

KINGDOM OF THAILAND  
MINISTRY OF TRANSPORT AND COMMUNICATIONS  
DEPARTMENT OF LAND TRANSPORT

THE STUDY ON GREATER BANGKOK TRUCK  
TERMINAL IN THE KINGDOM OF THAILAND

FINAL REPORT

VOLUME 1  
EXECUTIVE SUMMARY



SEPTEMBER 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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## Preface

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a feasibility study on Greater Bangkok Truck Terminal and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Thailand a study team headed by Mr. Masamitsu Toriyama, Pacific Consultants International, three times between December 1991 and September 1992.

The team held discussions with the officials concerned of the Government of Thailand, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the team.

September 1992



Kensuke Yanagiya

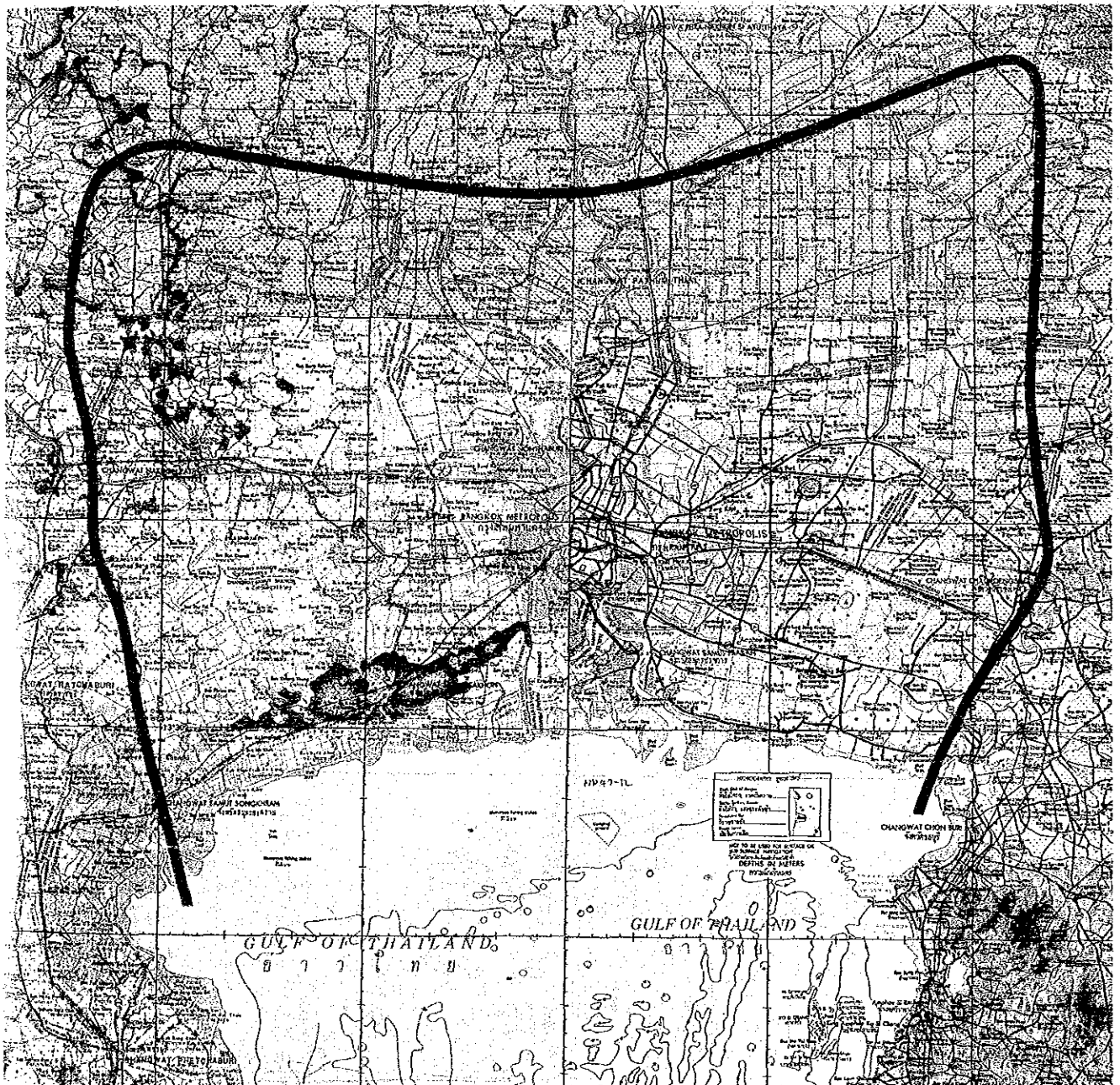
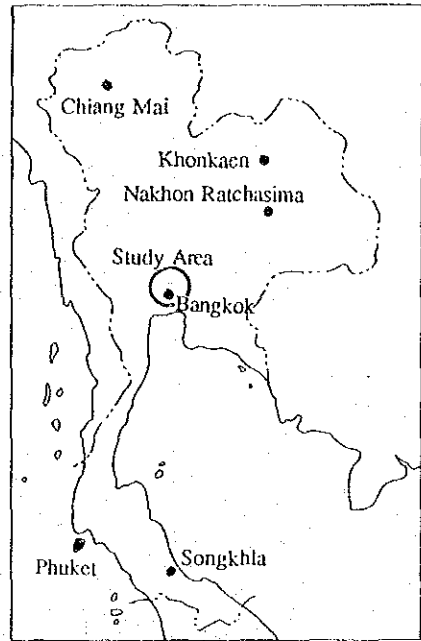
President

