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Improvement of port operation, service efficiency and competitiveness, in order to meet the logistical needs of clients : a case study of Bangkok port container terminals

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WORLD MARITIME UNIVERSITY

Malmö, Sweden

**IMPROVEMENT OF PORT OPERATION AND
SERVICE EFFICIENCY, AND COMPETITIVENESS
IN ORDER TO MEET THE LOGISTICAL NEEDS OF
THE CLIENTS: A CASE STUDY OF BANGKOK
PORT CONTAINER TERMINALS**

By

JIRAVICH KLOMPEREE

The Kingdom of Thailand

A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

PORT MANAGEMENT

2000

**To my parents, Charohn and Wasana Klomperee, whose love and support have
always been a source of love, inspiration and encouragement as well as
examples of dignity and grace.**

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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Above all, my deepest gratitude and appreciation to my lovely family for their love and support during my two years study at World Maritime University, Malmö, Sweden.

ABSTRACT

Title of Dissertation: **Improvement of port operation and service efficiency, and competitiveness in order to meet the logistical needs of the clients: A case study of Bangkok Port container terminals**

Degree: **MSc**

The international trade in Thailand mainly depends upon sea transport mode. The port is the main gateway of the country. As is widely accepted, containerization has risen rapidly; in Thailand Bangkok Port is one of the major ports who plays a very important role as the logistic platform for Thai economy.

According to the government policy to limit the number of container throughput via Bangkok Port at one million TEUs/year, hence, Bangkok Port has to emphasize on the increment of its efficiency of operations and services instead of expansion. Recently, Bangkok Port has improved its performance tremendously. However, the port still has problems creating inefficient operations and service systems.

This dissertation aims to examine the current situation of operation and service systems of Bangkok Port container terminals. Analysis and comparison with some local ports, modern ports and international regime and some recommendations to improve its efficiency and competitiveness in order to meet the needs of the clients will be made.

Based on the analysis, the major problems are long berthing time, low occupancy ratio, low productivity, high cost, congestion, dangerous conditions and inadequate cargo security. These problems are caused by both internal and external factors, for instance the economic crisis of the country, lack of proper plan, shortage of some equipment, shortage of skilled labour and know-how in the new system and deficient management.

In accordance with the result of the study, a number of recommendations are made concerning the need for the improvement of the efficiency of Bangkok Port container terminals. The recommendations given include both restructuring of management and operation systems and investment in necessary physical facilities in Bangkok Port. Both of these are indispensable and should be realized simultaneously. Additionally, it is recommended to set as the short-term plan with the target year 2003 of the Port Authority of Thailand Master Plan.

Keywords: Bangkok Port, Competitiveness, Containerization, Efficiency, Operations and Services, Management, Performance, Restructuring, Simultaneously

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LIST OF ABBREVIATIONS

AAT	Airport Authority of Thailand
BIMCO	The Baltic and International Maritime Council
BKK	Bangkok
BKP	Bangkok Port
B/L	Bill of Lading
BP	Berth Planning
CFS	Container Freight Station
CLP	Container Load Plan
CY	Container Yard
D/O	Dispatch Order
D/R	Damage Report
E/D	Export Declaration
EDI	Electronic Data Interchange
E/R	Equipment Receipt
ETA	Estimate Time of Arrival
FCL	Full Container Load
GDP	Gross Domestic Product
GM	Gravity of a ship (G) and her Metacentre (M)
GNP	Gross National Product
GRT	Gross Registered Tonnage
HP	Horse Power
HR	Hour
ICD	Inland Container Depot
IMF	International Monetary Fund
JIT	Just In Time System
JP	Job Controlling
KM	Kilometre
LCL	Less than Container Load
LCP	Laem Chabang Port
NO	Number
M	Meter

MDT	Monitor of Mobile Data Terminal
MEA	Metropolitan Electricity Authority
M/F	Manifest
O/D	Origin and Destination
PAT	Port Authority of Thailand
RMG	Rail Mounted Gantry Crane
RTG	Rubber Tired Gantry crane
SQ.M	Square Meter
SRT	State Railway of Thailand
TEU	Twenty –foot Equivalent Unit
TGS	Twenty Ground Slots
UNCTAD	United Nations Conference on Trade and Development
USD	United States of America Dollar
US\$	United States of America Dollar
UAE	United Arab Emirates
VP	Vessel Planning
YP	Yard Planning

Chapter 1

Introduction

The government's policy involves limiting the number of container throughput via Bangkok Port to one million TEUs/year in order to decentralize business out of Bangkok Metropolitan area and to promote Laem Chabang Port in the Eastern Seaboard.

The focal point of development of Bangkok Port, therefore, will be emphasized on increment of operation and service efficiency instead of expansion.

This study proposes to examine the current situation of operational and service systems of container terminals in Bangkok Port, analyze and compare with some local ports, modern ports and international regime. Furthermore, the recommendations and conclusions will be drawn and made respectively to overcome any problems in the present situation in order to improve the efficiency of port operations and services and competitiveness.

This study is divided into 6 chapters starting with a brief description of Thai economy, an outline of transport and international container transport trends. This is followed by the present situation in Bangkok Port, container terminal operational and service systems of international regime, analysis and comparison of Bangkok Port container terminal operational and service systems with some local ports and international regime.

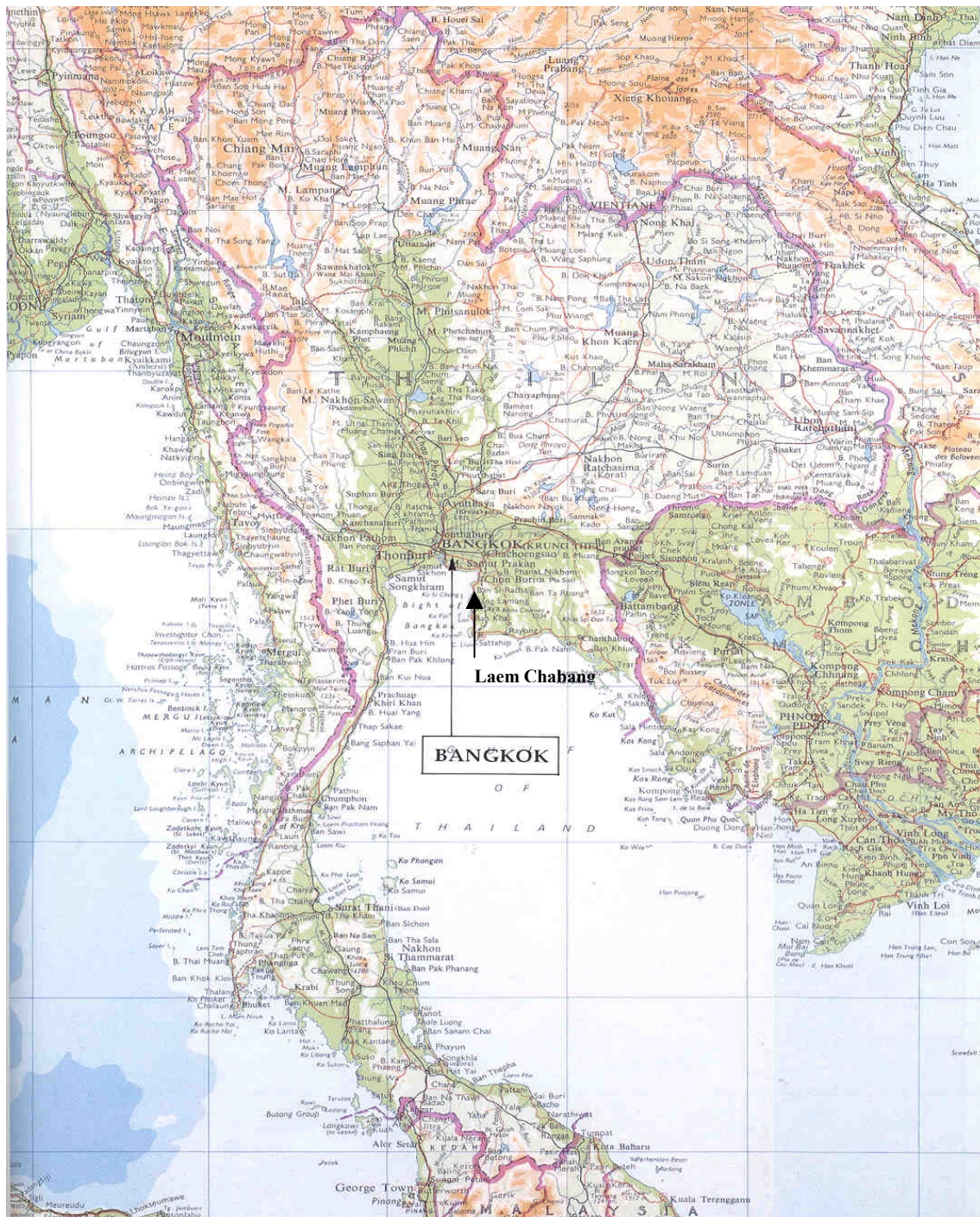


Figure 1: Map of Thailand
 Source: Port Authority of Thailand

1.1 Brief description of the Thai economy

Before examining the present situation in Bangkok Port, this chapter will give a brief description of the Thai economy in order to have a better understanding and a general view of Thai economy.

1.1.1 Economic situation

After more than a decade of sustained growth, the Thai economy entered a period of adjustment in 1996, when GDP growth slowed to 5.9 percent. The situation deteriorated in 1997 and then in August of 1997, Thailand was committed to a US\$ 17.2 billion rescue package arranged under the umbrella of the International Monetary Fund (IMF).

As part of the economic recovery program, Thailand has increased revenue streams and substantially reduced spending, instituted a wide range of finance sector reforms and initiated a program to privatize state-owned enterprises.

For the entire year of 1997, Thailand experienced a decline of 0.4 percent in GDP, and in 1998 GDP declined by 8.0 percent. However, in 1999, GDP was 4.1 percent growth.

From 1985-1994, Thailand's economy expanded by leaps and bounds, with GNP per capita averaging 8.2 percent (#1 in the world). In fact, between 1990 and 1996, GNP per capita more than doubled. However, with the devaluation of the Baht in June 1997, and slowdown in economic growth, 1998 per capita dropped to US\$ 1,857, and increase to US\$ 2,045 for the year 1999.

The kingdom has a projected 3.1 percent unemployment rate of the 32.9 million labour force for 1999. Full year inflation for 1998 came in at slightly over 8 percent, well below earlier projections while in 1999 inflation rate stood at around 0.3 percent. In May 1999 official reserves were US\$ 30.6 billion, a figure equal to more than 8 months of import

cover. Economic recovery is expected to steadily continue in 2000 with an economic growth of 4.4 percent, higher than the 4.1 percent growth in 1999. Factors contributing to further recovery in 2000 include export, private investment and private consumption expenditures. Inflation rate is expected to be contained at about 2.0 percent.

1.1.2 *The trade environment*

On the external front, export growth has traditionally been a major driver of Thai economy and has contributed to the diversification of industrial structure. Since 1991, exports have doubled in value, from US\$ 28.2 billion to US\$ 56.7 billion in 1997. Though exports declined to US\$ 52.9 billion in 1998, they are projected to grow by 7% in 1999. Manufactured export, in particular, has gained importance - accounting for computers and parts, textiles, gems and jewelry, electronic and automotive products, in addition to agricultural products.

Traditionally, imports have also shown strong increases, although they decreased in the wake of the Asian financial crisis, beginning in mid-1997. In 1998, imports fell 33.8 percent in US dollar terms, to US\$ 40.6 billion; however, for 1999 they totaled US\$ 47.0 billion, a 15.8 percent growth in terms of value. As a result reduced reliance on costly imports, Thailand's balance of trade showed a US\$ 12.2 billion surplus in 1998 and US\$ 9.6 billion surplus in 1999.

As a result, Thailand's current account, which has been in deficit throughout the 1990s, showed a US\$ 14.3 billion surplus for full year of 1998 and there was a US\$ 11.6 billion surplus in 1999. The balance of payments for 1998 was surplus by US\$ 1.7 billion, and in 1999 continued that trend, with a surplus of US\$ 4.6 billion.

For the year 2000, Thai exports are expected to remain a driving force for economic growth, increasing by 6.0 percent in US\$ value and 5 percent in volume, contributed by an expected strong demand of major trading partners. However, imports in US\$ terms

are forecasted to increase by 14.3 percent, reflecting the steady export performance and expanded investment activities, which together will stimulate the import of capital and raw material goods.

1.2 Outline of transport in Thailand

The transport network is very important for all businesses including maritime transport. In 1.2, the transport modes of Thailand related to the trade of the country will be analyzed.

1.2.1 *Marine transport*

Ports in Thailand are divided into sea ports which face the Gulf of Thailand or Andaman Sea and river ports which were developed along the Chao Praya River. Principle ports for international trade are Bangkok Port, which is the only river port used for international trade, Laem Chabang Port, Map Ta Phut Port, Songkla Port and Phuket Port.

Among these ports, only Bangkok Port and Laem Chabang Port, which were opened in 1991 as key projects of the Eastern Seaboard Development Plan, have been in operation as a gateway to the country. Laem Chabang Port is expected to become not only the center of maritime trade entering Thailand but also the rest of Indochina.

River ports are distributed along the Chao Praya River and mainly used to shuttle goods to and from the Bangkok area. There are about thirty coastal ports and most of them are located along the Gulf of Thailand Coast and Andaman Sea Coast in south Thailand. Besides these ports, there is the berthing area of Si Racha just north of Laem Chabang Port and used by big vessels for importing oil or exporting tapioca.

The ocean transit time between the United States and Thailand varies. From the West Coast, the time is roughly 20 days. From the Gulf of Mexico region, the time is about 30 days. From the East Coast, the estimated time is 40 days. Transit time also varies according to the ship's itinerary and the point of transshipment in the Far East.

By barge in waterways, it is hard to find any advantage of barge delivery in terms of efficient and economical transportation. Picking up disadvantages of barge transportation, it is less economical because of crane charges on both edges (loading/unloading), taking long transit time with poor reliability and low frequency in addition to non-attractive higher freight.

1.2.2 *Railway network*

The railway system is managed by the State Railway of Thailand (SRT) roughly 2,300 miles of track throughout the country. With over 600 stations, the SRT is a good form of transportation. The SRT owns 357 cars, of which 30 are for passenger use and 127 are for cargo. SRT also owns 75 diesel locomotives. By 1996, SRT had purchased 30 new 3+0 new locomotives, 270 new passenger cars and 750 new cargo cars.

Lines radiate in all directions from Bangkok to connect with important administrative and commercial centers. The southern line extends along the entire east coast of the peninsula Thailand and joins the Malaysian railroad system at the border. The northern line terminates at Chiang Mai. A third line branches to the east from the Bangkok-Chiang Mai line about 50 miles north of Bangkok, and at Nakhon Ratchasima forks northeast to the Laos border and east to Ubol. The link between Bangkok and the Eastern Seaboard ports will greatly facilitate the transportation of cargoes, particularly container cargo. There are four major freight terminals in the Bangkok area. Two other major terminals are located at Bang Sue, which is near Laem Chabang Port. There are also six other marshalling yards located throughout Thailand.

1.2.3 Road transport

The most important form of transportation in Thailand is the national highway system, which is recognized as one of the best developed in Southeast Asia. Thailand is actively upgrading the highways to help support the rapid economic growth in the regional areas like the Eastern Seaboard. Thailand's road network has roughly 26,700 miles of the national and provincial highways, and suburb roads. Bangkok is linked directly with all the other major Thai cities. In addition, highways also link Thailand with Laos, Cambodia, Malaysia and Myanmar. In addition, new primary highways are being built that will link the Eastern Seaboard with Northeastern Thailand. These projects will add roughly 3,500 additional miles to the highway network.

By large, truck and passenger transport is dominated by private companies. Transportation by truck can gain an advantage over the railroad service in delivery of cargoes in terms of transit time, flexibility and frequency.

Table 1: Length of road network under the responsibility of the Department of Highways

Year	Under maintenance (Kms)			Under construction and uner standard road (Kms)	Grand total (Kms)
	Concrete-asphalt	Unpaved road	Total		
1987	33,865	5,504	39,363	8,442	47,811
1988	35,874	5,920	41,794	6,074	47,868
1989	38,752	5,657	44,409	4,873	49,282
1990	39,932	5,513	45,445	4,360	49,805
1991	39,581	5,047	44,628	5,333	49,961
1992	43,170	3,542	46,712	3,745	50,457
1993	42,636	4,127	46,763	3,714	50,477
1994	45,675	4,186	49,861	2,359	52,220
1995	46,331	2,574	48,905	4,806	53,711
1996	46,660	2,206	48,806	4,962	53,768
1997	50,233	1,933	52,166	3,155	55,321

Source: The Ministry of Transport and Communications of Thailand

1.2.4 Air transport

The Airports Authority of Thailand (AAT) and the Aviation Department in the Ministry of Transport and Communications are responsible for national and international airport operations. The AAT is a state-owned enterprise that operates Don Muang (Bangkok International Airport), Chiang Mai International Airport and the provincial airports at Hat Yai and Phuket. The Aviation Department is responsible for the remaining airfields and provincial airports. Of the 6 provincial airports, 15 have regularly scheduled traffic. Don Muang is currently the main entry point for international traffic into the country and also serves as the central hub for the majority of domestic air traffic. There are 4 cargo terminal at Bangkok International Airport with a combined of 114,048 sq.m and an annual freight capacity of 1 million tons.

