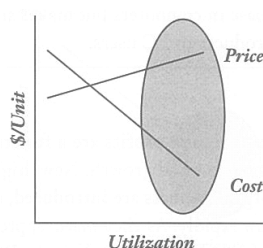
This pattern can be applied in analyzing cost distribution in constructing various buildings to quantities of usage of these buildings in each unit. It can be seen that when usage quantities of these buildings grows, the unit cost of freight volume utilizing these buildings will drop as well.

4. Gaining profit from some stages of business value chain (Value Chain Position Profit)



Profits can be gained from other activities in the value chain that might operate at a loss. For instance, the river port operators who have opportunity to operate ICD outside the port and freight distribution service between ports so that profits from those linking activities could be compensated with lowered service charges in the ports. Similarly, the shipping lines collect the same shipping cost of containers at Ladkrabang ICD as at Laem Chabang Port without adding transfer expenses despite extra distance of about 100 kilometers. This is since shipping lines can compensate expenses from concessionaire at Ladkrabang ICD, etc.

5. Gaining profit from cost cutting by increasing plant use or increase Utilization (Cycle Profit)



The profit can be gained from utilizing the existing facilities initially provided for modal shift from road to rail and water. This will help study maximum potential of those infrastructures and be indicator of the need for additional construction in the future especially when water and rail modes become popular. For example, the rice port in Nakhon Sawan and CY at Sila-Art Station in Uttaradit should be more utilized since complete facilities have been provided.

11. DEVELOPMENT AND APPLICATION OF TRANSPORT MODEL

11.1 PROPOSED COMMODITY MODEL

CUBE Cargo is a model for estimating freight transport demand which applies step-by-step approach. It will allow reviewing, testing, and calibrating the model results in each step. The way to estimate transport demand by CUBE Cargo contains 3 main steps as follows,

- Trip Generation
- Trip Distribution
- Modal Split

11.2 FREIGHT DEMAND IN THE STUDY AREA

Volume of cargo from the model in the basis year (2007) is approximately 520 million tons/year and distribution of cargo is listed in Table 11.2-1.

Table 11.2-1: Origin-destination Matrix of Domestic Freight Categorized by Region in 2007

Unit: tons per year

Source / Destination	BKK	Central	East	Upper NE	Lower NE	North	South	Grand Total
BKK	338,888	17,859,356	11,994,518	6,822,329	5,024,332	23,408,787	9,377,621	74,825,831
Central	43,319,100	107,372,760	29,552,425	3,413,692	11,005,517	16,085,006	7,053,061	217,801,561
East	17,582,172	38,185,618	689,074	2,061,287	8,954,043	3,078,285	1,047,889	71,598,368
Upper NE	5,241,380	4,759,046	284,862	1,124,918	1,059,534	48,759	211,757	12,730,256
Lower NE	5,051,418	9,143,525	1,077,784	3,866,515	1,540,007	814,113	160,292	21,653,654
North	12,253,367	24,396,336	1,676,169	831,408	750,370	48,361,753	446,032	88,715,435
South	3,433,397	1,612,295	543,764	73,821	261,650	335,288	24,468,934	30,729,149
Total	87,219,722	203,328,936	45,818,596	18,193,970	28,595,453	92,131,991	42,765,586	518,054,254

11.3 APPLICATION OF CUBE CARGO IN DEMAND FORECAST

Estimation of transport demand increased due to economic growth in 2012 and 2017. It is found that demand in 2012 will be approximately 661 million tons/year and in 2017 will be 844 million tons/year. The road transport plays the highest role with proportion of 88%, followed by water at 10% and rail at 2% as shown in Table 11.3-1. The demand forecast in 2007 and 2012 is shown in Tables 11.3-2 and 11.3-3.