Japan International Cooperation Agency





# Study Area





# THE STUDY ON GREATER BANGKOK TRUCK TERMINAL IN THE KINGDOM OF THAILAND

## Executive Summary

### I. Introduction

This report summarizes the results of "The Study Greater Bangkok Truck Terminal in the Kingdom of Thailand" carried out by Japan International Cooperation Agency during the period of December 1991 to August 1992.

The Study comprises two parts: one to select the highest priority truck terminal; and another to perform a feasibility study on the highest priority truck terminal.

The study results are compiled into the Final Report which consists of the following five volumes:

- Volume 1: Executive Summary
- Volume 2: Main Text
- Volume 3: Investors' Guide
- Volume 4: Operation and Management Guideline
- Volume 5: Policy and Administration Guideline

## II. Summary of "Main Text"

### CHAPTER 1 General

#### 1. Purpose of the Study

This report presents all the study results on where, how and what kinds of public truck terminals should be built in order to modernize the physical distribution system and to alleviate traffic congestion in Bangkok Metropolitan area.

### CHAPTER 2 Physical Distribution Facilities

#### 2. Difference between Public and Private Truck Terminals

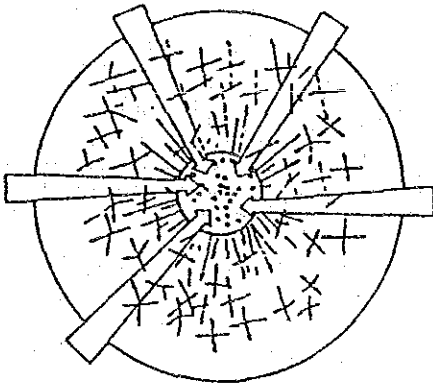
Difference between public and private truck terminals falls on scope of terminal users. Public truck terminal is open to any trucking companies without any discrimination, while private one limits its user to its own company. Ownership of truck terminal is not a subject to define a public truck terminal. Fig. 1 shows the function of the truck terminal.

#### 3. Ideal Physical Distribution Facilities

There are seven development strategies on physical distribution facilities, and Fig 2 shows all of them.

- A. Freight center : Physical distribution zone in a designated region.
- B. Physical distribution facilities : Physical distribution facilities within a specially designated district.
- C. Ordinary truck terminal : Least facility availability plan which centers a truck terminal.
- D. Mixed area development : A truck terminal as one of the facilities in a newly developed suburb.
- E. Dual transfer system : Suburban truck terminal and Central Business District truck terminal linkage plan by using line-haul trucks.