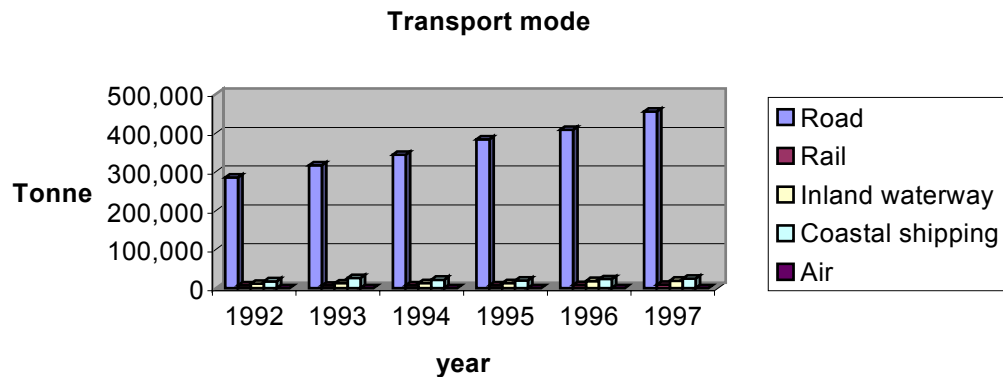


Figure 2: Domestic freight transportation

Source: The Ministry of Transport and Communications of Thailand

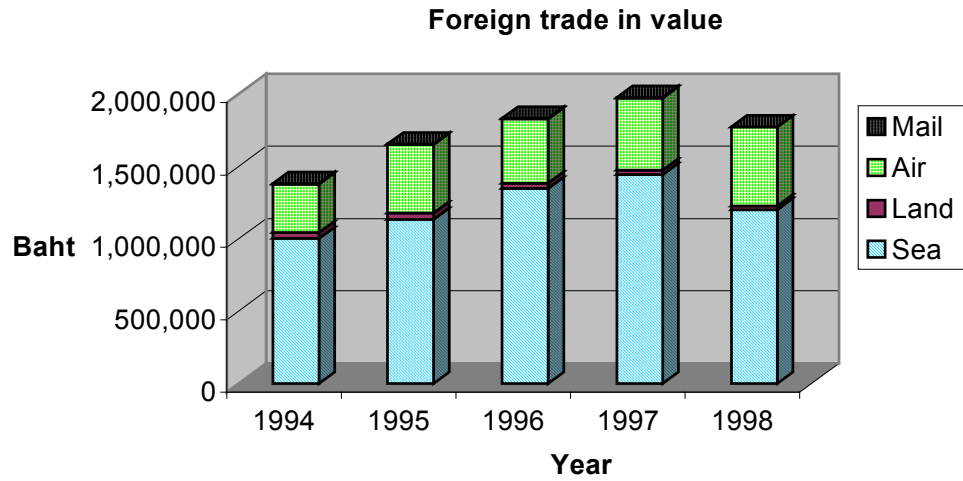


Figure 3: Foreign trade (imported) in term of value
 Source: The Ministry of Transport and Communications of Thailand

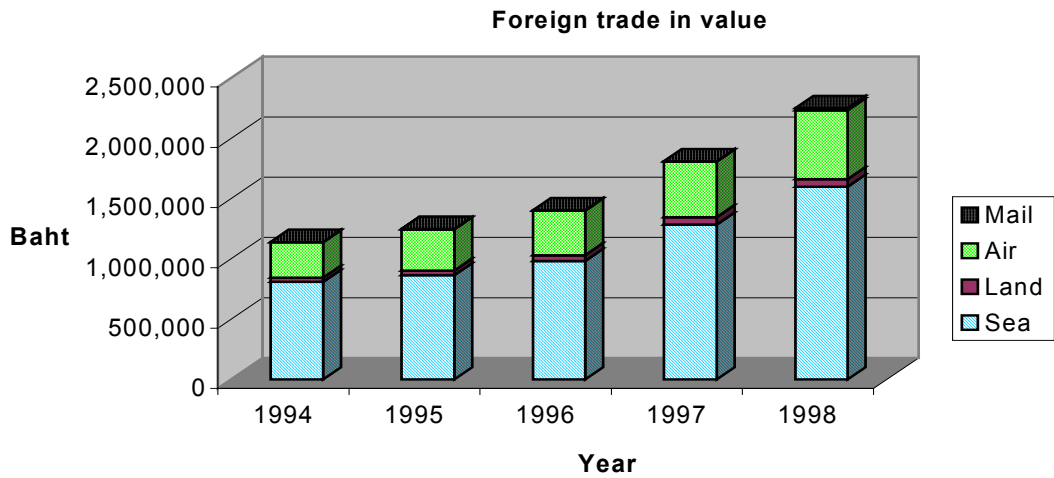


Figure 4: Foreign trade (exported) in term of value
 Source: The Ministry of Transport and Communications of Thailand

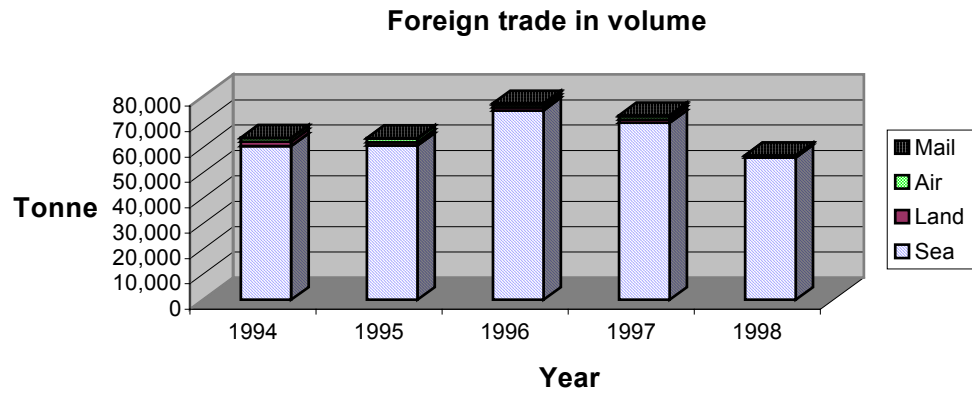


Figure 5: Foreign trade (imported) in term of volume
 Source: The Ministry of Transport and Communications of Thailand

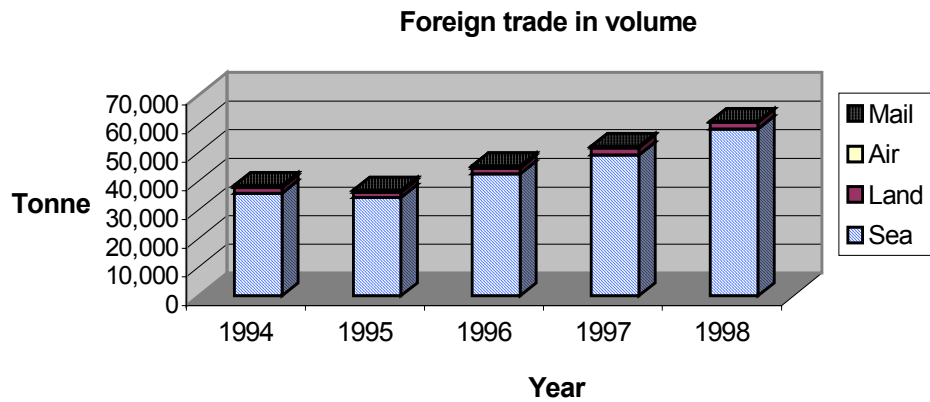


Figure 6: Foreign trade (exported) in term of volume
 Source: The Ministry of Transport and Communications of Thailand

1.3 International container transport trends in Thailand

It is obvious that sea transport plays a very important role in international trade of the country, and nowadays most of the cargoes are being containerized. Therefore, the international container transport trends in Thailand will be analyzed as follows:

1.3.1 *Outline of international container transport*

In 1999, the total foreign trade value of Thailand amounted to 56.6 billion US\$ for exports (increase of 7 percent over 1998) and 47.0 billion US\$ for imports (increase of 15.8 percent). However, if comparing the figure of 1999 with the year 1996, the total foreign trade value for exports increased just 3.5 percent, and decreased 33.6 percent for imports. This was caused by the slowdown of the Thai economy since 1997.

Due to the slowdown of the Thai economy in 1997 and the government policy to limit container traffic at Bangkok Port to one million TEUs in 1998, the number of ship calls at Bangkok Port went down to 2,694 in 1999 showing a decrease of 164 calls or 6 percent from the year 1998. The container throughput in 1999 was 1.052 million TEUs showing a decrease of 0.062 million TEUs or 5 percent from 1998. However, the economic crisis turned out to be a big plus for Laem Chabang Port which enjoyed an 8.2 percent increase of ship calls in 1999. The container throughput in 1999 was 1.75 million TEUs showing an increase of 0.33 million TEUs or 23 percent from 1998. This is due to the devaluation of the Thai Baht resulting in the increasing demand from foreign countries and the increasing number of imported empty containers for exporting cargoes.

Since the Thai economy is expected to recover in 2000, the number of ship calls and cargoes handled at Laem Chabang Port will slightly increase accordingly. For Bangkok Port which has limited the number of containers throughput at 1 million TEUs, the

volume of containers will decrease to 1 million TEUs excluding empty containers while those at Laem Chabang Port will be 1.85 million TEUs.

1.3.2 *Characteristics of the liner services for containers in Thailand*

- **Services with feeder**

Most containers originating from or designated to Thailand are loaded/unloaded at Bangkok Port and Laem Chabang Port at present. After or before being handled, long haul containers from/to the USA and Europe, for example, are transhipped from /to trunk liners at Singapore, Hong Kong, Kaoshung and the ports in Japan, among others liner services with feeder connecting Bangkok Port and Laem Chabang Port and the trunk routes are in operation.

- **Direct liner services**

In recent years, the number of vessel calls for direct shipping services shows an upward trend, for instance, routes for Japan, Korea, Hong Kong, Taiwan and China, routes for Singapore or routes for other areas comprising Europe, Bangladesh, South Africa, Durban, Cambodia and UAE.

For Laem Chabang Port, major world known shipping lines are offering regular Panamax and Post-Panamax vessel services which they back with various connection and extensive marketing and sales forces throughout the world. Since 1997, Laem Chabang Port has served both Panamax and Post-Panamax, and the cargo traffic from other major ports in the world has been calling Laem Chabang Port. The container cargo handled by Laem Chabang Port, therefore, may no longer depend on the transshipment traffic from the neighboring ports.

1.4 Conclusion

Although Thailand is still in the economic crisis situation, it is expected that the economy of the country will slightly recover. According to the economic statistic, basically, the economy in the country is based on foreign trade i.e., import and export. The sea transport mode plays a very important role for the Thai economy. More than 80 percent of goods and commodities are imported and exported by ships, so ports must be the main gateway for the country. Hence, regarding globalization, ports have to improve their efficiency to be competent for serving, facilitating and competing with the others for the benefit of the country as a whole.

As Bangkok Port is one of the major ports of the country, and in order to improve its operational and service system efficiency, some local ports, modern ports and international regime have to be taken into account for study and comparison purposes.

Chapter 2

Bangkok Port present situation

As mentioned in the previous chapter, it is obvious that the economy of Thailand highly depends on foreign trade and , furthermore, Bangkok Port plays a significant role as one of the main gateways of the country. The main objective of this study is to discuss how to improve operation and service efficiency and competitiveness of Bangkok Port in order to meet the logistical needs of the clients and to facilitate the foreign trade activities. This chapter, for better understanding, will examine the present situation in Bangkok Port, i.e., identification of the characteristics of operational and service systems and current condition of container movements.

2.1 General background of Bangkok Port

Bangkok Port is a river port and also operating (service) port supervised by the Port Authority of Thailand. It has been playing an important role as the main gateway of the international trade in Thailand. In the olden days, only vessels of medium tonnage and light draught could pass the channel to Bangkok. Since vessels of deep draught had to be discharged and loaded in the deep water anchorage about 80 km. from Bangkok, cargo had to be sent up to Bangkok or brought down for shipment by lighters, which caused problems both in terms of time and expense. In order to solve these problems, the government decided to build a new port with modern facilities. Therefore, the construction of a new wharf at Klong Toey (Bangkok Port) began in 1938 and was partly completed in 1940. In 1979, the east quay was constructed to handle the increasing cargo in Bangkok Port.

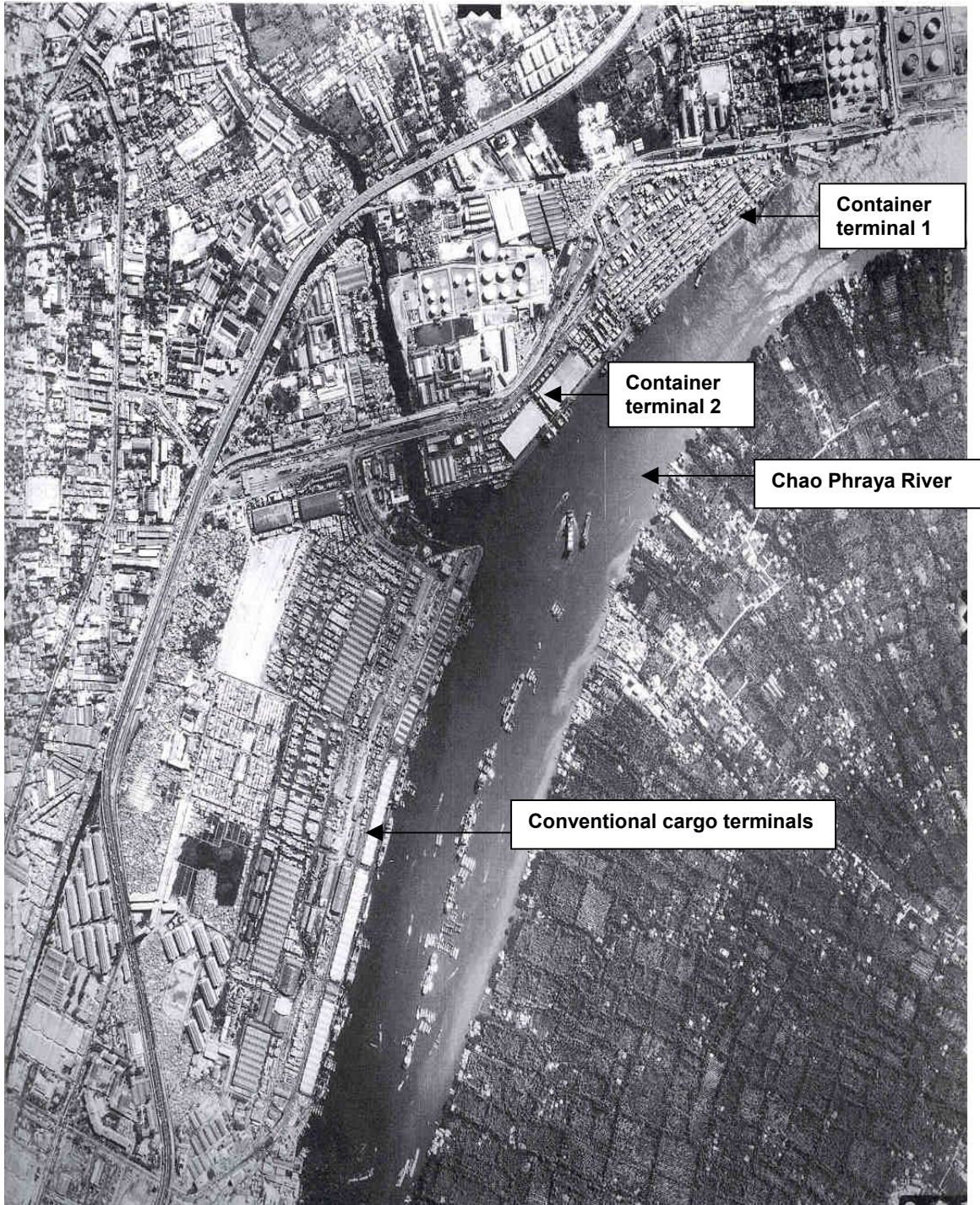


Figure 7: Map of Bangkok Port
Source: Port Authority of Thailand

2.2 Location

Bangkok Port is located on the left side of the Chao Phraya River at km. +26.5, Klongtoey District, Bangkok.

2.2.1 Land area use within the port

The Bangkok Port covers an area of about 930 acres, 340 acres of which are inside the customs fence and are utilized for operational purposes while 51 acres are outside the customs fence, 30 acres are for future expansion, 340 acres are rented for commercial use and housing projects, 100 acres are slum area and 74 acres are for access roads.

2.2.2 Water area use within the port

The offshore area under the jurisdiction of the Port Authority of Thailand (PAT) begins from the Memorial bridge of the Chao Phraya River downstream to the km -18 in the Gulf of Thailand, which is about 66 km long. It is the PAT's responsibility to conduct dredging operations and maintenance of the bar channel and berths to the depth of -8.5 and -10.72 meters below Mean Sea Level respectively including installation of navigation aids and other related facilities and also conducting surveys of the depth of the navigation channel in front of the wharves and in the basins.

2.3 Port facilities

2.3.1 Mooring facilities

In Bangkok Port, there are 5 mooring facilities, i.e., West quay, East quay, Klong Toey dolphins, Bang Hua Sua Dolphin and Sathu Pradit Buoy. The dimensions and constructed year of each mooring facility are summarized as shown in Table 2.

Table 2: Mooring facilities at Bangkok Port

Berth/dolphin/bouy	Length (ft.)	No. of berths & mooring points	Max. Size of vessel Length/Draught (ft.)	Capacity (No. of ships)
East quay	5,012	8	565/27	7
		.	300/15	1
West quay	5,445	10	565/27	10
Klong Toey dolphin	4,592	36	565/27	7
Bang Hua Sua dolphin	5,248	25	565/27	8
Mooring bouy at Sathupradit	5,182	5	565/27	4
		.	565/27	1

Sources: Port Authority of Thailand

2.3.2 Cargo sorting and storage facilities

The cargo sorting and storage facilities of Bangkok Port are summarized as shown in Table 3.

Table 3: Storage area at Bangkok Port

Storage area	Square meter
Transit sheds 1-17	61,230
Supplementary transit shed	15,700
Overtime cargo warehouse	9,820
Bonded warehouse	2,100
Import motor cars unit	13,050
Open yard for stuffing	106,920
General cargo storage area	120,890
Container Terminal 1	98,600
Container Terminal 2	49,000
In-transit warehouse and open storage area	16,360
Other storage area	26,652
Total	520,322

Source: Port Authority of Thailand

2.3.3 Service craft and mechanical handling equipment

Bangkok Port provides the facilities for craft services and mechanical handling equipment as shown in Table 4 and Table 5.