Table 11.3-1: Forecasted Freight Demand

Mode of Transport	2012		2017	
	Transport Demand (tons/year)	Modal Share (%)	Transport Demand (tons/year)	Modal Share (%)
Road	580,426,182	87.79	743,127,153	88.06
Rail	13,011,043	1.97	15,584,905	1.85
Water	67,742,039	10.25	85,138,846	10.09
Total	661,179,264	100.00	843,850,904	100.00

Table 11.3-2: Origin-destination Matrix of Domestic Freight Categorized by Region in 2012

Origin / Destination	BKK	Central	East	Upper NE	Lower NE	North	South	Grand Total
BKK	432,514	22,793,435	15,308,294	8,707,162	6,412,425	29,876,030	11,968,415	95,498,275
Central	55,287,048	137,037,080	37,716,997	4,356,807	14,046,057	20,528,878	9,001,640	277,974,507
East	22,439,672	48,735,318	879,447	2,630,767	11,427,814	3,928,736	1,337,394	91,379,148
Upper NE	6,689,438	6,073,847	363,562	1,435,704	1,352,256	62,230	270,260	16,247,297
Lower NE	6,446,994	11,669,645	1,375,548	4,934,733	1,965,471	1,039,031	204,577	27,635,999
North	15,638,656	31,136,414	2,139,251	1,061,105	957,678	61,722,856	569,259	113,225,219
South	4,381,956	2,057,730	693,992	94,216	333,937	427,919	31,229,068	39,218,818
Total	111,316,278	259,503,469	58,477,091	23,220,494	36,495,638	117,585,680	54,580,613	661,179,263

Table 11.3-3: Origin-destination Matrix of Domestic Freight Categorized by Region in 2017

Origin / Destination	BKK	Central	East	Upper NE	Lower NE	North	South	Grand Total
BKK	552,010	29,090,841	19,537,693	11,112,790	8,184,060	38,130,226	15,275,067	121,882,687
Central	70,561,840	174,897,899	48,137,508	5,560,512	17,926,724	26,200,628	11,488,627	354,773,738
East	28,639,340	62,199,988	1,122,422	3,357,599	14,585,108	5,014,173	1,706,891	116,625,521
Upper NE	8,537,606	7,751,939	464,007	1,832,363	1,725,859	79,423	344,928	20,736,125
Lower NE	8,228,180	14,893,753	1,755,587	6,298,109	2,508,494	1,326,096	261,098	35,271,317
North	19,959,328	39,738,831	2,730,287	1,354,269	1,222,267	78,775,743	726,535	144,507,260
South	5,592,610	2,626,243	885,729	120,246	426,198	546,145	39,857,084	50,054,255
Total	142,070,914	331,199,494	74,633,233	29,635,888	46,578,710	150,072,434	69,660,230	843,850,903

12. FORMULATION OF MODAL SHIFT STRATEGIES

12.1 FORMULATION GUIDELINE OF MODAL SHIFT STRATEGIES

The modal shift strategies need to be in consistent with the existing strategies formulated by the Ministry of Transport and other related agencies as well as they should contain expected objectives. As a result, the modal shift strategies proposed by this project comprise 4 strategies as follows:

- Strategy 1 Accelerating the development and improvement in transport system, laws and relevant regulations
- Strategy 2 Making balance in the transport sector
- Strategy 3 Increasing national competitiveness
- Strategy 4 Developing logistics system suited with energy and environmental situation

12.2 FORMULATION OF MODAL SHIFT SUB-STRATEGIES

Based on the above strategies, eight sub-strategies of modal shift are proposed as follows:

Sub-strategy 1: Development of Rail Transport System

This sub-strategy consists of 5 plans:

- Plan 1 - Improving efficiency of management
- Plan 2 - Improving efficiency of rail transport services
- Plan 3 - Development of rail transport network linking to neighboring countries
- Plan 4 - Development of rail freight routes
- Plan 5 - Development of domestic transport network

Sub-strategy 2: Development of Water Transport system

This sub-strategy consists of 2 plans:

- Plan 1 - Construction of public port or inland water and coastal distribution center
- Plan 2 - Promote and improve efficiency of water transport route to be used at all times

Sub-strategy 3: Development of Multimodal Transport System for Rail and Water Transport

This sub-strategy is to accelerate the development of multimodal transport consistently and sufficiently for the need.

Sub-strategy 4: Development Rail and Water Transport Providers

This sub-strategy is to provide a plan for development of logistics operator.

Sub-strategy 5: Development of Technologies for Freight Transport

This sub-strategy is to use technologies for management of freight transport and information to increase efficiency of management and decrease transport cost.

Sub-strategy 6: Public Involvement of Private Sector to State Activities

This sub-strategy is to support private sector both domestic and overseas to be involved in investment and management for reducing budget expense problem, as well as to increase management efficiency.