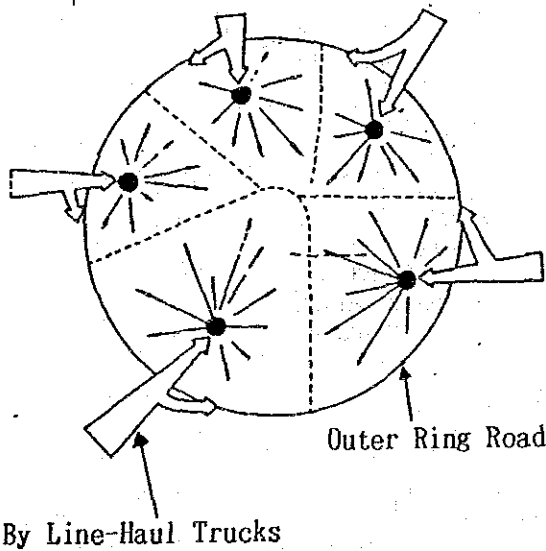
Without Public Truck Terminals



Natural Flow of Commodity and Trucks

- Heavy traffic congestion
- Under utilization of land
- Delay of commodity delivery
- Some small scale of private truck terminals

With Public Truck Terminals



Adjusted by Public Truck Terminal

- Grouping of collection and delivery area
- Consolidation of smaller cargo into truck load cargo
- Need large size of land
- Need big capital investment
- Public character being increased