Table 4: Service crafts at Bangkok Port

Item	Capacity	Quantity
Tug boat	1,125-2,400 hp	11
Garbage boat	160,200 hp	2
Rope boat	74-170 hp	14
Water supplying boat	425 hp	1
Yacht and inspection boat	1,470 hp	1
Trailing suction hopper dredger	2,500 cubic metres	3
Dredger	265-420 metric tons	3
Hopper barge	120 cubic metres	7
Coastal tug	150-350 hp	4

Source: Port Authority of Thailand

Table 5: Mechanical handling equipment at Bangkok port

Equipment	Capacity	Quantity
Rail Mounted Shoreside Gantry Crane	32.5-40 Tons	14
Rubber Typed Gantry Crane	30-40 Tons	36
Top Loader	40 Tons	33
Empty Container Stacker	7.5 Tons	25
Mobile Crane	10 Tons	3
	50 Tons	7
Forklift Truck	Various Sizes	223
Tractor for Trailer	30-40 Tons	154
Container Chassis	30-40 Tons	151
Towing Tractor	12,000 Lbs.	14
Trailer	10 Tons	14
Multi Purpose Trailer	5-7 Tons	11
Motor Truck	5-7 Tons	45

Source: Port Authority of Thailand

2.3.4 Utilities

The water supply system for Bangkok Port consists of the water supply from the municipal water supply system and the water supply from its own well water supply system. The water supply taps for ships are installed on the apron of the west quay and east quay. Furthermore, the electricity for the port is received from the Metropolitan Electricity Authority (MEA). This electricity supply system is supported by an emergency supply system which consists of 4 diesel engine generators.

2.3.5 Operation supporting facilities and port office buildings

The operation supporting facilities, such as repair shops, parking lots, gas stations, stores for maintenance materials, pump houses, substations and canteens, and the port office buildings, such as PAT's operation building, Bangkok Port operation building, Comptroller's department, Law division, Container division and Computer center.

2.4 Storage system

The storage operation and services of the Port Authority of Thailand are the following:

2.4.1 General cargo

Private stevedores are assigned to discharge general cargoes to quay side or reload them to trains, trucks or lighters. Cargoes that are kept in transit sheds, right behind the birth, will be alphabetically separated (A-Z) in each bay to make delivery easy.

- Valuable and damaged goods are stored separately.
- Other goods, such as dangerous goods, motor car, steel products and in-transit goods are stored at the dedicated warehouses.

2.4.2 Containers

LCL containers are hauled to the yard at the East Quay for unstuffing. The cargoes are then stored into sheds, pending delivery by the owners. FCL containers are directly moved to the consignees' premises or brought to the port's exporting yard. Stuffed containers waiting for loading on to vessels and empty containers are hauled to the marshalling yard at the East Quay. The storage system is implemented as international standard.

2.5 Information system

The Port Authority of Thailand has developed computer systems in controlling inward and outward container traffic within the customs fence, billing of tariff charge e.g. inward and outward cargo charge, container charge, port dues, and equipment hire including accounting and financial systems. In addition, PAT has implemented the computer system to the services on vessels, containers, billing and supporting program.

2.6 Container operational and service systems

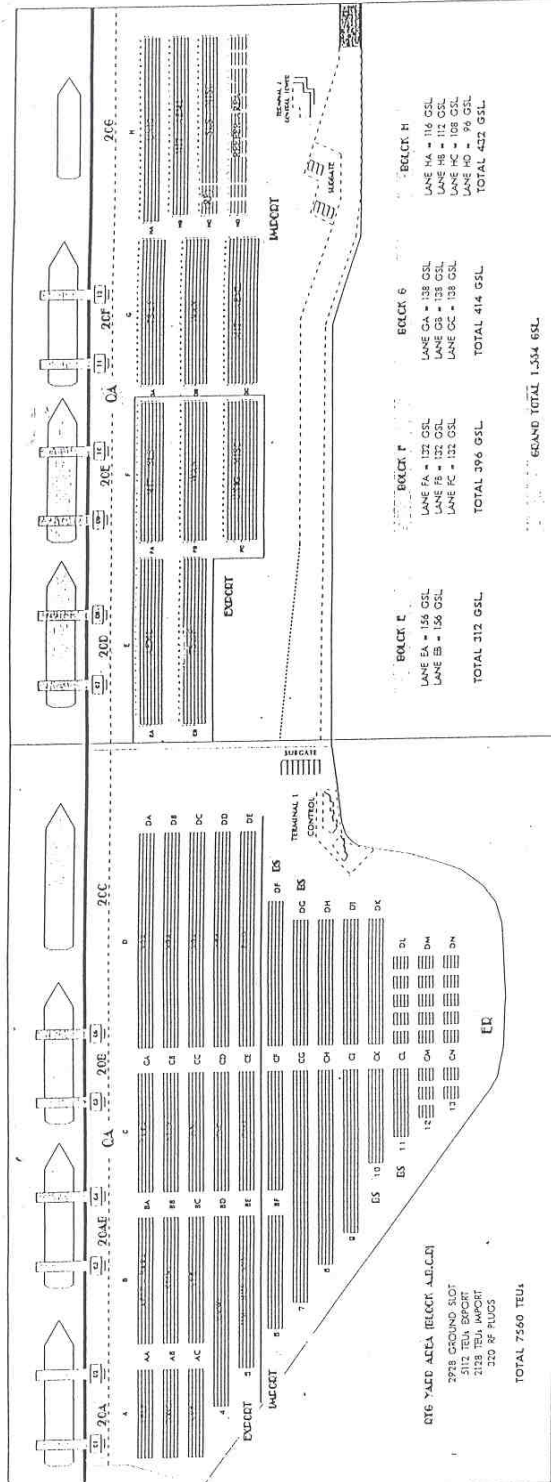
The Bangkok Port container terminal operational and service systems are the following:

2.6.1 *Concept of establishing container terminal operations system*

Containers are loaded and discharged at the berths of the East Quay (Container Terminal 1 and 2). The following concept of establishing the system of container terminal operations at Bangkok Port is for the purpose of achieving safe, efficient and reliable operations for the customers.

- The introduction of a Closed Container Terminal System, controlled by a terminal operator, responsible for receipt, storage and delivery of

CONTAINER TERMINAL



TERMINAL 1

TERMINAL 2

Figure 8: Map of Bangkok Port container terminals
Source: Port Authority of Thailand

containers at the terminal by conducting yard planning and inventory control of containers, which is indispensable for a modernized container terminal.

- Introduction of Closing Time so as to make a loading sequence plan at least 3 hours before ship arrives.
- Increase of container stacking capacity at marshalling yard in the East Quay. It is necessary to demolish Transit Shed No. 11 and No. 12. Actual capacity will be increased from 6,200 TEUs to 10,000 TEUs.

All exported containers should arrive at the marshalling yard before ship arrival. Imported containers must be stacked on the marshalling yard after being discharged from the ship (even during peak condition: FCL container must be stacked on the marshalling yard, LCL containers will be delivered to sheds and to the empty container area for empty container). In such case, berthing hours of container ship are expected to be 20 hours instead of 24 hours and generating benefits to the saving of ship staying cost.

2.6.2 Discharging of containers

Before discharging, a ship's agent must inform data on the inward container list and inward cargo manifest to the container terminal. The computer system will generate the discharging operational plan in order to allocate a yard area for import containers and also arrange the operational schedule. For the discharging operation at the quay side, hand held is used by the tally clerk for confirmation of discharging containers and at the yard, a mobile data terminal which is installed in the cabin of transtainer will show the job that should be done. The job on lifting containers from chassis and stacking the location is shown at the monitor of the mobile data terminal (MDT).

2.6.3 *Container delivery*

After the importer has cleared the Customs procedure and paid for the tariffs. he/she will receive a container receipt which will also be shown at sub gate of the container terminal where he/she could handover his/her container. At the sub gate, the container number will be put into the computer by an officer; the system will print out the location of the container and on-line to RTG (MDT).

2.6.4 *Receiving of container*

Before arrival of a vessel and first container at the container terminal, the booking forecast will be submitted to the terminal. The container terminal will then utilize such data to plan the export yard in order to stack the container by grouping the containers for the vessel.

2.6.5 *Loading containers*

PAT has announced the closing time system by loading only containers which have reached the port at least 3 hours before the arrival of the vessel. For loading operations, PAT will bring the container to quay side on the request of the stevedoring company. Containers will then be loaded onto the vessel.

2.6.6 *Sub-system*

In order to develop the container terminal management as above, the sub-function of the computer system consists of:

- Berth planning (BP) which is provided for assigning a coming vessel to a berth and allocating quay for vessel.

- Vessel planning (VP) in the loading plan; the vessel planner receives the lists for a loading plan from the yard planning computer system. These lists are loading container lists, loading summary lists and loading special container lists. After the plan is completed, the loading sequence list and loading bay plan sheets are delivered to yard foreman and tally officer. For vessel planning in the discharging plan, the necessary information requested is number and container No. to be stacked at the marshalling yard, discharging container list, discharging summary list and discharging special container list.
- Yard planning (YP) which provides for the yard allocation both for import and export containers and also do in-yard shift plan.
- Job controlling (JC) takes place at the vessel operation monitor in order to optimize the transtainer operation; the yard operational system will serve this purpose.

2.6.7 EDI (Electronic Data Interchange)

PAT requires information from port users before starting its operation. Instead of submitting documents, PAT introduces receiving information on EDI. In order to increase speed and accuracy of information as well as to reduce paper cost, PAT has announced EDI for Inward Container List and Inward Cargo Manifest by applying the United Nations Rules for Electronic Data Interchange for Administration, Commerce and Transport standard or UN-EDIFACT. In addition, PAT has developed INTRANET as the implementing information system for its organization. The information includes news, statistics and summary reports on port performance.

2.6.8 Container terminal facilities at Bangkok port

Bangkok Port provides the facilities for container terminal operations and services as shown in Table 6 below.

Table 6: Container terminal facilities at Bangkok port

Specifications	Container Terminal 1	Container terminal 2
Berth	4 Berths	4 Berths
- No. of berths	1) 20 A 137 M. 2) 20 AB 152 M. 3) 20 B 152 M. 4) 20 C 227 M.	1) 20 D 183 M. 2) 20 E 183 M. 3) 20 F 183 M. 4) 20 G 91.5 M.
- Overall length	668 M.	640.5 M.
- Water depth	8.2 M.	8.2 M.
- Accommodation	10,000-12,000 DWT	10,000-12,000 DWT
Container yard & equipment		
- Stock capacity	3,036 Ground slots	1,554 Ground slots
1) Block A,B,C,D	8,824 TEUs	6,357 TEUs
2) Reefer plugs	210 Points	150 Points
- Rail Mounted Shoreside Crane	8 Units	6 Units
- Rubber Tyred Gantry crane	1) 1 over 3, 14 Units 2) 1 over 2, 10 Units	1) 1 over 3, 4 Units 2) 1 over 4, 8 Units
- Empty container handling reach stacker	2 Units (10 Tons)	1 Unit (7 Tons)
- Full container handling reach stacker	2 Units (40 Tons)	2 Units (40 Tons)
- Tractor head	50 Units	47 Units
- Container chassis	50 Units	47 Units
- Computer system IBM RISC 600 Base MES	1 Unit	1 Unit
Gate delivery		
- Sub - in - gate	5 Lanes	4 Lanes
- Sub - out – gate	2 Lanes	3 Lanes
Service	Staff 250 Persons 24 hours a day, 7 days a week 24 hours at gate receiving & delivering In house Customs clearance Customs service	Staff 103 Persons Driver 143 Persons 24 hours a day, 7 days a week 24 hours at gate receiving & delivering In house Customs clearance Customs service

Source: Port Authority of Thailand

2.7 Present conditions which have an impact on container terminals at Bangkok Port

Presently, there are many conditions which have an impact on Bangkok Port container terminal operations and services, they are as follows:

2.7.1 *Government policy*

The government policies which have an impact on container terminal operations at Bangkok Port are:

- The promotion of export policy.
- The policy to limit the number of container throughput at Bangkok Port at 1 million TEUs per year.
- The policy of reorganization of Bangkok Port to increase the private roles to take part and operate in some activities.

2.7.2 *Transport situation*

According to the changing of transport forms, these can have an impact on the operations and services in Bangkok Port , as follows:

- The volume of container cargo handled through the port has shown a sharp increase.
- The size of container ships is becoming bigger, and it is clear that the port cost per ton of cargo carried is cheaper because of the extra voyage and quicker turnaround. Therefore, this may cause some problems to Bangkok Port which is a river port and can not accommodate these big ships.

Consequently, they will change their routes or move to other ports that can accommodate larger ships.

- Nowadays shipping companies have a policy to merge or set up a group of co-operation in order to operate in container terminals. Some of them operate ICD or CFS. Therefore, their ships and cargo will be no longer served and operated by Bangkok Port.

2.7.3 Services

A part from the external environment mentioned above, the efficiency of services is highly dependent on the internal conditions which will be analyzed in depth in Chapter 4 and Chapter 5.

2.7.4 Consequences

- According to the present situations mentioned above, the full container throughputs at Bangkok Port have decreased while empty containers have increased. However, the number of container throughputs at Bangkok port has slightly increased compared with the last two years. It is expected that this situation will continue unless Bangkok Port creates some strategies to solve this problem.
- If empty containers are considered, it is clear that empty containers have sharply increased caused by the imbalance of traffic due to the increasing of demand for export. In 1998 empty containers handled at Bangkok Port increased 89 percent compared with the previous year or increased 0.109 TEUs. For this reason, the revenue from container handling of Bangkok Port containers especially from full import container has sharply decreased.
- According to the government policy to limit the number of container throughput at 1 million TEUs per year, currently, the container throughput at Bangkok Port is less than that limited (excluding empty containers).

However, if the capacity of container handling at Bangkok Port, which can handle 1.3 million TEUs per year is considered, it is clear that it has not been utilized.

- In terms of reorganization and privatization, Bangkok Port has to improve its performance and the efficiency of operations and services in order to persuade the private sectors to invest in its business.
- The changing of transport forms could have an impact on the number of ship calls at Bangkok Port. Presently, some companies that used to be the customers of Bangkok Port have changed their port of calls to the port including ICD and CFS operated by themselves. This reduces very much the number of container throughputs at Bangkok Port.

2.8 Container volume handled at Bangkok Port

Container volume handled at Bangkok port is shown in Table 7 and Figure 9.

Table 7: Through container at Bangkok Port for the Fiscal Year 1997 – 1999

Million TEUs			
Fiscal Year	1997	1998	1999
Import container	0.44	0.306	0.333
Export container	0.537	0.577	0.548
Empty container	0.122	0.231	0.171
Total	1.099	1.114	1.052

Source: Port Authority of Thailand

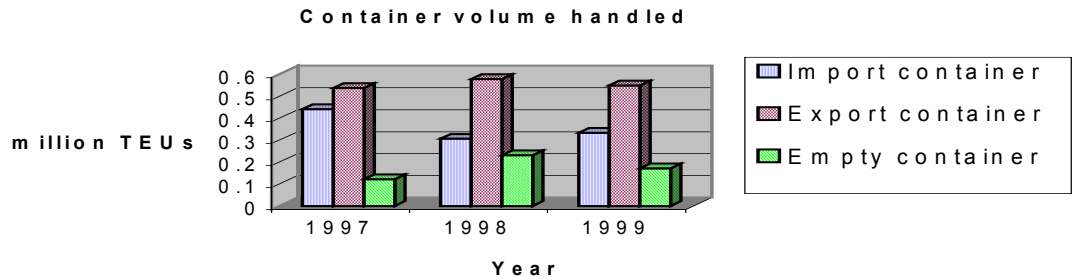


Figure 9: Container volume handled at Bangkok Port

Source: Port Authority of Thailand

2.9 Conclusion

It is self-evident that Bangkok Port has been improved tremendously during the past years. However, in terms of productivity, there is still some distance existing between Bangkok Port and some local ports and other modern ports in the world. Nevertheless, the information and data of Bangkok Port mentioned above could clearly show that Bangkok Port has great potentiality to be improved further by the efforts which focus on increment of operation and service efficiency, which will be discussed in Chapter 4 and Chapter 5.

Chapter 3

Container terminal operational and service systems of an international regime

The scope of this chapter is to provide concept of logistic management, the impact on containerization on port operations and a practical overall understanding of the elements of port operation and management as a means of providing a viable high quality service, competence and efficiency to sustain and expand international trade passing through the port.

This chapter consists of the following aspects of international regime:

- Logistic management concept
- The impact of containerization on port operations
- Container terminal
- Area requirement
- Container handling systems
- Terminal layout
- Container terminal operations
- Maintenance
- Analysis of terminal operating performance
- Pilotage and mooring time
- Port congestion

3.1 Logistics management concept

A widely adopted textbook defines logistics management as “the process of planning, implementing and controlling the efficient, effective flow and storage of goods, service, and related information from point of origin to point of consumption for the purpose of conforming to customer requirements” (Lambert, 1998, p.3). As the port is one part of the supply chains which are the network of facilitating and distribution options, the most recent development of logistics and supply chain management describes logistics as an optimization process of the location, movement and storage of resources from the point of origin, through various economic activities, to the final consumer.

Logistics plays a key role in the economy in two significant ways. Firstly, logistics is one of the major expenditures for businesses, thereby affecting and being affected by other economic activities. Thus, by improving the efficiency of logistics operations, logistics makes an important contribution to the economy as a whole. Secondly, logistics supports the movement and flow of many economic transactions; it is an important activity in facilitating the sale of virtually all goods and services, for instance, if goods do not arrive or are delivered on time, in proper place or condition, no sale can be made. Thus, all economic activities throughout the supply chain will suffer. Logistics may be the best source of competitive advantage for a firm, for it is less easily duplicated than other elements of marketing mix: product, price and promotion. The power of logistics, therefore, can achieving an organization’s customer service goals and supporting customer satisfaction. Organization that understand and utilize the potential of logistics as a competitive weapon includes logistics as a key component of its strategic planning process (Lambert, 1998).