Sub-strategy 7: Improve the Relevant Regulations

This sub-strategy is to support and enhance the standard of transport for shifting transport mode by legislation and legal reform.

Sub-strategy 8: Development of Road Network to Support Rail and Water Transport

This sub-strategy consists of 2 plans:

Plan 1 - Improvement of existing roads

Plan 2 - Construction of new roads

12.3 RECOMMENDATION FOR PROJECT PLAN

To achieve those strategies and sub-strategies, the proposed plans are divided into two phases that is short/medium term plan, which should implement within 10 years (2007–2017) and long term plan, which should implement within 10-20 years. The detail is shown in Table 12.3-1.

Table 12.3-1: Proposed Plans and Projects for Modal Shift Promotion to Rail and Water Transport

Item no.	Project Description	Short/Medium Term Plan		Long Term Plan (within 10-20 yrs)	Budget (Million Baht)	Responsible Agency
		Short Term (within 5 yrs)	Medium Term (within 10 yrs)			
1	<u>Sub-strategy 1 : Development of Rail Transport System</u>					
	<u>Plan 1 - Improving efficiency of management</u>					
	1) Improving efficiency of SRT rail transport services	✓			-	SRT
	2) Adjust schedules to meet demand and ensure greater reliability	✓			-	SRT
	3) Locomotive management to increase the number of service cycles	✓			-	SRT
	4) Supporting the use of containers for freight transport	✓			-	SRT
	<u>Plan 2 - Improving efficiency of rail transport services</u>					
	1) Improvement of signal system	✓			-	SRT
	2) Construction of shunting rail	✓			-	SRT
	3) Construction of underpass/overpass at rail crossings	✓			-	SRT
	4) Track rehabilitation phases 5 and 6	✓			18,175.00	SRT
	5) Provision of 20 locomotives and 308 container bogies	✓			4,070	SRT
	<u>Plan 3 - Development of rail transport network linking to neighboring countries</u>					
	1) Development of connection points with neighboring countries					
	• Nong Khai Station with Laos		✓		-	SRT
	• Padang Besar Station with Malaysia		✓		-	SRT

Table 12.3-1: Proposed Plans and Projects for Modal Shift Promotion to Rail and Water Transport (Continued)

Item no.	Project Description	Short/Medium Term Plan		Long Term Plan (within 10-20 yrs)	Budget (Million Baht)	Responsible Agency
		Short Term (within 5 yrs)	Medium Term (within 10 yrs)			
	2) Construction of Rail Link to New Gateways					
	• Rail link on Chiang Saen – Chiang Khong: Denchai – Chiang Rai and Chiang Rai – Chiang Saen – Chiang Khong Section		✓		34,000.00	SRT
	• Rail link to Pak Bara Port (Trang – Pak Bara Port)		✓		-	SRT
	• Development of Wisai Station and rail link to Ranong Port		✓		-	SRT
	Plan 4 - Development of rail freight routes					
	1) Construction of Eastern double-track rail: Chachoengsao – Sri Racha – Laem Chabang (78 km)	✓			3,926.00	SRT
	2) Construction of Eastern double-track rail: Chachoengsao – Khlong Sibkhao – Kaeng Khoi (106 km)	✓			7,648.00	SRT
	3) Improvement of double-track rail network					
	• Northern rail line (418 km)			✓	37,680.00	SRT
	• Northeastern rail line (78 km)			✓	7,032.00	SRT
	• Southern rail line (336 km)			✓	30,280.00	SRT

Table 12.3-1: Proposed Plans and Projects for Modal Shift Promotion to Rail and Water Transport (Continued)