Fig. 1

Function of Truck Terminal

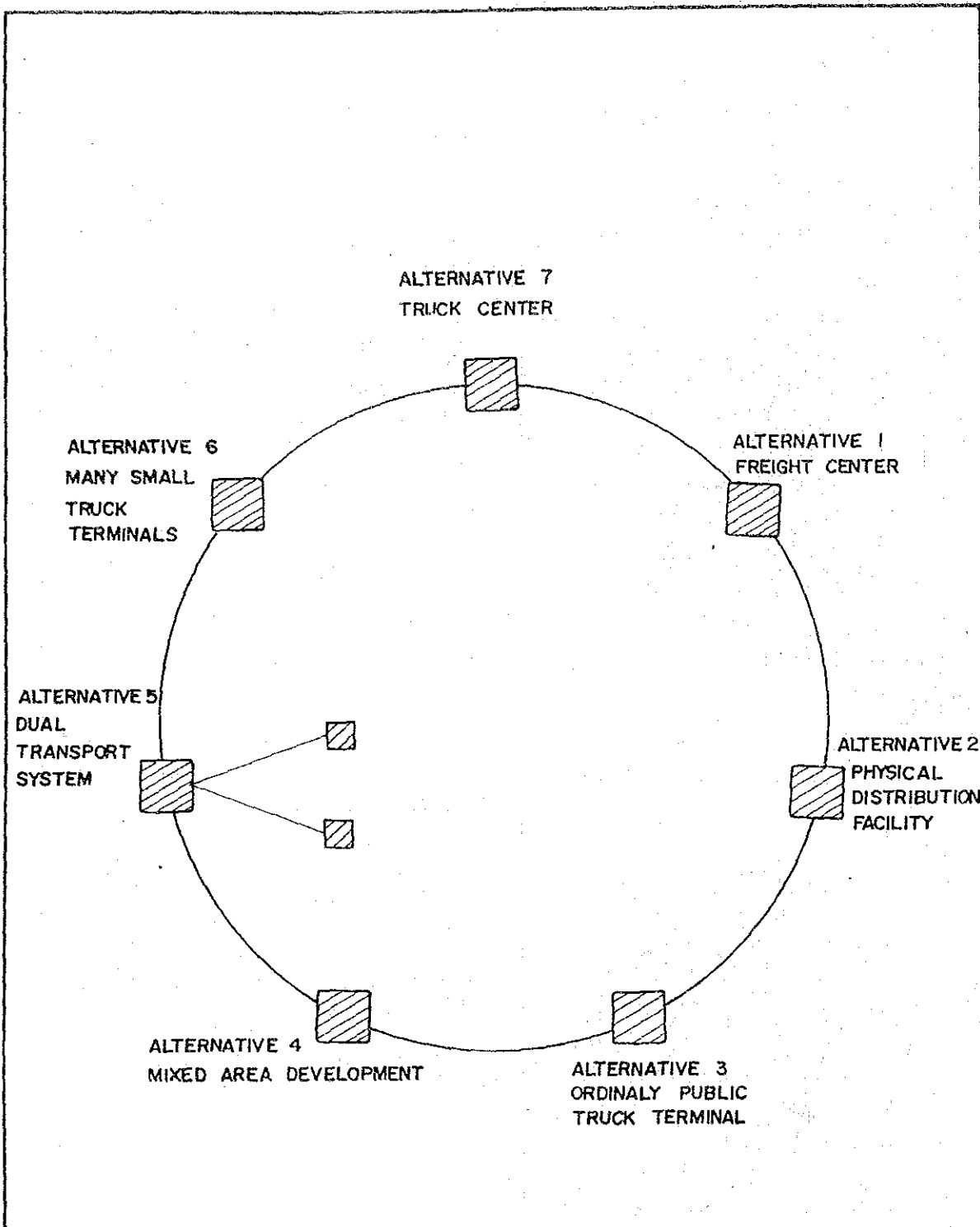


Fig. 2 Seven Kinds of Truck Terminal

- F. Truck Center : Use of truck terminal is limited to parking only.
- G. Many small scale truck terminals : Many small truck terminal development plan.

Physical distribution facilities was selected as a most suitable truck terminal in Bangkok Metropolitan area judging from the following items:

- Land availability and affordability,
- Modernization of physical distribution facilities,
- Impact to urban redevelopment,
- Alleviation of traffic congestion,
- Social equity of public facilities,
- Financing availability, and
- Management difficulty level.

The Study concluded that the best plan was "C": least facility plan which centers a truck terminal. When the initial plan was completed, the Study suggest that "C" (Physical distribution facilities within a specially designated district) be expanded to be "B".

### **CHAPTER 3 Analysis on Present Physical Distribution Status**

#### **4. Present Conditions of Trucking Industry**

The population of BMR (Bangkok Metropolitan Region) is 9 million at the year 1990, equivalent to 16% of the total population of Thailand. BMR produced a half of GDP, and 330,000 trucks are registered in this region.

There are four areas where trucking companies are concentrated in Bangkok. Most of them are small companies which has 30 to 50 square meter for office/storage place. Cargo loading/unloading works take ten (10) to sixty (60) minutes for one time, and roads in front of storage are usually occupied for this works. The machines are not used for cargo handling works except import/export products and industrial products. The cargo handling status in present BMR have been far behind the modern system.

Direct interviews were conducted to six trucking companies, six warehouse companies, two wholesalers, and nineteen manufacturers. This aims at studying current physical distribution conditions. This survey clarified: necessity of truck terminals is apparent; the development is urgent.

According to the interview survey, current parking restriction on the major arterial roads depresses private business. In March and April, when cargo volume is the largest in a year, transmission of cargoes between pick-up/delivery and the line-haul trucks becomes difficult and the forwarders face this non-smooth linkage problem. Pick-up/delivery by small trucks (operated by different corporations) has the same scheduling problem.

Seventy (70) percent of trucking companies answered "yes" for using public truck terminal when the facilities would be available. As for the twenty-four-hour-restriction on heavy trucks in Bangkok, the companies' responses are grouped into two: one to change their operation to small trucks; another to end up their businesses.

#### 5. Present Conditions of Physical Distribution.

Northward traffic volume on Route 1 reaches 17,000 per day. The 10-wheel truck volumes occupies more than 45% of the total volume. Freight inflow is recorded twice as much as outflow at various locations. Construction materials occupy 40% of the freight tonnage of inflow and outflow, and this is followed by agricultural products such as rice and cassava. The DLT data shows 63%, a bit larger share of construction materials. The average trip distance of construction material is 95 km, and 222 km for the agricultural products. Generally, trip length of outflow is longer than inflow trip. Fruit and vegetables are transported by 4 - 6 ton trucks; cement is transported by trailers.



## CHAPTER 4 Demand Forecast of Truck Terminal

### 6. Zoning for Demand Forecast

Fig. 3 presents a whole procedure of demand forecast of truck terminal.

Zoning was carried out by unifying the present administrative units of 36 in BMR into 12 according to the present land use and physical distribution activities. Whole Thailand is divided into 8 regions. These zonings are shown in Figs. 4 and 5.

All the freight flows are integrated into three major flows according to the road network, physical distribution pattern and land use pattern. And 12 zones in BMR are integrated into collection/delivery territories of three truck terminals. This collection/delivery territories are presented in Fig. 6.