3.2 The impact of containerization on port operations

It is obvious that the growth and development of containerization has been increasing rapidly and affecting trade routes and ports all over the world including in Thailand. For instance, the traditional landscape of a port has been changed

fundamentally; some handling equipment has to be replaced and also big amounts of money will have been invested in terminal construction. Furthermore, far fewer dockers, clerks, supervisors and managers are required than on conventional berths. Men need to be trained to operate equipment worth many millions of dollars, to handle documents and administrative procedures, while supervisors and managers must be of the highest calibre to plan, control and supervise the high speed and complex terminal operations. Cargoes are expected to stay in port for a short time, so streamlined documentation, customs and administrative procedures are needed. Computerized information systems have been introduced widely to monitor and control the movements of containers. Tariffs and contracts have to be changed as have the managerial and organizational structures of the terminals.

However, many ports have responded to containerization, and now they are developing terminals for it. Certainly, Thai ports are not achieving the level of performance that their terminals were designed for and far from successful for several reasons such as lack of appropriate facilities, lack of transport chain, handling performance is below expectation, purchasing wrong types of machines, construction started before a decision on equipment choice has been made, bad layout and design, shortage of handling equipment, inadequate maintenance of machines, inadequate and unreliable tracking and inventory systems, and poor planning.

What strategy should, then, be adopted in planning for container terminal operation? The container trade is very different from conventional trade. Therefore, a completely new approach is needed by management for the introduction of the new container handling technology, carefully thought out plans and policies, and appropriate solutions to the problems (UNCTAD, 1986).

3.3 Container terminal

The container terminal is different from the conventional berth. First, the quay has to be longer to accommodate the latest generation of vessels; 300 metres is the normal length of a single terminal unit, and 500 and 750 metres would be the

respective accepted length of 2-unit and 3-unit terminals. Container terminals have a wide area for landing import containers and marshalling export containers prior to loading-wide and free of obstruction, to allow the unimpeded movement of large pieces of equipment.

Behind the marshalling area is an extensive stacking area - the container yard (CY) taking up to 60-70% of the total space of the terminal. The CY is used primarily to stack containers awaiting onward movement, up to 7,500 of them at a time at large terminals. The CY may well be 500 to 750 metres deep, and it is set out in a series of well-marked and numbered blocks for the movement of equipment (the actual layout depends on the type of equipment selected). Some stacking areas are set aside specifically for special containers - refrigerated and controlled atmosphere containers requiring an electricity supply; overheight, overlength and out-of-gauge containers; hazardous- cargo containers. Import and export areas are distinguished, as are areas for empties, to separate these activities as far as possible.

Where a high proportion of LCLs pass through the terminal, a consolidation shed or CFS is commonly provided within the terminal though there are good arguments for moving the CFS out of the terminal area. It is here that import LCLs are unpacked and the separate consignments stacked for collection, and that export consignments are consolidated into empty containers.

Documentary security and container inspection procedures are undertaken at a gate complex. A rail reception/dispatch terminal may also be located in some suitable area of the container terminal. Good access roads and parking areas are needed.

Finally, maintenance and repair workshops, office accommodation and a control tower should be provided where operations can be co-ordinated and controlled. Weighbridges, trailer parks and other miscellaneous facilities take up their space, so that the total surface area of a container terminal is very extensive indeed.

On the quayside is seen the transfer equipment for handling the containers to and from the ship-to-shore cranes. There may be straddle carriers, heavy-duty tractor-

trailer systems or front-end loaders. Within the CY, and moving containers to and from CFS, interchange point and within the various areas in the CY, are more sets of equipment, including rubber-tyred or rail-mounted yard gantry cranes (UNCTAD, 1986).

It is, therefore, better to consider the space and length of berth and area per gantry crane. From a sample of 20 modern container terminals from ports around the world one can see that a typical container terminal might have 7.4 hectares per gantry crane with a standard deviation of 3 hectares and 170 metres of berth length per gantry crane with a standard deviation of 60 metres.

Labour requirements are in the region of 12-15 men per shift and at many container berths three shifts may be worked a day. Working individual ships 50 containers can be handled per hour per crane, though it is unlikely to be able to sustain this throughput over a long period.

3.4 Area requirement

Containers should not be transferred directly between the quayside and inland transport. A storage yard has to be provided at the terminal for in-transit storage of containers while all the administrative procedures are involved. Up to 70% of the terminal area is assigned to stacking, while the other terminal areas occupy only about 25%. The amount of space needed for handling and storage is not only related to the number of containers throughput but also the time that a container can expect to remain in the stacking area; this is caused the Dwell Time which is obviously a very important factor influencing the land requirement of a CY.

Dwell Times are not easy to establish, then, and it is not wise to predict an optimistically low value for the mean time spent in the port. It is best to be estimated on the basis of experience as far as possible. Dwell Times for imports, exports, LCLs, FCLs, empties, transshipment containers should be estimated separately.

However, all terminals have peaks and troughs in the container flow, so the average value conceals days when demand is lower than the calculated number of TEUs and others when it is higher. To overcome this problem, planners apply a Peaking Factor to cover these routine fluctuations in trade. Normally, some rule-of-thumb is applied, allowing perhaps 20% or 30% TEUs slots above those calculated as the mean daily demand. In practice, containers need to be separated into groups in the CY by type, by size, by ship call, etc, to allow easy access for in-terminal moves and operational flexibility. This extra space is allowed for by applying a Separation Factor. Usually, a figure of 20-30% is allowed as reserve. i.e., a Separation Factor of about 1.25.

After establishing stacking capacity in terms of the number of TEU slots, the space in the CY must be calculated, for containers are not normally spread out one high. The land area actually needed (expressed as Twenty-foot Ground Slots, TGS) will be calculated by dividing the stacking capacity by the stacking height. Thus, TGS required for the container terminal can be calculated by using the formula below:

$$\frac{\text{TEUs} \times \text{Dwell time} \times \text{Peaking Factor} \times \text{Separation Factor}}{365 \times \text{Stacking Height}}$$

The average area occupied per TGS depends on the container handling system. Obviously, the higher that containers are stacked in a CY, the greater the number of containers that it can hold, or the smaller the land area that it needs for given daily demand. Yet, it is not to imply that the maximum safe stacking height should necessarily be aimed at. In practice, stacking height is varied according to container categories.

Export boxes can be stacked higher than imports, for they are stacked in relation to the way they will be loaded. For imports, call-off is quite unpredictable, so import FCLs awaiting collection should be stacked one-high, two-high or perhaps three high. This gives good accessibility combined with reasonable utilization of the CY surface area. However, empty containers can be stacked 3,4 or even 5 high. Establishing a mean stacking height value for the CY thus involves careful

calculation and planning, compromising between block-stacking and accessibility. However, after getting a net surface area, the calculation of roadways for aiseways between rows, for equipment access, for safety space, offices and other non-stacking areas must be taken into account (UNCTAD, 1986).

3.5 Container handling systems

As mentioned earlier, the stacking height and layout of the stacking blocks are highly dependent on the equipment being used in quay transfer and stacking operations, and choice of equipment is such a significant factor in determining efficiency and cost effectiveness of container terminal operations. There are four main types of equipment used in container handling, i.e., tractor/chassis sets, straddle carriers, yard gantry cranes and front-end loaders.

Different handling systems are reflected in the layouts of the different terminals using them. It can not be generally concluded that any one of these systems is superior to the others. Furthermore, the systems are not necessarily applied in their pure forms; very often mixed system are used. In such mixed systems the most suitable equipment can be used for each particular operation. Mixed systems might become a necessity in case where lo/lo and ro/ro container operations are carried out at the same terminal.

3.5.1 Trailer storage system (*chassis system*)

In this system, containers are discharged from the ship by crane, directly placed on road trailers and subsequently towed to an assigned position where they are stored until they are picked up by road tractor. For export containers, the same procedure is applied in reverse order. The advantages of this system are: high flexibility; speed of terminal transport; random access to containers; low ground pressures and consequently low requirements for soil condition. On the other hand, there are severe constraints on the use of the system, so that its application tends to be limited to terminals operated by shipping companies. These constraints are the large space requirements and, most important, the considerable expense entailed

by the large number of trailers required. Moreover, the major disadvantage of this system is high demand on land surface needed for manoeuvring.

Four to six tractors are needed per ship-to-shore gantry crane, depending on terminal size. Manning levels for a chassis operation are relatively high: perhaps 16 men for a one-crane operation and 28 for a two-crane terminal, and the average area required for one TGS is 50 sq.m. Therefore, tractor-chassis systems are recommendable for startup operations with low traffic but are not suitable for high throughputs because of their need for a large terminal surface area.

3.5.2 Straddle carrier system

The most commonly used handling system is the straddle carrier system, either in a pure form or combined with tractor-trailer units to perform transfers between quayside and storage areas. Straddle carriers have a theoretical capacity of stacking containers three or even four high although in practice this capacity will not be attained. The main advantages of the straddle carrier system are: good space utilization; high flexibility; ability to meet peak requirements; relatively low expenses for storage area pavement owing to the weight distribution over eight wheels and compensating suspension system. Improving the performance of the equipment can be done by creating a new design and by reducing the excessive use of straddle carriers for transfer operations between quay and storage areas using the combined system.

For good features of straddle carrier (direct) operations include operating flexibility and efficiency, the average area required for one TGS is 45 sq.m. or 26 sq.m. is achievable for a 50:50 import/export split (either direct or relay systems). Empties stacked three high, can be even more densely stored. For every gantry crane, at least 4 straddle carriers are required to transfer and stack containers with another on the receipt/delivery operation and at least one more in maintenance - a minimum 6 per crane. Manning levels of 13 men for a one-crane operation (including supervisors, checkers and at least 6 skilled drivers) and 22 for a two-crane operation are common in developed countries.

For relay systems, manning levels are higher than in direct systems - about 16 men for a one-crane operation and 28 men for a two-crane operation. However, less skilled labourers can be employed on the transfer part of the operation. For each working ship-to-shore gantry crane, two or three straddle carriers will be needed on stacking, one on receipt/delivery and one in reserve.

3.5.3 Gantry crane system

The gantry crane system is based either on rubber tired or rail mounted gantries. The basic differences being, first, that rubber tired gantries can serve different areas of the terminal while rail mounted gantries are tied to the location of rails. Secondly, rail mounted gantries are able to serve a wider area under the portal than rubber tired ones. Transfers between quayside and storage area are normally made by tractor-trailer units. The advantages of the system are: good area utilization by high stacking; low maintenance requirements. However, this system is less flexible than the straddle carrier system and is often difficult to operate in developing countries, where import containers constitute the major proportion of the traffic. The main attraction of this system is its economical use of the land area. The average area required for one TGS is 35 sq.m. with average stacking heights of 2.5 for imports and 3.5 for exports and overall 13 sq.m. required for one TGS for 50:50 import/export split.

3.5.4 Front-end loader system

The front-end loader system is used at the terminals with a relatively low throughput. Yet, this system can be used in many locations within the terminal - lifting, stacking, transferring to and from the quayside, receiving from and delivering to road vehicles. However, it is difficult to pick up a container from between the legs of a ship-to-shore gantry crane, and so in practice transfer of containers is often performed by tractor-trailers sets, with the front-end loaders working within the CY and between the CY and CFS. Land utilization on a terminal built around front-end loaders is poor. Further, productivity is lower than in case of straddle carriers. In addition, heavy pavement is required to withstand front axle loads of loaded front-end loader. The

average area required for one TGS is 80 sq.m. Export containers can, however, be stacked 3 high and import containers 1.5 high, so an overall average area required for one TGS is about 36 sq.m. in a 50:50 import/export terminal.

3.5.5 Combination system

The objective of adopting this system is to take the maximum advantages of all the positive features of each type of equipment used in it and to minimize its disadvantages. On the face of it, adopting a combination system is a very sensible and cost effective approach, but it does need well qualified management and labour, more elaborate maintenance schemes and spare parts control, and a very effective communication and supervisory system on the terminal; the opportunities for mismanagement and inefficiency are extensive. The land area required for one TGS is 40 sq.m. (UNCTAD, 1986).

3.6 Terminal layout

There are a number of good layouts to be followed depending on the various facilities and activity areas. First, the stacking areas for import, export, empty and special containers need to be located within the terminal plan. Normally, import stacking areas are located on the landward side while exports on the quay side and empties well to the back of the terminal, where they will cause least obstruction to activities. Specials require their own locations where they can receive the services and attention they need such as electricity and security without interfering with operations. Interchange areas must be provided to the systems where road vehicles do not have access to the CY stacking areas. Locations must be chosen to minimize interference between operations. The size of each interchange area and the number of parking slots are obviously based on estimates of demand.

The gate complex, workshops, control tower, administrative offices and other service facilities must then be located so that good flow patterns are established and to allow efficient and reliable control procedures. Aisleways and roadways of suitable widths are set out to allow the free and uninterrupted movement of

equipment and vehicles. Non-essential facilities, for example, CFS should be located away from the terminal and maintenance workshops should not be located within the operational area.

Good road and rail communications are essential. The road entrance must not be narrow or constricted or else traffic bottlenecks can too easily build up. Rail terminals must be sensibly located and so should adequate parking areas for vehicles.

3.7 Container terminal operations

Being the hub of the whole transport system, it is charged with the important functions of planning and performing orderly loading of ships and storage, handling and delivery of containers in the terminal, while always collecting all necessary information concerning ships' schedules, booking position, land transport situation, progress of jobs in the CY and the CFS, demand and supply of containers, delivery schedules, etc., to organize the smooth flow of containers through all segments. Terminal operation work is an integrated manner with large-scale mechanization and limited use of manpower. Accordingly, port operations have been much more rationalized than in the conventional trade, and punctual, rapid and rationalized terminal operations have led to much improved handling efficiency in addition to the all-weather feature of container handling.

3.7.1 Terminal operator

The terminal operator not only controls the container system as a whole within the port area, but performs the operation and may often come from the existing licensed stevedores, or may be the joint venture between the stevedores and the shipping company. The terminal planner's job is shown in Appendix 1.

3.7.2 Shipside operation

Shipside operation means loading and unloading containers onto and from ships. In LO-LO ships, the work is done by gantry cranes and with a view to minimizing ships' time in port. An orderly marshalling plan and onboard stowage plan must be prepared in advance. According to such plan, gantry cranes and other yard handling equipment must be engaged systematically for maximum efficiency.

- **Stowage plan**

Before the arrival of the ships, the accurate booking position, number and weight of containers, destination of each container among others must be known. Furthermore, the position of containers on board and those being discharged at the port must be fully at hand. The stowage planning must take all information on other calling ports into consideration and has to be very complex. Thus, each terminal usually assigns personnel for planning who prepare stowage plans exclusively, in close touch with shipping lines.

- **Rehandling**

Some of the containers stowed on board are to be shifted to another position, owing to increase in number of calling ports and containers handled or for the sake of the ship's stability in navigation; this is called rehandling. One of the terminal operators' tasks is to minimize, as far as practicable, the number of containers to be rehandled.

- **Lashing**

When containers are loaded on deck, they must be secured by means of lashing rods or turn buckles. Whereas containers are handled by the latest mechanical equipment, lashing must depend on manpower.

- **Gang composition**

In container handling, a gang may be composed of 10 to 20 workers per gantry crane, depending upon the type of equipment employed, each of whom is usually the operator of some equipment, for which he is required to have special skills.

3.7.3 Container yard operation

All the containers loaded on or discharged from the ships must pass through the CY for receipt or delivery from/to consignees or shippers. The CY may be considered an extension of the shipside. It is, therefore, the originating or terminal point of the domestic distribution system and the advantage of the containerization hinge on how smoothly a CY is operated. Moreover, a CY functions not only as the site for handling containers but also as a place for storing them.

- **Yard plan**

The yard plan is to arrange the storage of containers in the CY and may be called a stowage plan in the CY area. It aims at delivering and receiving import and export containers and storing them efficiently in the limited space of the CY in order to facilitate the process of delivering or loading to the ship smoothly. The yard planners, in close touch with the gate clerk, must ensure smooth receipt and delivery of the containers which are stored and delivered according to the yard plan. The main jobs of a yard planner and gate clerk are shown in Appendix 2 and Appendix 3.

- **Marshalling plan**

The marshalling plan is almost the same as the yard plan but the term is often used to imply a container storing/arranging plan with more emphasis on shipside handling.

- **Gate job**

All containers are all checked at gate at the CY entrance for confirmation of correct interchange. Interchanging of containers is one of the most important functions of a terminal and, as the boundary between the liabilities of shipping lines and cargo owners. Furthermore, it is the place where the receipts are exchanged between the terminal operator and the forwarder or trucker as agents for the respective parties.

- **Security in CY**

The containers are stored in the CY, where they must be kept safe from unforeseen accidents, for instance, by storm or high tide. In addition, they must also be kept and secured carefully from theft. Therefore, the terminal operators must always be attentive to weather and environmental conditions in order to prepare for any disaster or unforeseen circumstances.

3.7.4 Container Freight Station (CFS) job

The CFS operators receive or deliver such Less than Container Load (LCL) cargo, load or unload it to/from a container, and store it in the CFS. The CFS may be located within or adjacent to the terminal, or nearby in the port area. In general, the CFS has an elevated floor so that cargo can be handled on the same level as the floor of containers outside placed on chassis, for ease of packing cargo into or taking it out of the containers. The job descriptions for handling of export/import cargo in the CFS are shown in Appendix 4 and Appendix 5.

3.7.5 Terminal documentation

The handling plan must be set out so as to correspond to every movement of the cargo and containers, in close and up-to-date communication with the shipping lines, shippers/consignees and forwarders. The information must flow instantly to each division of the terminal and the outcome must be fed back to parties concerned

so that the smooth flow of containers is ensured. Appendix 6 and Appendix 7 show establishing documentation for export and import respectively.

3.8 Maintenance

The main feature of the container terminal is to transfer voluminous cargo efficiently by means of a rapid and accurate handling system, employing all the modernized handling equipment. In order to operate these machines without failures, regular maintenance is indispensable. For this purpose, it is common to most terminals that a maintenance shop is set up within the terminal and machines are maintained to a specified standard by experts.

A mechanized container terminal can not carry out its operation without proper maintenance of machinery it employs, since an accident to one type of handling equipment in the entire terminal operation system may well stop the flow of all containers.