Item no.	Project Description	Short/Medium Term Plan		Long Term Plan (within 10-20 yrs)	Budget (Million Baht)	Responsible Agency
		Short Term (within 5 yrs)	Medium Term (within 10 yrs)			
	<u>Plan 5 - Development of transport network linking nationally</u>					
	1) Enhancement of existing container yard					
	• Northeastern Line: Jira Junction, Bua Yai Junction, Ban Koh Station (Nakhon Ratchasima), Non Phayom Station, and Tha Phra (Khon Kaen)	✓			150.00	SRT
	• Northern Line: Sila-Art Station (Uttaradit)	✓			30.00	SRT
	• Southern Line: Thung Pho Junction (Surat Thani) and Lak Chang Station (Nakhon Si Thammarat)	✓			60.00	SRT
	2) Development of additional container yards					
	• Northeastern Line: Nong Takai Station (Udon Thani), Bu Rue Si Station (Surin)	✓			60.00	SRT
	• Northern Line: The Khao Kamnan Song Station (Nakhon Sawan)		✓		30.00	SRT
	• Southern Line: Wisai Station (Chumphon)		✓		30.00	SRT
	• Construction of 2 nd phase Ladkrabang ICD	✓			6,066.00	SRT

Table 12.3-1: Proposed Plans and Projects for Modal Shift Promotion to Rail and Water Transport (Continued)

Item no.	Project Description	Short/Medium Term Plan		Long Term Plan (within 10-20 yrs)	Budget (Million Baht)	Responsible Agency
		Short Term (within 5 yrs)	Medium Term (within 10 yrs)			
2	<u>Sub-strategy 2 : Development of water transport systems</u>					
	<u>Plan 1: Construction of public port or the consolidation and distribution center for river and coastal transport</u>					
	1) Construction of public ports in Phra Nakhon Si Ayuttaya and Angthong	✓			490.28	MD
	2) Development of Songkhla Deep-Sea Port 2		✓		8,140.00	MD
	3) Construction of Donsak Port, Surat Thani Province		✓		-	MD
	4) Construction of Khlong Yai Port, Trat Province		✓		1,300.00	MD
	<u>Plan 2: Promote and improve efficiency of water transport route to be used at all times</u>					
	1) Dredging the channel	✓			994.91	MD
3	<u>Sub-strategy 3 : Development of multimodal system of rail and water transport</u>					
	1) Development of Coastal Berth at Laem Chabang Port	✓			-	PAT
	2) Development of Pak Bara Port with hinterland activities		✓		-	MD
	3) Development of connection points with tax privilege to freight transport users	✓			-	MOT
	4) Increase the role of connection points	✓			-	MOT

Table 12.3-1: Proposed Plans and Projects for Modal Shift Promotion to Rail and Water Transport (Continued)

Item no.	Project Description	Short/Medium Term Plan		Long Term Plan (within 10-20 yrs)	Budget (Million Baht)	Responsible Agency
		Short Term (within 5 yrs)	Medium Term (within 10 yrs)			
4	<u>Sub-strategy 4 : Development of rail and water transport operators</u>					
	<u>Plan 1 Development of logistics operator</u>					
	1) Tax incentive measures	✓			-	MOT
	2) Support Thai private sector to join together as LSP/logistics cluster	✓			-	MOT
	3) Enhance logistics management performance	✓			-	MOT
	4) Promote joint investment and strategic alliances	✓			-	MOT
5	<u>Sub-strategy 5 : Development of technologies for freight transport</u>					
	1) Study on application of freight transport technology to increase efficiency and decrease cost of transports	✓			20.00	OTP
	2) Development of database and information technology systems for logistics management	✓			-	MOT
	3) Application of information technology and logistics management software for freight transport providers	✓			-	MOT
	4) Application of AVI (Automatic Vehicle Identification) and AVL (Automatic Vehicle Location) technologies for multimodal transport efficiency	✓			-	MOT
	5) Development of Single Window Entry and One-Stop Service	✓			-	MOT
	6) Packaging development for freight transport enhancement	✓			-	MOT

Table 12.3-1: Proposed Plans and Projects for Modal Shift Promotion to Rail and Water Transport (Continued)

Item no.	Project Description	Short/Medium Term Plan		Long Term Plan (within 10-20 yrs)	Budget (Million Baht)	Responsible Agency
		Short Term (within 5 yrs)	Medium Term (within 10 yrs)			
6	<u>Sub-strategy 6</u> : Public involvement on private sector to state activities					
	1) Study on private sector involvement in rail transport operation	✓			20.00	OTP
	2) Enhancement of transport performance by granting concession to private sector in freight transport services	✓			-	SRT
	3) Private participation in construction and management of rail transport with SRT	✓			-	SRT
	4) Private participation in provision of freight equipment information technology system for rail transport	✓			-	SRT
	5) Private participation in investment and offensive marketing	✓			-	SRT
	6) Private participation in locomotive and carriage improvement	✓			-	SRT
	7) Improvement of regulations related to investment promotion	✓			-	SRT
7	<u>Sub-strategy 7</u> : Improve the relevant regulations					
	1) Study on improvement of legislation and regulation for modal shift	✓			20.00	OTP
	2) Reform plan of SRT's management structure by establishing "Department of Rail Transport"	✓			-	MOT
	3) Encouragement of private sector participation in rail transport by announcing draft Transport Management Act year.....	✓			-	MOT
	4) Encouragement of investment promotion for rail transport	✓			-	SRT