### 7. Total Quantity of Freight In-/Out- Flows of Bangkok

Commodities transported by truck at present are forecasted based on the data such as (1) the DLT Cargo O-D survey results, (2) the Annual DLT Freight Movement Statistics and (3) the inter-zonal production and attraction cargo trips used in the JICA's 1989 SMIR study. In addition, various future variables are incorporated in the forecast works which are GDP forecast, population, number of trucks in future etc.

The study forecasts that total quantity of inflow freight to Bangkok on road at the year 2000 will become 93 million tons per annum, and out-flow freight 23.9 million tons per annum. Inflow is four times larger than out-flow. This is attributable to dynamic economic activities in Bangkok. Especially, construction materials and machinery occupy large portion of the inflow cargo to BMR. Railways carry 7 million tons per year, of which 70% are cement and oil. Mode of transportation for cement and oil is expected not to change to trucks.

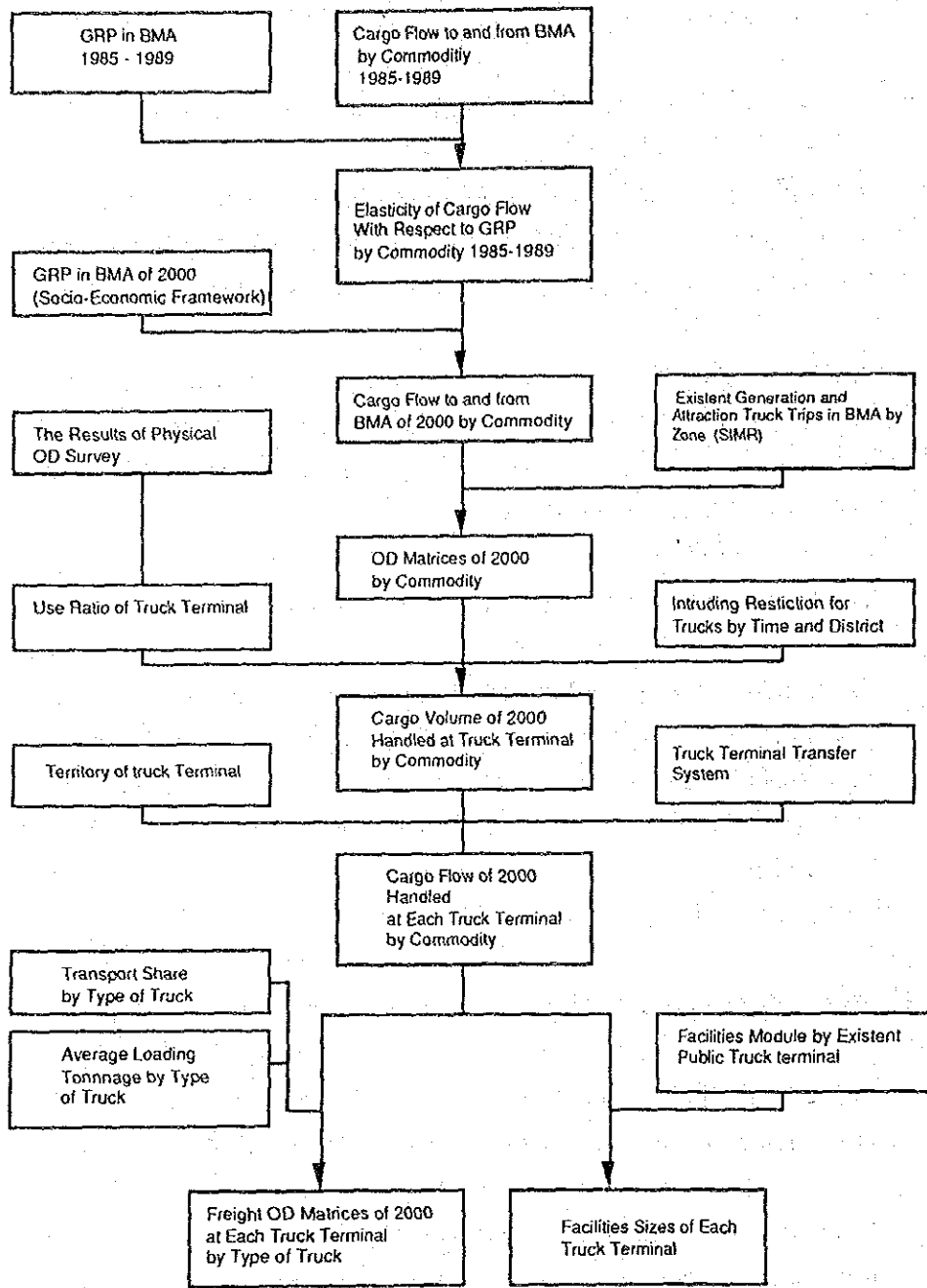
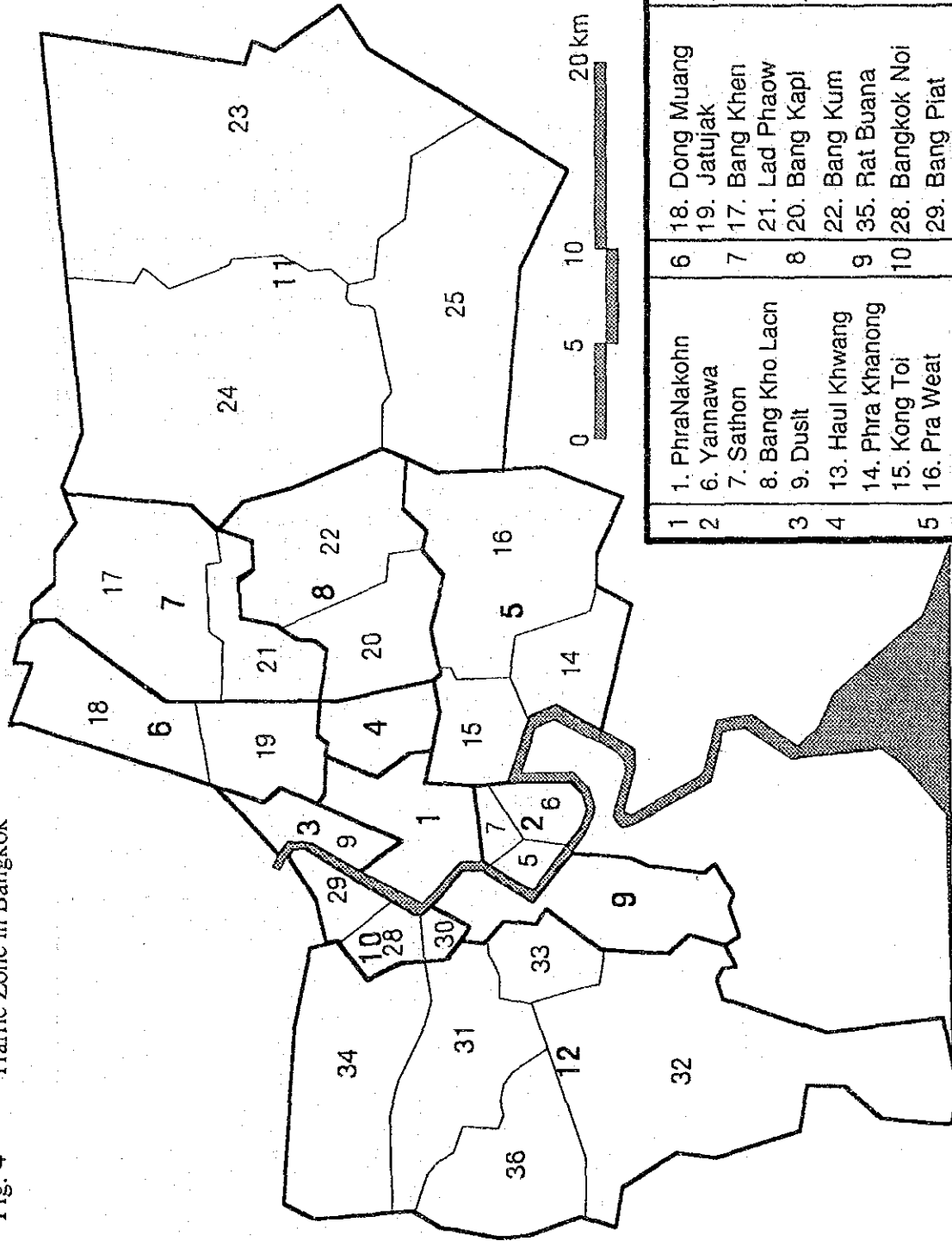