Cranes such as gantry cranes or transtainers must satisfy the voluntary periodic inspection every year and the performance inspection every two years, in accordance with the safety regulations and attended by official inspectors. Specialized large pieces of handling equipment such as straddle carriers or fork-lifts are also subject to the voluntary periodic inspection every year, similar to cranes. In addition, the filing inspection records are required. However, even in a mechanized, computerized container terminal, automation or unification of maintenance jobs are difficult to achieve, much depending on actual experience, and each terminal may establish its own standards and perform maintenance according to them. It is possible to divide the different approaches to maintenance into three broad categories of policy options:

3.8.1 Preventive maintenance

It is based on routine inspection of equipment at prescribed intervals or at set times, designed to take action before failure occurs.

3.8.2 Corrective maintenance

This involves the carrying out of repairs when equipment has failed - a policy of repair after failure.

3.8.3 Designing-out maintenance

This policy is a long- term policy which attempts to eliminate (generally through a succession of small improvements) the need for maintenance.

3.9 Analysis of terminal operating performance

It is difficult to obtain detailed data on the performance of container terminals in developed countries, including such information as output per hour and ship time in port, worked hour/service hour ratio. This information is either not available from the port authority because the terminal operation is done by private operators, or is not suitable for publication, for such data might have a negative influence on a port's competitive position. However, some organizations such as UNCTAD secretariat were able to obtain certain information of leading container terminals of the world. A number of comments can be made as follows:

3.9.1 Output

Average gross productivity per hour per vessel varies from one terminal to another. It is remarkable that speed in boxes per hour per ship varies between 10-50 and 30 is an average for a good port. In container feeder services, the load factor of feeder vessels is normally very high, approaching unit. At the ports serviced only by feeder vessels, however, handling rates although much higher than with the traditional break bulk operation - will be lower than at the pivot or gateway specialized terminal. A typical figure of 15 units per hour may be achieved for a feeder ship.

3.9.2 Worked hour/Service hour ratio

The ratios vary between a peak of 95 percent and a low of 40 percent, but an improvement on the figure of 70-85 percent must surely be possible.

3.9.3 Berth occupancy ratio

Experience confirms that when berth occupancy of a single container berth exceeds 50 percent, it can be considered an upper limit to berth occupancy of a single container berth. Once traffic develops to the point at which further berths are essential, the permitted berth occupancy can gradually be increased. At present, as far as the liner services are concerned, this can be simplified by using the following table:

Table 8: Maximum berth occupancy ratio

Number of berths	Max. occupancy ratio
1	30%
2	50%
3	60%
4	66%
5	70%
6	74%
7	77%
8	78%

Source: UNCTAD

As a maximum occupancy ratio the rate resulting in a 10 percent of waiting time/service time ratio has been considered.

3.9.4 Number of TEUs/Terminal area

The average number of TEUs per terminal area in sq.m. seems to vary between 0.53 and 2.1.

3.9.5 *Vehicle turn-round time*

Average vehicle turn-round time in the terminal when receiving/delivering containers, for an efficient port should lie between about 20-30 minutes.

3.9.6 *Terminal cargo handling charge*

On a world wide basis, the total terminal cargo handling charge per TEU is about 136.8 USD on average.

3.10 **Pilotage and mooring time**

Obviously, this will vary for each port depending on interalia the length of pilotage, tide, current, and weather. Table 9 shows the pilotage times for large powerful vessels arriving and leaving eighteen randomly selected ports on the world's major trade routes, and of these pilotage movement, more than 80 percent were under four hours.

Table 9: Pilotage and mooring time

Pilotage time (hrs)	Number of ports
0	0
0.5	4
1	5
2	2
3	2
4	2
5	1
8	1
22	1

Source: Sea Transport, 1995

3.11 Port congestion

Port congestion arises when port capacity is insufficient to cope with the traffic arriving at the port. BIMCO summarized the ten major causes of congestion as follows:

3.11.1 Planning

- Insufficient back-up areas, port access and operating capacities such as cargo handling equipment, trained manpower, storage areas.
- Inadequate inland transport system, both in capacity and efficiency, In relation to trucks, wagons, highways and port access routes.
- Expected capacity is not available on time due to late completion of development project.
- Failure to keep traffic forecasts updated.
- Failure of port management and planning to make adequate plans in time for port developments.
- Inflexibility in development plans to allow later changes.
- Low appeal of port and shipping problems in the public mind.
- Political and social interference which bear on the decision making process.

3.11.2 Management

- Lack of continuity in senior port management positions.
- Senior port management chosen without regard for the qualifications required.
- Inadequate training for the staff such as the middle management and operating levels.
- Lack of direct authority of management to effect remedial actions.

3.11.3 Labour

- Poor labour relations.
- Problems caused by too much or too little labour.
- Insufficient deployment of labour.
- Failure to adapt working practice to local circumstances.
- Lack of training of dockworkers especially in the use of sophisticated equipment.

3.11.4 Co-ordination

- Lack of co-ordination between different private and governmental organization working in the port area.
- Inadequate consultation between the port authority and users.

3.11.5 Traffic

- Irregular traffic due to erratic import and export policies.
- Short-term traffic variations due to unrationalized shipping schedules.
- Too many ships operating on certain routes making insufficient use of berths.
- Insufficient distribution of cargo between hatches thus preventing intensive working of the ship.
- Inefficiency of loading/discharging.
- Unsuitable forms of packaging and cargo presentation.
- Consignees without adequate financial resources or physical facilities to take cargo.
- Ships spending longer time than necessary at berth.

3.11.6 Operation

- Inappropriate policies which lead to transit facilities being used for long-term storage where place is inadequate.
- Lack of inland and port facilities such as storage area, causing cargo having to remain too long in the port.
- Lack of reserve capacity.
- Pilferage and smuggling resulting in tight controls which lead to inefficient movement of cargo.
- Lack of finance for modern handling equipment.
- Inefficient mix of handling equipment.

3.11.7 Maintenance

Inadequate maintenance policies which result in a high proportion of equipment being out of service due to:

- Absence of preventive and running maintenance.
- Lack of qualified maintenance personnel.
- Lack of adequate stocks of spare parts.
- Insufficient standardization of equipment types.

3.11.8 Clearance procedures and documentation

- Late arriving documents.
- Faulty documents.
- Outmoded documentation requirements and processing methods.
- Outmoded clearance facilities for vessel and cargo.

3.11.9 *Dynamic effects*

- Change in ship types, leading to temporary inefficiency.
- Teething troubles with new cargo handling methods.
- Emergency diversion and transshipment of cargo destined for another port which can bring temporary peak in quantities of cargoes.
- Period of exceptionally bad weather.

3.11.10 *Function and location of the port*

- Impossibility to improve back-up land area.
- Some activities are not related directly to cargo handling, which may conflict with higher port throughput. (For instance, customs controls, inspection procedures).
- Traffic of landlocked countries may cause difficulties.
- Ports may be serving a regional trade and traffic may be dislocated by decision of neighboring countries.

3.12 Information system

At present, the increasing use of computers in the port industry will contribute towards greater efficiency and profitability by facilitating the optimum use of available resources. There are, however, cases where efficient manual systems have been successfully used for much larger throughputs. The manual system serves manually to assist the terminal operator in the control of all terminal operations. The computer-assisted system is used to process invoices, gather statistic data and to present the container operators with detailed information. All departments likely to use the computer should be consulted to ensure that any scheme ultimately adopted contains the data. Scope should also be provided for future development. In the port industry computers can be used in the following fields:

3.12.1 Stores control

By recording in the computer details of store in stock.

3.12.2 Personnel record

Details of all the port authority labour force can be recorded.

3.12.3 Wage bills

Staff salaries including national insurance contribution, overtime, productivity bonuses, pension contributions and tax deductions can be calculated by the computer.

3.12.4 Container control

The use of computers to record containers entering and leaving the port, enables the container movement to be monitored. It also enables shippers seeking the warehouse of the container to enquire through the port authority computer system.

3.12.5 Preparation of bills

The Port authority can bill their customers at regular intervals with the aid of a computer thereby ensuring prompt dispatch, automatically reminding late payers, and identifying potential bad debts.

3.12.6 Berth allocation

Formulation of allocation of berths/slots schedules for ship owners.

3.12.7 Documentation

Port documents can be electronically produced for dispatch to the client.

3.12.8 Customs clearance

This enables the imported cargo details to be fed into the computer by the shipper/agent for presentation to Customs for clearance.

3.12.9 Cargo manifest

Many shipowners send the cargo manifest details to the destination port by using computer, for instance, details of ship, ETA, cargo specification details, container number, name of consignee/consignor, and so on. Then, the ship's agent receiving such details can plan adequate port resources accordingly. Furthermore, the agent can inform the importer of the anticipated arrival date of the goods and prepare all the requisite documentation for Customs.

3.12.10 Tariff

Details of all port tariffs and individual client's tariffs are contained on a computer master file.

3.12.11 Management information

Statistical data on the many subjects mentioned above (e.g. staff number, number of sailings, berth utilization, cargo handling cost and productivity, cost analysis, and so on) can be obtained from the computer whenever required and used to generate further information.

3.13 Ports in the future

It will demand higher professional standards in all areas of the business in the next decade. Ports and their infrastructure will feature more in government long-term economic planning and development within the context of international trade development. The growth of containerization of cargo will be increasing. It will, therefore, have a profound effect on all areas of port business. Computerization will

play a very important role in the management and operation of the port, and this can help to improve port efficiency. Dockworkers will be rationalized through cargo mechanization. Customs documentation and the processing/clearance of cargo will tend to become more simple. Furthermore, the expansion of free port/free trade zone will accelerate in non-manufacturing economically based countries. Container Freight Stations (CFS) will continue to reduce port congestion. Moreover, the throughput per berth will increase after modernizing berth layout, operations and facilities. Port traffic control systems are becoming more common thanks to computerization and radar systems. In addition, the tendency to encourage private company such as shipping companies to lease and manage the berth and also cargo handling equipment operations will continue. One of the most important strategies of the ports in the future is port management techniques will continue to be rationalized and modernized. In particular great emphasis will be given to budgetary and marketing controls. Finally, the role of the ports will change to be a part of a link in the transport chain.

3.14 Conclusion

It is obvious that world container trade has risen rapidly and it is expected that the sort of high growth figures will continue as a feature of container trade. With this strong growth rate, more rather than less competition can be expected from container terminal operators. High professional standards are essential if the port industry is to remain viable and foster international trade. The efficiency of port operations and services is very important because the cost of the ships and the goods at ports are determining the major part of the maritime transport chain. Furthermore, the ports are still involved in the control of efficiency, for the survival of the ports in a competitive market is determined by the efficiency. Therefore, the responsibility of the ports are to smooth and free the operations as much as possible (flexibility) and to prepare the future by a good planning (the forecasting and planning). This chapter has explained the requirements of a container terminal system in order to be used as a guideline for Bangkok Port. The next chapter will analyze the compliance of Bangkok Port with the requirements.

Chapter 4

Analysis and comparison of operation and service systems in Bangkok Port container terminals with some local ports and international regime

This chapter will analyze the internal environment of Bangkok Port operation and service systems by comparing with some local ports and international regime. The chapter will be divided into three main parts, i.e. scope of Bangkok Port container terminal operation and service systems which have been implemented, Bangkok Port container terminals operations and services analysis and finally, management and operations in order to realize the problem, strength and weakness of the operation and service systems. Then, proper functional operation and service systems of the Bangkok Port container terminals are expected to be done, and these will be beneficial not only for the port which can have more efficiency and competence but also port users who will have better quality of service at the same time.

4.1. Scope of Bangkok Port container terminal operation and service systems, which have been implemented

Recently, Bangkok Port has implemented new systems of operation and services according to the modernization plan. Furthermore, the efficiency of its operation and service performances has been being improved. The summary of these activities done are the following:

4.1.1 The modernization of Bangkok Port

As Bangkok Port has established a Closed Container Terminal System, introduced closing time so as to make a loading sequence plan at least 3 hours before a ship arrives and increased the stacking capacity of containers at the CY in the east quay, by implementing these, the procedure time of operations and services have been decreased to save total cost. Furthermore, the targets of port performances have been set up as shown in Table 10 below:

Table 10: The targets of port performances set up

Item	Past performance	Present performance	Target
Berthing time (hours)	33	20	16
Gang output (TEUs)	18	26	30
Berth occupancy ratio (%)	80	56	65

Source: Port Authority of Thailand

4.1.2 Export container services

- Allowing the companies to keep more number of empty containers being stuffed for exporting within the port area to 15 percent.
- Providing more area for stuffing cargo into empty containers for exporting to 30 percent.
- Allowing customers to stuff all kinds of cargoes within the port area except dangerous goods, frozen cargo and the cargo, which is not packed properly.
- Adopting transport liberalization policies by awarding 18 truck operators to competitively operate at Bangkok Port since July 1, 1997 to enable to reduce transportation cost and save time.

4.1.3 *Reduce the process of services and documentation*

- Documents can be checked after paying the tariffs.
- Implementing port tariff charges payment through e-mail.
- Introduce One Stop Service system at shed no. 14 and this system will be implemented completely at new headquarters by the end of 2000 or early of 2001
- FCL containers can be checked by Customs at the terminal instead of doing so at the warehouse.
- Setting up the time that export containers have to be at the terminal in order to reduce loading time.

4.1.4 *Implementation in computer system*

- Implementation in computers into seven systems of operations and services such as container control system, ship services and some support systems. It is expected that the computer system will be applied to most of the area of operations and services by the end of Year 2000.
- Introducing the Electronic Data Interchange (EDI) system.
- Intranet and Internet have been implemented.

4.1.5 *Flexibility and exception of tariffs at Bangkok Port*

- Port dues will not be charged to less than 750 GRT ships.
- Port dues for all ships except tankers and conventional cargo ships which access the Bangkok Port bar channel more than 10 times a month will be collected with 50 percent discount from the 11th afterward.
- Containers which are transported by using inland waterways and being loaded/unloaded at Bangkok Port will be charged at 50 percent of the normal fee of cargo handling charge.

4.1.6 Marketing promotion

The budget was provided for marketing promotion about 0.5 - 0.8 USD annually, yet it was spent mainly on advertising via media.

4.1.7 Help Desk

The Help Desk should be able to handle all complaints, provide preliminary assistance to the customers and pass on those problems to other agencies concerned for further action.

4.2 Analysis of operations and services in Bangkok Port Container terminals

According to the clients they are constantly searching for those ports where they are offered the best price and quality of services. Thus, commercial port strategy should be considered by implementing an overall quality of operation and service management.

4.2.1 Ship operations and services

It is clear that in terms of ship services productivity, Bangkok Port has great potentiality to be improved further as follows:

- **Ship berthing time**

The average of ship berthing time of container vessels is 20.19 hours/ship call while the target is 16 hours/ship call. The performance, therefore, is still lower than the target expected. In 1999, there were 1,741 ship calls and 1,113,756 TEUs loaded and unloaded at Bangkok Port, so the average shipload is 639 TEUs/ship call. Meanwhile, at Laem Chabang Port (LCP), the average of ship berthing time was 16.44 hours/call (average shipload is 538 TEUs/ship call) and for private berths

alongside the Chao Phraya River, the average ship berthing time is 18-20 hours/ship call (average shipload is 540 TEUs/ship call).

In order to simplify the comparison, the calculation will be based on LCP standard that the average of one container spent in the port is 3 minutes. Hence, the difference of shiploads between Bangkok Port and LCP and private berths is about 100 TEUs/ship call multiplied by 3 minutes will come up with the time difference (5 hours). By this calculation, the ship berthing time at LCP will be about 21.44 hours/ship call and 23-25 hours/ship call for private berths. Compared with the performance at Bangkok Port, it is obvious that there is not much difference in ship berthing time among them. However, LCP has some advantages, for it is a deep seaport and does not have obstacle in the channels i.e., tidal streams.

In addition, the shipping lines/agents are often forced to do costly direct loading of containers onto ships from the open yard at the west quay or off-dock CYs outside the port. When conducting the direct loading, traffic jams in and around the port cause unpredictability of box' arrivals to ship. Even in the port, it sometimes takes a long time to get from the west quay to the east quay.

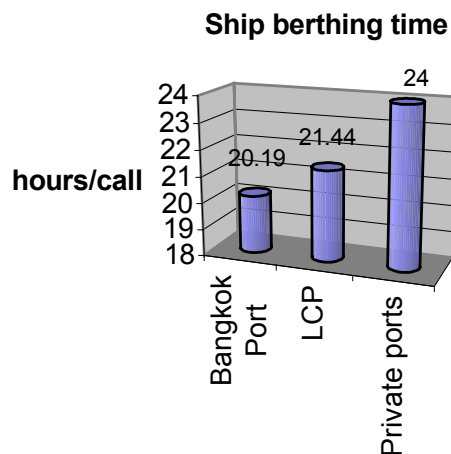


Figure 10: Ship berthing time at Bangkok Port, LCP and private ports
Source: Port Authority of Thailand

Furthermore, the direct loading, and long hauls of outbound boxes once stacked within the CY from stacking places to dockside are often found due to lack of proper yard planning. Thus, the actual gross container handling productivity per crane is small, with the result that costly container ships are forced to berth there for a long period.

- **Berth occupancy**

Berth occupancy ratios of the berths at container terminals is 55.88 percent while the target expected is 65 percent. Judging from the low value of the average berth occupancy ratios of 55.88 percent, the east quay seems to have been less utilized. The main reason is the policy not to allow ships with more than 50 TEUs/call to call at the west quay. This causes combo ships, which carry both conventional cargo, and containers to have to load/discharge cargo at both the east quay (container terminals) and the west quay (conventional cargo terminal) and spend more money and time. As a result, the ship owners have changed their routes to cheaper ports.