Table 12.3-1: Proposed Plans and Projects for Modal Shift Promotion to Rail and Water Transport (Continued)

Item no.	Project Description	Short/Medium Term Plan		Long Term Plan (within 10-20 Yrs)	Budget (Million Baht)	Responsible Agency
		Short Term (within 5 yrs)	Medium Term (within 10 yrs)			
8	5) Encouragement and negotiation with Malaysia to allow SRT cross-border train to receive and dispatch goods at Padang Besar Station	✓			-	SRT
	<u>Sub-strategy 8 : Development of road network to support rail and water transports</u>					
	<u>Plan 1 Improvement of existing roads</u>	✓			1,571.00	DOH
	1) Widen main highway that links to main gateway to 4 lanes or more (Chiang Saen Port 2 Project, Pak Bara Port Project)	✓			480.00	DOH
	2) Widen Highway No. 4, Chumphon – Ranong section, to 4 lanes linking between CY at Wisai station in Chumphon and Ranong Port					
	<u>Plan 2 Construction of new roads</u>					
	1) Construction of road linking Tha Khao Kamnan Song to become international multimodal transport hub	✓			-	DOH

12.4 IMPLEMENTATION GUIDELINES

From results of the study, it was found that proportions of freight shipment via rail and water modes are still low. Shifting freight from road to rail and water requires a period of time for achievement, especially in terms of logistics infrastructure development including networks and services. Therefore, acceleration of immediate plan to promote and increase the proportion of freight shipment using rail and water modes is very necessary. Meanwhile, the long-term plan with sustainable development including comprehensive and efficient transportation network system is needed.

In the immediate stage, it is necessary to promote and support modal shift to rail and water modes in order to reduce transportation cost and lessen environmental and social impacts, as follows:

- Enhance existing rail and water service efficiency
 - Rail:** Enhance SRT's structure, provide adequate locomotives, carriages and handling equipment; construct and upgrade rail routes and signaling system.
 - Water:** maintain and dredge channels regularly including develop water traffic management
- Apply technology in freight shipment and information management to enhance management efficiency and to lower transportation cost.
- Support rail and water transportation operators by amending obstructive regulations and reducing duplication in operations.

In the long run, infrastructure and facilities will be developed to induce modal shift to rail and water modes with appropriate volumes and proportions, as follows:

- The need for building and improving rail networks to satisfy demand covering areas and link to gateways and neighboring countries. This includes the development of connection points for rail and water transport so that they can serve as distribution centers and are consistent with urban and economic growth. In addition, the production and consumption sources of existing key industries and provision of industrial zones in suitable locations should be taken into account.
- Construct and upgrade major highways linking with rail and water transport as well as main gateways.
- Support the private sector, both local and international, focusing especially on Thai private networks to participate in investment and management in order to limit government budget as well as enhance administrative efficiency.

Aside from prescribing modal shift strategy for Thailand, further implementation is as follows:

- 1) Set up an agency/organization to directly oversee and administer so that it can provide facilitation for operators and promote fair competition.
- 2) Consider environmental and safety standards and social acceptance, whereby in comparative cost assessment of each transportation mode, consider the external cost of transportation, which is usually overlooked, especially environmental cost and social cost through accidents, and energy consumption. This is to promote fair and sustainable system of competition, whereby control and adjustment of demand volume of transportation can be done through pricing measures, by setting price close to social cost of each transportation mode.
- 3) Expand groups of goods to promote and apply pressure to advocate modal shift in the next phase of implementation, such as shifting fuel oil from road and rail to pipeline or shifting heavy bulk goods, such as soil, rock, sand, cement, construction materials to water transport, etc.