Table11: Ship operation and service performances

Items	Performance				
	Unit	1996	1997	1998	1999
Ship waiting time	hours/call	4.25	4.44	2.37	2.52
Ship berthing time	hours/call	32.14	24.54	22.1	20.19
Ship worked time	hours/call	22.48	19.15	17.49	14.28
Berth occupancy	%	79.91	63.53	60.06	55.38
Waiting time/Berthing time ratio	%	13.22	18.09	10.72	12.48
Worked time/Berthing time ratio	%	69.94	78.04	79.14	70.73

Source: Port Authority of Thailand

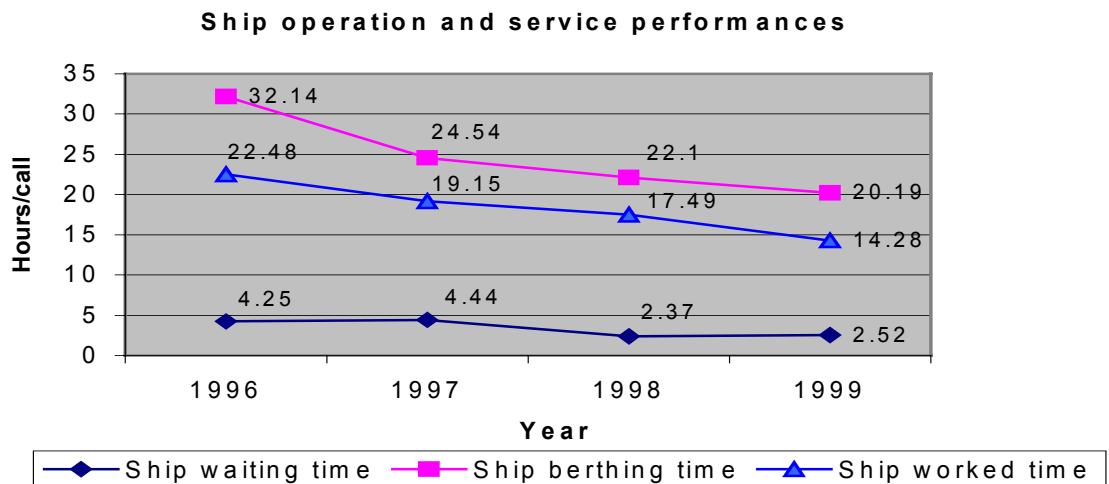


Figure 11: Ship operation and service performances
 Source: Port Authority of Thailand

From Table 11, in 1999, the waiting time ratio (waiting time/berthing time) was about 12 percent (the total number of ship calls are 2,175), and this is a little bit higher than the international standard level, i.e. 10 percent for container terminal. If worked time/berthing time ratio is considered, it is clear that the ratio of about 71 percent is still low. However, from Figure 11, obviously, Bangkok Port has improved its performance a great deal.

4.2.2 Cargo operations and services

- **Flow of import containers**

Containers are discharged at container terminals at the east quay as mentioned previously. After being discharged, containers are handled according to the respective container status in the sense of PAT's tariff definition as follows:

➤ FCL containers

After being discharged from the vessels, import FCL containers are stacked on the CY at the east quay. Presently, free rent for import container storage is 3 days, and therefore, most import containers are brought out within the free days from the premises of Bangkok Port to consignees' premises or ICDs in bonded condition.

➤ LCL containers except for direct delivery

After being discharged, LCL containers are transferred to CFSs or sheds to be unstuffed, stored, cleared and delivered to consignees. Average dwell time of import LCL cargoes is about 3 days.

➤ LCL direct delivery

After being discharged, LCL direct delivery containers are hauled to the designated open yards surrounding CFS or sheds, and then, stored, cleared, unstuffed and directly delivered to consignees without being stored in loose cargoes inside sheds.

● **Flow of export containers**

Containers are handled according to the respective container status in the sense of PAT's tariff definition as follow:

➤ FCL containers

Presently, around 72 percent of the total export containers are FCL containers. Most of them are stuffed at off-dock CFS or ICD, and then moved to the CY to be loaded into the vessels. According to the existing tariff, free rent for export containers storage is 3 days and therefore, most of them are stored within the free rent period.

- LCL except for direct delivery

Presently, around 27 percent of the total export containers are LCL containers. They are stuffed at the open stuffing yard because the CFS for export container has not been provided yet. Then LCL containers are hauled to and loaded onto the vessels being stacked on the CY at the east quay for about three hours (pre-loaded) before ship sailing, namely by so-called direct loading. As export LCL containers have to be consolidated at the open stuffing area. This causes certain damage to goods, for instance, electronic goods is damaged by being mixed with agricultural products.

Table12 : Percentage of containers in terms of container status defined by PAT's tariff

Year	Import container (TEUs)				Export container (TEUs)				Total TEUs
	Empty	LCL	FCL	Reefer	Empty	LCL	FCL	Reefer	
1996	101,518	169,206	341,571	16,552	21,426	188,872	456,122	50,244	1,345,511
%	8	13	25	1	2	14	34	4	100
1997	107,636	149,112	290,918	0	14,629	130,725	405,985	0	1,099,005
%	10	14	26	0	1	12	37	0	100
1998	225,758	92,102	213,833	0	4,777	158,759	418,527	0	1,113,756
%	20	8	19	0	0.4	14	38	0	100

Source: Port Authority of Thailand

- **Flow of empty containers**

Presently, the import empty containers are about 20 percent of the total container throughputs. Once they are discharged, they are transferred to the empty container yard without being stacking in the CY. On the other hand, the empty containers for

The average distribution of import – export containers during 1996-1998

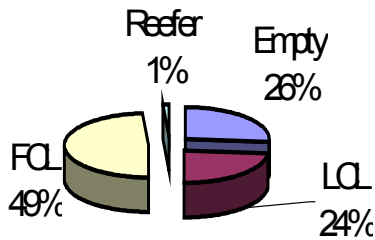


Figure 12: The average distribution of import containers
Source: Port Authority of Thailand

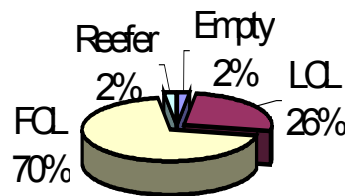


Figure 13: The average distribution of export containers
Source: Port Authority of Thailand

export is about 0.4 percent of the total container throughputs, and they are stacked in the CY before being loaded onto the vessels.

- **Container handling productivity**

Containers are discharged or loaded by container gantry cranes installed on the apron. The average of gross container handling productivity per vessel is 19.44 boxes/crane/hour. It is obvious that the container handling productivity at Bangkok Port container terminals is low compared with LCP, local private ports and some European ports which have the average of about 26, 25 and 25-30 boxes/crane/hour respectively.

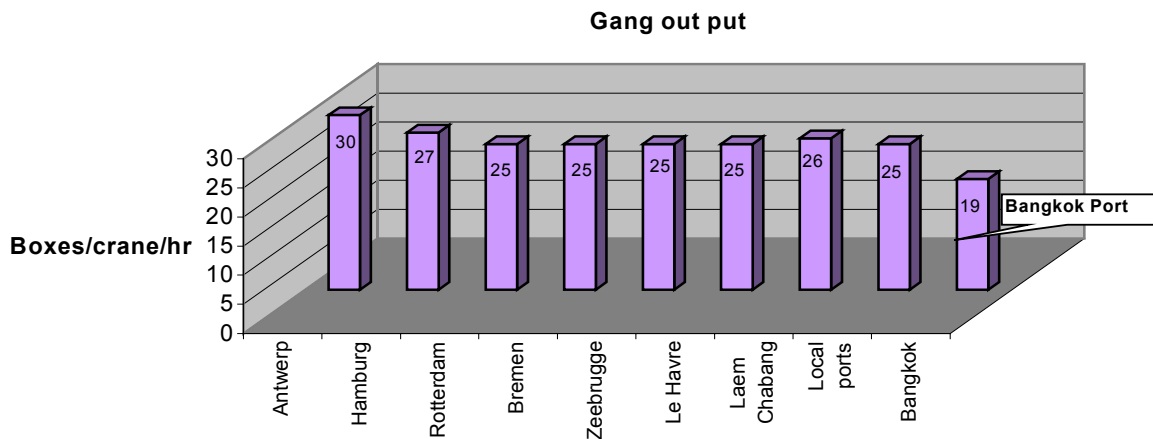


Figure 14: Cargo handling productivity of Bangkok Port compared with other ports

Source: Port Authority of Thailand and Port of Arhus, Denmark

Obviously, Bangkok Port still has some distances from them. Although Bangkok Port has been improving its performance from 17 boxes/crane/hour in the year 1998 up to about 19 boxes/crane/hour in 1999, it has to be improved in year order to compete with some local ports and to increase the productivity to the international standard level. One of the main reasons for Bangkok Port container terminals being insufficient is lack of efficient labour including a port traffic plan.

- Operating cost per ton of cargo

Approximately, the operating costs (shiphandling, cargo handling, service and administration) per ton of cargo at Bangkok Port container terminals are about 210 Baht/ton (6 USD/ton) while at LCP the average operating costs per ton of cargo are about 124 Baht/ton (3.5 USD/ton). Obviously, the customers will pay higher costs at Bangkok Port compared with LCP.

4.2.3 Cargo handling equipment

Presently, as to the vessel side operations, it seems that containers are handled under fairly good conditions. It is possible to cater for eight vessels simultaneously, provided the container gantry cranes are kept in good conditions by being maintained.

On the other hand, as to the land side operations, it seems that containers are handled in poor conditions: some full or empty containers are stacked roughly, and various kinds of machines run disorderly on narrow roads in the yard, causing serious traffic congestion even within the yard.

Open yards at the west quay are used for stuffing export container cargoes. Within the yard, a lot of heavy machines such as cranes, top loaders, top lifters, tractor-chassis units and ordinary trucks move disorderly on the narrow roads inside the yards, stack up many empty containers above empty containers during stuffing operations, all of which cause chaotic conditions.

- **Main container handling equipment**

- **Rail Mounted Gantry Crane (RMG)**

At present, 14 units of Rail Mounted Gantry cranes (RTG) are installed on the dockside of the east quay. Gross container handling productivity seems to be a little poor, whereas the net productivity is estimated at least in the range of 20-25 boxes/crane/hour. The poor achievement seems to be induced by long waiting times for tractor-chassis units on the dockside due to the congestion of the CY.

As for the dimensions of the existing cranes, judging from the principal dimensions of container vessels which actually call at Bangkok Port and actual stevedoring operations on the dock side, in some cases, the crane dimension seems to be a little bit short as follows:

- Out reach (26 M) is a little bit short in the following cases. When a wide vessel with ten rows of containers on deck (maximum number of row among the vessels calling actually at Bangkok Port) berths, the outreach of the cranes is too short to lift most outside containers.
- Rail gauge (15 M) is a little bit narrow, which poses a problem for the passage of tractor chassis units. When many vessels berth and handle containers at the same time, there are only four lanes that can be arranged between the crane legs for tractor chassis units. Hence, it is necessary to keep other lanes at the back reach of the cranes.
- Lifting height (20.5 M) is a little bit low in the following case. When a tall vessel with five high containers on deck (the maximum among the vessels calling actually at Bangkok Port) berths, the lifting height of the existing cranes is too short to lift containers of the top layer.

However, the existing number of RMGs is sufficient for good operation according to the calculation based on the capacity of container handled at Bangkok Port container terminals, which is shown below:

$$\begin{aligned}
 \text{The number of RMGs required} &= \frac{\text{Number of container movements per year}}{\text{Hourly productivity (moves/hr) X Hour day worked X No. of days per year X Max. berth utilization}} \\
 &= \frac{720,000 \text{ boxes/year (1.0 mill. TEUs/year)}}{19 \text{ boxes/crane/hr X 24 hr X 365 days X 0.65}} \\
 &= 7 \text{ units}
 \end{aligned}$$

It is obvious that the existing number of RMGs is still sufficient.

- Rubber Tired Gantry Crane (RTG)

Almost all RTGs are used up to full capacity. As is well know, shifting within the same lane for RTGs does not take much time. On the contrary, the shifting between different lanes takes longer than the former case. These causes tractor chassis units have to wait for RTGs in the CY.

- **The performance of container handling equipment**

Table13: Equipment availability and utilization of the year 1999

Equipment	Unit	Availability	Utilization
RMG	%	86.00	51.65
RTG	%	84.94	60.00
Mobile crane	%	78.31	23.97
Top loader	%	59.81	38.74
Forklift truck for hiring	%	88.53	26.53
Forklift truck for services	%	77.34	59.40
Tractor chassis	%	72.08	46.49

Source: Port Authority of Thailand

From Table13, it is obvious that some equipment has low availability, for instance, mobile cranes, top loader, forklifts and tractors. One of the main causes is the long time the equipment spends under breakdown maintenance. Moreover, the long delay in obtaining spare parts is one of the reasons. The utilization of fork lift trucks and tractors for chassis are considered to be low with the figures of about 26.53 and 46.49 percent respectively.

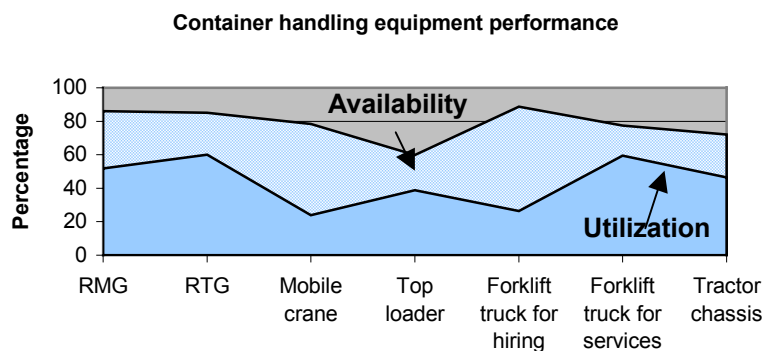


Figure 15: Equipment availability and utilization of the year 1999
Source: Port Authority of Thailand

However, RMGs, RTGs, mobile cranes and top loaders are considered as very essential to the port, as they could have an average utilization of 20 percent and this could be acceptable. If compared with the last three years, the utilization of equipment is lower. This was caused by the economic crisis in Thailand. The container throughput has been decreasing, and as a result, the demand for container handling equipment is low in spite of the high availability ratio.

- **The number of container handling equipment required**

The number of equipment required will be calculated according to 1.0 million TEUs/year of containers handled at Bangkok Port and the average of equipment availability during the period 1996-1999.

- **Toplifters used in the empty container yard**

The typical operation of the toplifter is for receiving empty containers from the marshalling yard, import CFS or outside the port and delivery of empty containers to the marshalling yard, export CFS or outside the port.

Number of empty containers received from outside the yard (Peaking factor: 1.6)	1,452	boxes/day
Number of empty containers delivered to outside the yard (peaking factor: 1.6)	1,325	boxes/day
Daily working hours	16.5	hours
Gross cargo handling productivity	20	boxes/hr
Average availability	67%	
Percentage of dug containers	10%	
Average handling time for dug containers	9	times

$$\text{The number of toplifters required} = \frac{((1,452+1,325) \times 0.9) + ((1,452+1,325) \times 0.1 \times 9)}{16.5 \times 20 \times 0.67}$$

$$= \mathbf{23 \text{ units}}$$

□ Yard tractor

a) Export CFS (Delivery export LCL containers to the CY)

Number of LCL containers (Peaking factor: 2.7)	746	boxes/day
Daily working hours	16.5	hours
Number of container boxes hauled	2.3	boxes/hr/unit
Average availability	76	%
The number of yard tractors required	=	$\frac{746}{16.5 \times 2.3 \times 0.76}$
	=	<u>26</u> units

b) Import CFS (Receiving import LCL containers from the marshalling yard)

Number of LCL containers (Peaking factor: 2.3)	544	boxes/day
Daily working working hours	16.5	hours
Number of container boxes hauled	2.3	boxes/hr/unit
Average availability	76	%
The number of yard tractors required	=	$\frac{544}{16.5 \times 2.3 \times 0.76}$
	=	<u>19</u> units

c) At dock side

Total cycle time of the operation	10	minutes
Cycle time of a gantry crane	3	minutes
Average availability	76	%
Number of gantry cranes	14	units
The number of yard tractors required	=	$\frac{4 \times 10}{3 \times 0.76}$
	=	<u>62</u> units
Therefore, the total number of yard tractors required		107 units

□ Container chassis

a) Export CFS (Delivery of export LCL containers to the CY)

Number of LCL containers		746	boxes/day
Total cycle time of the operation		116	minutes
Number of container boxes hauled		0.52	boxes/hr/unit
Average availability		76	%
The number of chassis required	=	$\frac{746}{16.5 \times 0.52 \times 0.76}$	
	=	<u>114</u>	units

b) Import CFS (Receiving import LCL containers from the marshalling yard)

Number of LCL containers		544	boxes/day
The number of chassis required	=	$\frac{544}{16.5 \times 0.52 \times 0.76}$	
	=	<u>83</u>	units

c) At dock side

The number of chassis required	=	<u>72</u>	units
(Same as tractors plus 10 units for damaged or over-size container)			
Therefore, the total number of chassis required	=	269	units

□ Forklift

a) Export CFS

Number of export LCL containers (Peaking factor: 2.7)		746	boxes/day
Unit weight		12.5	tons/TEU
Daily working hours		16.5	hours
Cargo handling productivity		14	tons/hr

Average availability		76 %
Percentage of forklift's use (Stuffing by forklift)		70 %
The number of forklifts required	=	$\frac{12,950 \times 0.70}{16.5 \times 14 \times 0.76}$
	=	<u>103</u> units

b) Import CFS

Number of import LCL containers		544 boxes/day
Unit weight		10.8 tons/TEU
Cargo handling productivity		14 tons/hr
Average availability		76 %
Percentage of forklift's use		70 %
The number of forklifts required	=	$\frac{8,165 \times 0.70 \times 2}{16.5 \times 14 \times 0.76}$
	=	<u>65</u> units
Therefore, the total number of forklifts required	=	168 units

□ Rubber Tired Gantry Crane (RTG)

Number of container received or delivered (Peaking factor: 2)

Export FCL containers	1,499	boxes/day
Import FCL containers	750	boxes/day
Export LCL containers	552	boxes/day
Export empty containers	16	boxes/day
Total containers	2,817	boxes/day
Daily working hours	24	hours
Average cargo handling productivity (present condition)	20	boxes/hr
Average availability	91 %	
Percentage of dug containers when being lifted	50 %	

Average handling time when container being digged 2 times

The number of RTG required = $\frac{(2,817 \times 0.5) + ((2,817 \times 0.5) \times 2)}{24 \times 20 \times 0.91}$

= 10 units

1.5 RTGs required per a dock side crane 1.5 X 14 cranes = 21 units

Therefore, the total number of RTGs required = **31 units**

A comparison of the number of required and existing container handling equipment is summarized in Figure 16 below.

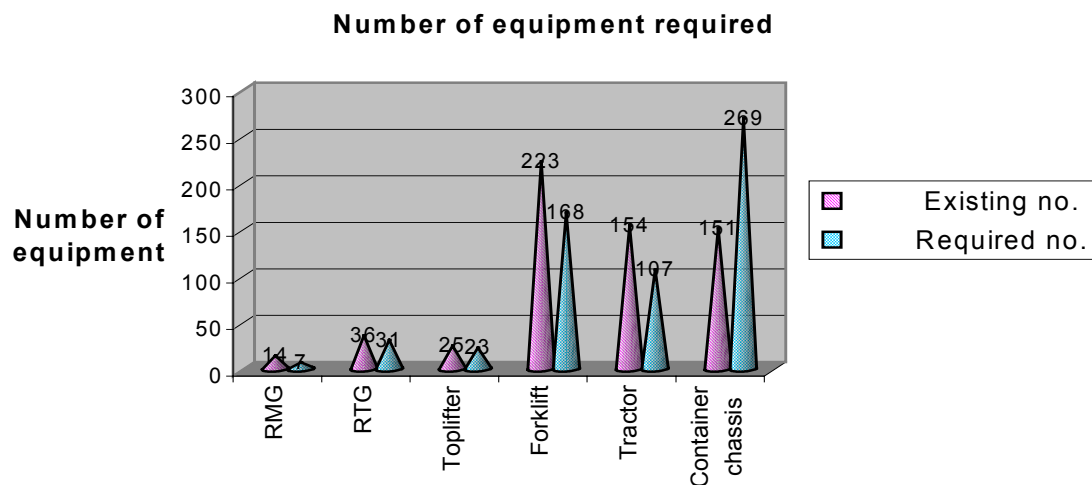


Figure 16: The number of container handling equipment required
Source: Port Authority of Thailand

It is obvious that the existing number of container handling equipment is still sufficient except container chassis, which Bangkok Port has to purchase for better operations and services.

4.2.4 Storage operations

Twenty Foot Ground Slots (TGS) required for stacking container in the CY are computed based on the maximum capacity of container handled at Bangkok Port and also based on the container handling system operating (yard crane system).

$$\text{TGS} = \frac{\text{TEUs} \times \text{Dwell time} \times \text{Peaking factor} \times \text{Separation factor}}{\text{Number of working days per year} \times \text{Stacking factor}}$$

Number of containers handled	1,000,000	TEUs
Containers stacked in the CY:		
Export FCL containers (38 % of the total throughputs)	380,000	TEUs
Import FCL containers (19 % of the total throughputs)	190,000	TEUs
Export LCL containers (14% of the total throughputs)	140,000	TEUs
Export empty containers (0.4 % of the total throughputs)	<u>4,000</u>	TEUs
Total containers stacked in the CY	<u>714,000</u>	TEUs
Average dwell time of export empty and FCL containers	3.5	Days
Average dwell time for import FCL containers	4	Days
Average dwell time for export LCL containers	1	Day
Peaking factor	1.3	
Separation factor	1.25	
Number of working days per year	365	Days
Average stacking factor for import containers	2.5	High
Average stacking factor for export containers	3.5	High
Therefore,		
FCL export required	1,692	TGS
FCL import required	1,353	TGS
LCL export required	178	TGS
Empty export required	<u>18</u>	TGS
Total TGS required for the CY	<u>3,241</u>	TGS

Compared with the existing capacity ground slots at Bangkok Port container terminals, the stacking area which has 4,590 ground slots is still sufficient.

However, presently many containers are stacked on the back reach space of the gantry cranes of the apron. Those containers are handled by toplifters. Such stacking conditions cause traffic congestion on the apron. At most international container terminals, the reach space of the gantry crane is generally used for tractor passage or miscellaneous space. Sometimes such back reach space is used for emergency cases. Hence, the back reach space of gantry cranes should be kept for such cases without stacking any containers.

Apart from the above mentioned, traffic congestion and subsequent dangerous conditions could happen caused by following factors:

- Many heavy machines such as toplifters, top loaders, forklifts are in operation together with RTGs in the CY.
- Many people belonging to shipping agents and private companies for various kinds of operations such as stevedoring and stuffing/unstuffing are working on ground of the CY together with the heavy machines, whereas, in ordinary international container terminals, it is strictly prohibited for people to enter the CY without permission of a control center in view of security and safety of people and efficient operations.
- RTGs are not repaired or maintained at a repair shop specialized for the RTGs, but at the places where RTGs are usually in operation, a fact which also causes a dangerous situation both for mechanics repairing/maintaining the RTGs and other mobile machines.
- As is well known, the strength of an ordinary container is defined in the condition of being supported by four corner fittings made of strong materials. At Bangkok Port, however, many containers are found to be stacked and supported by upper or lower beams outside of the strong corner fittings.

Sometimes two 20' containers are stacked on top of a 40' container, and that causes some damage to the upper beam of the 40' container.

- Some containers are lifted up by using forklifts without inserting their forks to the right positions, namely fork pockets of containers, which also causes some damages to the lower beams of the container boxes.
- Many empty containers are found to be stacked at the reefer container yard along the Customs fence. Such empty containers are stacked on or between reefer containers, and therefore, sometimes disturb normal checking or maintenance of reefer containers. At some places in the reefer container yard, drainage conditions are poor, especially in the rainy season, and this possibly causes some electric trouble for the reefer containers.
- At the open yard for empty containers, they are stacked disorderly; the passages for heavy mobile machines are not controlled suitably; various kinds of machines work and pass on very narrow and curved passages, causing serious traffic congestion within the yard.
- At some places of the open yard, many dented and scraped spots are found at the pavement surface. Such bad ground conditions possibly induce not only spoilage of smooth cargo operations but also damages to containers. Moreover, in the rainy season, water pools made at the above spots evidently cause cargo damages.

4.3 Management and operations

In principle, the following three points are commonly required for port management and operations around the world, i.e. efficiency, provision of services at reasonable charges and reliability and safety.

Presently, in PAT, a system for employees to work hard and to improve their own skills according to the advancement of technology does not seem to function well. As shown

in Chapter 4, at Bangkok Port container terminals, there is much room for improvement in container handling such as berthing time and occupancy ratio. No matter how great the plan may be, it can not succeed if employees do not learn the new system and work hard with strong incentives.

At present, the number of personnel of Bangkok Port is about 5,000 and almost half of them are working in the area of serving customers directly. The problems from personnel impact on the efficiency of operations and services can be analyzed as follows:

4.3.1 *Container handling equipment drivers are old*

The equipment drivers are a little bit old, for example, more than half of the RMGs drivers are 45-58 years of age. Therefore, some of them are not very healthy, energetic and able to manage container handling accurately. As a result, the service time (berthing time), transit time between quay apron and the CY or CFS and total cost are high. Furthermore, the movement of containers is not efficient.

4.3.2 *Lack of knowledge and skills in the new operational systems*

Accordingly Bangkok Port has implemented a new system of operations and services by using a computer system to control and manage container terminals. Some of the Bangkok Port staff are not familiar with this system and some of them have no experience or know-how enough. As a result, the system has not been much utilized.

4.3.3 *Lack of service mind*

Many staff of Bangkok Port who are working in the field of service and dealing directly with the customers still lack service mind. This causes delay and inefficiency in operations and services. Some of them are dishonest especially through accepting

bribes. However, Bangkok Port has been solving these problems seriously by implementing the policy of transparency of all operation and service procedures. Nowadays, the situation is getting much better than before.

4.3.4 *Insufficient security*

Security matters is one of PAT's problems. Nowadays security checks at the gate are insufficient, so that many people who are not related to port operations can go in and out of the port area at will. This causes many accidents, crimes and smuggling of cargo. One reason is that many office buildings for PAT personnel whose duties are not directly related to the operational areas are located within the operational areas. As a result, a lot of cars, and neighbouring inhabitants are able to freely go in and out of the gate.

Therefore, it is recommended that PAT personnel be considered, and it is important for top managers to make quick and effective decisions.

4.4 Conclusion

From the analysis mentioned above, although Bangkok Port is a big and well known river port, located near production sites and customers, good domestic communication and transportation network and more modern in terms of cargo handling equipment and facilities compared with other local ports, presently, it is clear that there are some deficiencies in operations and services which have to be solved especially in the area of ship operations, cargo operations and services and manpower compared with some local ports and international ports. The recommendations for solving these problems and improving the efficiency of operational and service systems in Bangkok Port container terminals, therefore, have to be made in the next chapter.

Chapter 5

Recommendations

In accordance with the analysis in the previous chapter, although presently the Port Authority of Thailand has implemented the modernization project of Bangkok Port by introducing a Closed Container Terminal System, which is controlled by a terminal operator responsible for receipt, storage and delivery of containers at the terminal by conducting yard planning and inventory control of containers, it is obvious that Bangkok Port still has some problems with its operations and services. This needs to be solved.

Hence, in order not only to increase the efficiency of operations, service systems and competitiveness at Bangkok Port but also to achieve economical, efficient, safe and reliable operations and services to port users, it is recommended that Bangkok Port take some necessary actions and introduce some solutions in order to achieve the above mentioned targets by doing the following:

5.1 Ship operations and services

Obviously, the productivity of ship services in Bangkok Port is still low compared with some local ports, modern ports and international ports. It is recommended that the following be improved:

5.1.1 Ship berthing time

According to the lack of proper yard and traffic planning, the actual gross container handling productivity is small. As a result, container ships have to berth for a long period. Berthing time for container vessels is expected to be reduced remarkably

from the present level (20 hours/call) to at least 16 hours/call on average, generating benefits from the savings of ship staying cost. Therefore, it is recommended that Bangkok Port has to have proper yard and traffic planning for the direct loading of long hauls of outbound boxes from stacking places outside the port area to dockside. Moreover, CFSs for export LCL containers must be provided sufficiently close to the CY. Consequently, the actual gross container handling productivity per dockside crane could be increased. As a result, costly container ships are not forced to berth for long periods to load/discharge 639 TEUs on average in 1998.

5.1.2 Berth occupancy

As analyzed in the previous chapter the berth occupancy ratio at Bangkok Port container terminals is about 55.88 percent, and the main reason is fewer ships calling caused by the economic crisis of the country and high berthing cost. In order to encourage the ships to call at Bangkok Port container terminals, it is recommended that the present problems be resolved. Thus, it is necessary to establish the following measures:

- Reducing the berth hire for container ships at their 7th and 8th calling within 30 days at the rate of 10 percent of the normal rate and 20 percent for the 9th call and afterward (normally the maximum number of calls for the same ship within 30 days are seven).
- Reviewing the policy regarding combo ships by allowing combo ships which have shiploads of 100 TEUs or even 200 TEUs per call instead of 50 TEUs per call to berth at the west quay (conventional cargo terminal). This can persuade not only the former customers who has changed their routes to other ports such as Port Klang, Singapore and Hong Kong to come back but also new customers.

5.2 Cargo operations and services

Currently, the efficiency of cargo operations and services at Bangkok Port container terminal is still low due to the low handling productivity, high cost per ton of cargo and some technical problems with the cargo handling equipment. Hence, in order to increase the efficiency of cargo operations and services, it is recommended that Bangkok Port should take actions in the following aspects:

5.2.1 *Improvement of container handling productivity*

In order to increase the productivity of container handling, apart from the recommendations mentioned in 5.1.1, i.e. providing sufficient CFSs for exporting LCLs close to the CY, planning the yard and traffic systems for direct loading of long hauls of outbound boxes from outside. Therefore, it is recommended that the handling productivity target be set up, for instance, 22 boxes/crane/hr, and be assessed monthly. In addition, if the crane driver is not able to achieve that target without any good reasons, he has to be replaced by somebody else.

On the other hand, if he could perform very well such as 23 boxes/crane/hr or even more on average, he should be awarded by receiving some extra money as a prize. This can motivate them to work harder, improve their performances and also keep their positions.

Furthermore, it is proposed to plan for training of container handling equipment drivers in order to replace some of those who constantly have low ability of performance. The performance evaluation of all equipment drivers must be done in order to know the efficiency of them, and if there is something wrong, Bangkok Port should be able to solve the problems on time. As a result, the flow of every operation will be smoother, and the productivity of container handling can be eventually improved.

In terms of equipment, as analyzed in Chapter 4, the shortage of chassis used for receiving/delivery containers between the CY and CFS or empty yard may cause low container handling productivity. It is recommended that Bangkok Port provide the container chassis as required for proper operations.

5.2.2 *Reducing operating cost per ton of cargo*

As analyzed in 4.2.2, the operating cost per ton of cargo at Bangkok Port is higher compared with LCP due to the high cost of ship handling, cargo handling, service and administration. This is one of the main reasons that had an impact on the number of container throughputs and ship calls.

It is recommended that Bangkok Port should implement Just in Time system (JIT), whereby containers or components must be at a destination of operations at the exact time needed in order to maximize the utilization of equipment and manpower. As a result, the movement of vehicles without containers will be decreased, and eventually operating costs will be reduced.

5.3 Storage operations

In storage operations, traffic congestion and subsequent dangerous conditions within Bangkok Port could happen for many reasons, such as insufficiency of the CFS, containers not being stacked properly, as well as people and heavy machines in operation together in the CY. Therefore, it is recommended that the storage operation systems be improved as follows:

5.3.1 *Container handling system*

As mentioned in Chapter 3, there are five representative container handling systems. As to the container handling system adopted at the CY of the east quay the space there is narrow and difficult to be expanded. Therefore, the yard crane system (RTG system falls under yard crane system), taking into consideration

container handling operations at narrow space of the CY of the east quay, enabling safe, clear and noiseless operations. Furthermore, maintenance is easier than that of straddle carriers. Although the yard crane system has a general disadvantage in terms of speedy yard operation compared with the straddle carrier system, it could be overcome by supplying a sufficient number of RTGs.

Thus, the yard crane system is selected as the most appropriate system to be adopted at the CY of the east quay as it is at present. On the other hand, as to the container handling system adopted at the empty container yard of the west quay, toplifters can move empty containers speedily from chassis onto stacking yards or vice versa compared with other systems. In addition, even in the front-end loader system, empty containers can be stacked in blocks like the yard crane system because the percentage of digged empty containers is generally low by being stacked by side, type and shipping line, resulting in space saving. Other advantages of the front-end loader system is that it is much cheaper than other systems including the low cost of paving or repairing yards and flexibility in the layout of ground slots. Thus, the front-end loader system is selected as the optimum system at the empty container yard.

5.3.2 Necessity of land for Container Freight Station (CFS)

To back up container handling operations at the CY of the east quay, it is proposed to rationalize LCL handling operations at the west quay and thereby LCL containers can be delivered to the CY of the east quay swiftly before a closing time from the west quay or be delivered to the west quay from the CY just after the completion of the necessary procedure at the CY.

For that purpose, it is proposed to install new specialized CFS for export LCL containers for stuffing cargoes separately without damaging of cargo by mixing with conventional cargo in the open storage yard. Furthermore, the movement of ordinary trucks from outside to CFS will be separated from the movements of tractor chassis units. The capacity of yard for storing containers can be computed as follows:

The maximum capacity of container throughput	1,300,000	TEUs
Export LCL containers (14% of the total throughput)	182,000	TEUs
Average dwell time for LCL containers at CFS	1	Days
Average stacking factor for export containers	3.5	High
Number of working days per year	365	Days
Peaking factor	1.3	
Separation factor	1.25	
Therefore, CFS for export LCL containers required	= $\frac{182,000 \times 3 \times 1.3 \times 1.25}{365 \times 3.5}$	
	=	695 TGS
The area required (based on front-end loader system)	=	695X 80 sq.m/TGS
	=	55,600 sq.m

5.4 Safety in container handling operations

As mentioned in 4.2.4 of Chapter 4, presently, operational congestion and subsequent dangerous conditions confronting staff, cargo and machines are found at the container yards of both the east and west quays. These dangerous conditions are summarized as follows:

- Intricate movement of many heavy machines such as toplifters and forklifts.
- Many people are working on ground of the CY together with heavy machines.
- RTGs are repaired at the places where RTGs are in operation, creating a dangerous situation both for machines and other mobile machines.
- At the open yards behind and west of the sheds nos.15-17 of the west quay, stuffing operations of export cargoes and stacking operations of empty containers are conducted in mixture, creating a dangerous situation both for the people working on ground and mobile machines within the yards.

The dangerous conditions listed above will be removed by adopting the following countermeasures proposed in this study:

- Preparation of repair areas specialized for RTGs within the CY.
- Preparation of the new export CFS for LCL containers.
- Training of manpower to be familiar with and experienced in the new system of operations and services.

5.5 Introduction of modernized information system using computer

The level of computerization in the container handling operation at Bangkok Port is not so advanced compared with other container terminals in the world. The information processing function of the computer has become indispensable to ensure smooth, accurate and efficient handling of intermodal containerized cargo.

Therefore, it is recommended that the Port Authority of Thailand should study what kind of information should be submitted by shipping companies/agents to PAT for terminal operations, and realign the format of documents under consideration with related bodies. Moreover, it is proposed that PAT upgrade the information system using electronic computers to participate in the computer network system concerning port users and authorities concerned internationally.

5.6 Management and operations

In order to ensure efficient utilization of the port facilities and port services and to minimize the cost of transport through the port, efficient port management and operations are indispensable. In many cases, congestion or dangerous conditions, which happen during ship and cargo operations and services, are mainly caused by inefficient management, especially personnel management. It is strongly recommended that personnel management be taken into consideration and improved. In order to do so, it is proposed that personnel management should be dealt with as follows:

5.6.1 Improvement of the personnel management system

As analyzed in the previous chapter, some of the main causes of inefficiency of operations and services at Bangkok Port container terminals are, for instance, high berthing time, low cargo handling productivity, congestion and dangerous conditions, caused by port workers. In order to carry out the proper management and operation of the port, the ability and skills of the personnel of Bangkok Port have to be kept high. Therefore, the personnel management system is required to be improved as follows:

- **Personnel evaluation and management**

The personnel ability should be evaluated properly and fairly with objective standards and reflect that evaluation in promotions and wages. The proper personnel transfer according to experience, knowledge and judgement becomes possible. Furthermore, it also gives the personnel the incentive to work hard and to display their abilities, for they are satisfied with the proper evaluation of their works.

At the time of evaluation, a manager of each division should make efforts to improve abilities of personnel under him/her through training on the job or through some training courses and seminars. In addition, evaluation items should include the contribution and attitude toward efficient business.

- **Improvement of the training system**

In order to cope with the new efficient management and operation system, it is recommended that PAT should develop and supplement its training courses in terms of the following matters:

- To make the new port management and operation system including cargo handling and information system understood by the personnel.

- To recognize the importance of correct, proper, safe, responsible and efficient operation for the enhancement of the port.
- To recognize the service mind and improve the image of the organization.
- To instil a cost consciousness in the personnel.

5.6.2 *Improvement of reliability and safety*

It is recommended that the number of vehicles unrelated to the port activities entering and leaving the port area be minimized by constructing parking lots outside of the port and promoting the removal of the offices for management departments outside of the port gate. As a result, the checking procedures at the gate would be easier than now, and thus improvement of reliability and safety within the port area can be expected.

5.7 Conclusion

In conclusion, the government has set up a policy to reduce the number of containers handled at Bangkok Port container terminals to one million TEUs per year. Effective and swift handling of container cargo by improving the efficiency of operations, services and management of the port is also required. As mentioned in the previous chapter Bangkok Port still has some deficiencies of its operations, services and management. In order to become a competitive port under the limited conditions, for example, the limitation of land and financial constraint, the only way to achieve this is to emphasize the improvement of port operations and services efficiency including the management system. This chapter has given some recommendations in the area of ship, cargo, storage operations and services. Container handling equipment and management have also been considered. However, recommended actions may not be accomplished if there is no co-operation among the people concerned. Thus, as it is very urgent for Bangkok Port to start improving its performance efficiency, it is important for top managers to make quick and effective decisions.

Chapter 6

Conclusions

Since the sea transport mode plays a very important role for the Thai economy - most goods and commodities are imported and exported by ship -; therefore, the port must be the main gateway for the country as analyzed in Chapter 1.

Bangkok Port is one of the major ports in Thailand. According to government policy to limit the number of container throughput via Bangkok Port at one million TUEs/year. Bangkok Port, therefore, has to emphasize on incrementing efficiency instead of expansion. As explained in Chapter 2, during the past years this has been improved tremendously. However, it is obvious that in terms of operations and services, there are still some gaps existing compared with some local ports, modern ports and international ports.

As explained in Chapter 3, the world container trade has risen rapidly. Hence, the efficiency of port operations and services is very important because the cost of the ships and goods at port are determining the major part of the maritime transport chain. The requirements of container terminal operations and services in an international regime was discussed in this chapter in order to be used as a guideline for Bangkok Port.

Based on the analysis made in Chapter 4 by comparing Bangkok Port with some local ports, modern ports and international ports, it was found that the present major problems are:

- ❖ Long berthing time
- ❖ Low berth occupancy ratio
- ❖ Low productivity of container handling
- ❖ High operating cost per ton of cargo
- ❖ Congestion and dangerous conditions in container handling operations
- ❖ Inadequacy of cargo security

The above problems are caused by either internal or external factors as follows:

- Decrease in ship calls
- Lack of yard and traffic planning
- Some technical problems with the equipment
- Low availability and utilization of some types of equipment
- Shortage of container chassis
- Insufficiency of export CFS
- Shortage of skilled labour and know-how, particularly in the new operation and services systems
- Deficiency in management and operation systems
- Deficiency in information systems

Once the major problems are identified and analyzed, in order to solve these problems and improve the efficiency of operations and services including the competitiveness of Bangkok Port container terminals to meet the needs of clients, alternative solutions are recommended in Chapter 5. The summary of recommendations are the following:

6.1 Ship operations and services

- Encouraging the ships to call at Bangkok Port by reducing the berth hire and reviewing the policy regarding combo ships.

- Reducing ship berthing time by establishing proper yard and traffic planning for the direct loading of outbound boxes from outside the port area.

6.2 Cargo operations and services

- Providing the land for CFS especially for LCL containers in order to avoid the damage of cargo, which could be mixed with conventional cargo during stuffing/unstuffing operations.
- Reducing operating cost per ton of cargo by implementing the Just-In-Time system.
- Improving the productivity of container handling by motivating and training manpower
- Providing container chassis as required

6.3 Management

- Improving the personnel management systems in order to increase the ability of personnel of Bangkok Port. To do so, personnel evaluation and management and improvement of the training system must be taken into consideration.
- Improving reliability and safety in order to reduce the congestion and dangerous conditions within the port area during cargo operations.
- Introducing a modernized information system using computers to ensure smooth, accurate and efficient operations and services.

The recommendations given include both restructuring of management and operation systems and investment in necessary physical facilities in Bangkok Port. Both of these are indispensable for the improvement of its efficiency and should be realized simultaneously; therefore, it is proposed to set a the short-term plan with the target year 2003 of the Port Authority of Thailand Master Plan.

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Appendix 1: Terminal planner's job

Job description	Related documents	Remarks
<ol style="list-style-type: none"> 1. Communicate with the preceding and next ports on stowage planning. 2. Check destination and weight of containers, collecting gate slip and dock receipt. 3. Examine onboard stowage position from inbound stowage plan and determine space for loading. 4. Divide schematic plan by destinations by colouring and distribute among parties concerned. 5. Prepare handling sequence list from inbound stowage plan and schematic plan. 6. Stowage planning by each bay. 7. Prepare stowage plan 8. Calculate GM, trim, etc., from stowage plan to prepare stowage plan summary. 9. Prepare dangerous goods, reefer, break bulk list. 10. Integrate arrangement before and after ship's arrival. 11. Prepare ship's cargo handling log. 12. Watch progress of handling and instruct each equipment operator to facilitate smooth operation. 	<ol style="list-style-type: none"> 1. "Loading Instruction" of shipping line. 4. "Schematic Plan" 5. "Handling Sequence List" 7. "Stowage Plan" 8. "Stowage Plan Summary" 9. "Dangerous Cargo List, reefer Cargo List, Exception List" 11. "Cargo Handling Log" 	<ol style="list-style-type: none"> 3. Prepare final loading plan subject to loading instruction. 4. In preparing schematic plan, consider utilizing space vacated by discharge containers and try to save time in handling, ascertain number of containers to be discharged and loaded, and plan to prevent over-stowage at destination. 5. In preparing handling sequence list, consider the position of containers to be discharged and loaded by each bay, and the proceeding of yard operation linked with gantry crane performance. 6. Pay attention to special containers, consider avoiding over-stowage and check weight by each destination. 7. In preparing stowage plan, confirm port, weight, container no., service, etc. In shipside handling, supervise and instruct so that work is done according to handling sequence list and stowage plan.

Source: Economic and Social Commission for Asia and the Pacific

Appendix 2: Yard planner's job

Job description	Related documents	Remarks
<ol style="list-style-type: none"> 1. Give yard location to received container from gate slip. 2. Prepare yard location plan. 3. Prepare sequence check list for discharge from inbound stowage plan. 4. Prepare check list for shift/reload from handling sequence list. 5. Collate stowage plan and location plan, plan sequence of loading and delivery. 6. Collate gate slip and sequence check list. 7. Examine container status. 8. Prepare dispatch order and distribute to parties concerned. 9. Prepare yard throughput, total list 10. Give proper instruction to gate. 	<ol style="list-style-type: none"> 2. "Yard Location Plan" (ship's name, destination, weight and container no.) 3. "Sequence Check List" (for discharge) (sequence no., loading port, container no., yard location, tractor no., ship's stowage. (for loading) (sequence no., tractor no., yard location, container no., weight, destination, onboard stowage). 4. "Rehandling List" (Original stowage, origin, destination, container no., weight, revised stowage). 8. "Dispatch Order" (Ship's name, B/L no., container no., consignee, forwarder, destination, detail). 9. "Throughput Total List" 	<ol style="list-style-type: none"> 3. In preparing check list, plan the sequence simultaneous discharging and loading, with due attention to special containers. Decide yard plan for discharged containers with due attention to dispatch date. (Controller at gantry crane side) Confirm container no., damages, if any, from sequence check list and stowage plan, give yard location to tractor driver according to handling sequence list and facilitate smooth rotation of chassis. Watch the handling process by each day (time keeper), give instructions to gantry crane operator and facilitate efficient shipside handling.

Source: Economic and Social Commission for Asia and the Pacific

Appendix 3: Gate clerk's job

Job description	Related documents	Remarks
1. Check receipt and delivery of container (empty or loaded).		1. Must conduct strict inspection of containers, check not only external condition but inside by opening door.
2. Prepare and sort gate slip.	2. "Gate Slip" (Ship's name, container no., shipper, forwarder, typ, destination, Customs clearance, weight, yard location).	
3. Receive and check export documents (D/R, E/D, CLP).		
4. Receive D/O and check delivery/receipt instructions or way bill.		
5. Fill in gate log.	5. "Gate Log" (Container no., empty or loaded, type, destination, shipper/consignee	
6. Inspect container no., seal no., damage, etc.	6. "Damage Report" (Ship's name, container no., yard location, state of damage).	6. If damage to containers is found at gate, quickly contact the staff in charge and receive instructions from maintenance engineer.
7. Take weight of loaded container.		7. If container weight is not stated on the slip, measure with surveyor and fill in gate slip.
8. Prepare E/R and take driver's signature.	8. "Equipment Receipt" (ship's name, container no., chassis no., place of delivery, date, shipper/consignee, destination, etc).	
9. Designate container location (storage of special containers).		9. On receiving special containers, check dangerous cargo label or specified temperature and give proper location.
10. Supervise stored empty containers and control detention period.	10. "Empty Container List" (Ship's name, container no., type, date of receipt).	
11. Prepare inventory report to keep daily check on containers held.	11. "Inventory Report" (Ship's name, container no., type, date of receipt, yard location, etc).	
12. Input E/R in/out into computer.		12. Control status and inventory of containers by computer, through input of E/R in/out.

Source: Economic and Social Commission for Asia and the Pacific

Appendix 4: Export cargo job

Job description	Related documents	Remarks
<ol style="list-style-type: none"> 1. Receive booking 2. Check expected time of shed-in, forwarder, shipper, etc. 3. Confirm invoice. 4. Fill in Shed-in book. 5. Register Shed-in no. 6. Receive cargo. <ol style="list-style-type: none"> a) Give location by Customs clearance or pending status. b) Tally and affix label. c) Sign for cargo receipt. 7. Receive Export documents. <ol style="list-style-type: none"> a) Receive D/R, E/D. b) Check cargo received against D/R, E/D and their contents. c) Give D/R no. d) Prepare cargo receiving log. e) Prepare exception list. 8. Inside CFS, <ol style="list-style-type: none"> a) Arrange and attend to tally/measure b) Attend to Customs inspection. c) Prepare location plan. 9. Dispatch. <ol style="list-style-type: none"> a) Schedule data and job order for stuffing. b) Prepare stuffing plan. c) Collate and confirm cargo and E/D, D/R. d) Stuff into container according to stuffing plan. e) Inspect inside CFS by location plan to recheck missing cargo. f) Communicate with terminal for dispatching loaded container. 10. Process clerical work: <ol style="list-style-type: none"> a) Prepare CLP. b) All-over check E/D, D/R, 	<ol style="list-style-type: none"> 2. "Expected Shed-in List" 5. "Shed-in no. Register" 6. "Cargo Receiving Particulars" 7. "Exception List" 8. "Location Plan" 9. "Stuffing Plan" 10. "Container Load Plan" 	<ol style="list-style-type: none"> 2. Contact shippers or forwarders to check date of shed-in and fill in the list. 3. Upon receipt of cargo, confirm destination, intended line and ship, etc. from invoice. 5. Shed-in no. is indispensable for subsequent processing and must be registered upon receipt of cargo. 6. In "Cargo Receiving Particulars", describe fully. <ol style="list-style-type: none"> a) Affix receiving details (for labelling) b) Place cargo on pallets by destination and lot. c) Notify shipper and forwarder if any damage found. 7. Collate D/R, E/D and receiving particulars. 8. Prepare location plan to clarify the status of cargo stored in CFS. <ol style="list-style-type: none"> a) Consider efficient use of container space. b) In principle, sort cargo by B/L lot and put in same container. c) In principle, avoid mix loading of CFS and CY cargo at destination. If inevitable, load CFS cargo towards door side and separate from CY cargo. d) Ensure that contents of one container is for one destination. a) Consider preventing damage from crushing of contents.

Job description	Related documents	Remarks
<ul style="list-style-type: none"> c) Hand over shipping documents (E/D,D/R,CLP) to terminal. d) File cargo receiving particulars (for shipper, Customers office). e) Prepare vanning report. 		<ul style="list-style-type: none"> b) Ensure that empty containers have been cleaned and not damaged. c) Arrange loading heavier cargo beneath and light cargo above. d) Check number and destination of packages by stuffing plan.

Source: Economic and Social Commission for Asia and the Pacific

Appendix 5: Import cargo job

Job description	Related documents	Remarks
<ol style="list-style-type: none"> 1. Receive containers en bloc against M/F (for CFS). 2. Contact consignee for delivery. 3. Receive document for delivery from shipping line. 4. Plan devanning/delivery from consignee list, B/L copy, etc. 5. Prepare devanning instruction. 6. Prepare devanning report. 7. Receive and check D/O. 8. Deliver cargo. 9. Prepare delivery report. 10. Cross-out inward M/F 11. Inspect undelivered cargo and remind shipping line, consignee, etc. for disposal. 12. Check quarantine and clearance status. 	<ol style="list-style-type: none"> 5. "Devanning Instruction" 6. "Devanning Report" "Exception Report" 9. "Delivery Report" 11. "Undelivered Cargo List" 	<ol style="list-style-type: none"> 1. Primarily receive loaded containers from CY, take out contents by consignee's lot and deliver to consignee. (Attention) If unnoticed damage or surplus/shortage was found during devanning, promptly notify shipping line and Customs officer to make M/F correction upon inspection. Upon completion of Customs clearance (transport in bound, import declaration, etc.) collect one copy each. 7. Confirm marks and number, container no., sequence of endorsements, etc. 10. Enter delivery date, destination, in bound or not, forwarder.

Source: Economic and Social Commission for Asia and the Pacific

Appendix 6: Export documentation

Job description	Related documents	Remarks
1. Receive booking list from shipping line.		
2. Ascertain number of containers to be loaded and prepare job schedule.	2. "Job Schedule" (Ship's name, destination, shipper, forwarder, number of containers, receiving date, commodities).	
3. Expedite dispatch of cargo and documents, inform shipping line.		
4. Examine shipping documents /E/D, D/R, CLP) and issue D/R.		
5. Prepare special cargo (dangerous, reefer, etc.) list and distribute to divisions concerned.	5. "Special Cargo List" (Shipping line, container no., commodity, shipper, forwarder, hazard class, specific temperature).	
6. Confirm container with uncleared cargo and designate location.		
7. Check detention period of export containers.	7. "Detention Expiry Report" and application.	7. For cargo detained for more than one month, report to Customs office.
8. Check detention period of containers at hand (three months after being discharged).	8. "Application for extension of re-export period for duty free containers.	8. As containers discharged must be re-exported within three months in principle, apply to Customs office for extension of detention period if unable to re-export within specified period.
9. Attend to Customs inspection, spot check.	9. Confirmation of "Inspection Order"	9. During Customs inspection, take cargo sample as specified by inspection order and remark dispatch date/time and re-venting date/time upon completion.
10. Process container list (under Customs procedures).	10. "Container List" (Type, marks, no., domestic or foreign).	10. Submit container list for re-exported containers to Customs office and clear procedures prior to be loaded.
11. Enter cargo contents into record.	11. "Customs Copy of Dock Receipt"	11. Stamp receipt date, on board date, ship's name, and check E/D no, approval date, dispatch date, marks, no., commodity, number of packages, etc.
12. Obtain captain's signature on Customs copy of D/R and check with E/D to finalize export documentation.	12. As above.	
13. Communicate with shipping line and parties concerned on overall export procedures.		

Source: Economic and Social Commission for Asia and the Pacific

Appendix 7: Import documentation

Job description	Related documents	Remarks
<ol style="list-style-type: none"> 1. Check inward stowage plan and CLP. 2. Prepare inward container list and distribute to division concerned. 3. Prepare special container list and instruct staff concerned. 4. Arrange for transferring containers and cargo to Customs custody. 5. Prepare container list. 6. Execute Customs procedures related to operations. 7. Communicate with shipping line and other parties concerned on overall import procedures. 	<ol style="list-style-type: none"> 2. "Inward Container List" (Origin, service type, B/L no., container no., type, consignee, commodity, number of packages, weight, measurement, etc.). 3. "Special Container List" (Same as above plus label class or specified temperature). 4. One copy M/F in place of boat note, one copy M/F for delivery to Customs. 5. "Container List" 6. <ol style="list-style-type: none"> a) "Application for M/F Correction" b) "Application for Cargo handling" c) "Application for Foreign cargo Transport" d) "Application for use of duty free container for domestic transport" e) "Application for use of duty free container to other purposes" 	<ol style="list-style-type: none"> 4. Obtain captain's signature, one for boat note and another for delivery. 5. Submit container list (empty or loaded) which is accepted as import declaration. d) Apply Customs when empty duty free container is used for domestic transport on the way to next port of loading. e) Apply Customs when duty free container is used for purposes other than for foreign trade (i.e. for storing domestic cargo or refrigerating) subject to import duty.

Source: Economic and Social Commission for Asia and the Pacific

Appendix 8: Map of Bangkok Port area