Fig. 3 Whole Procedure of Demand Forecast

Fig. 4 Traffic Zone in Bangkok



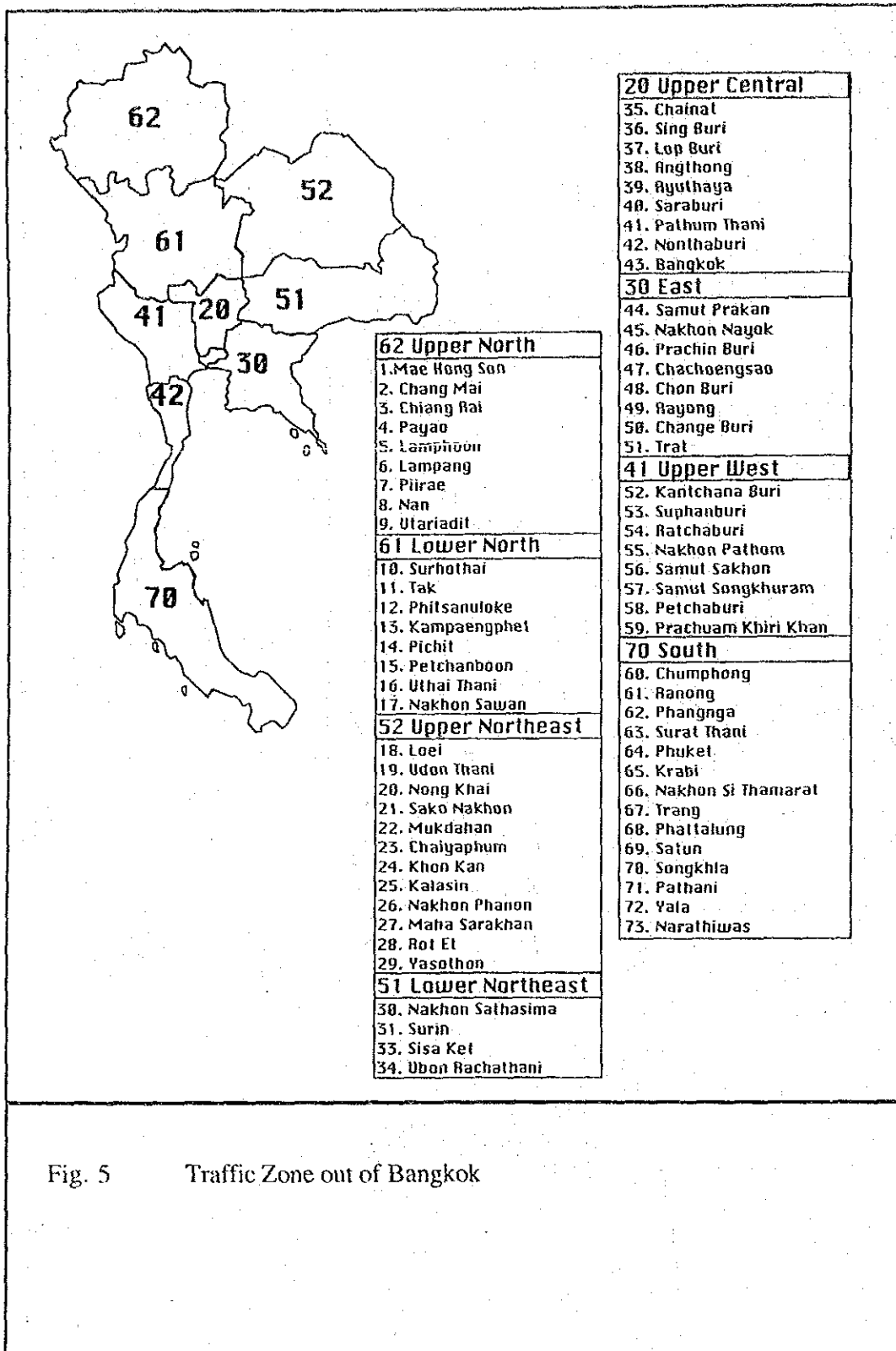


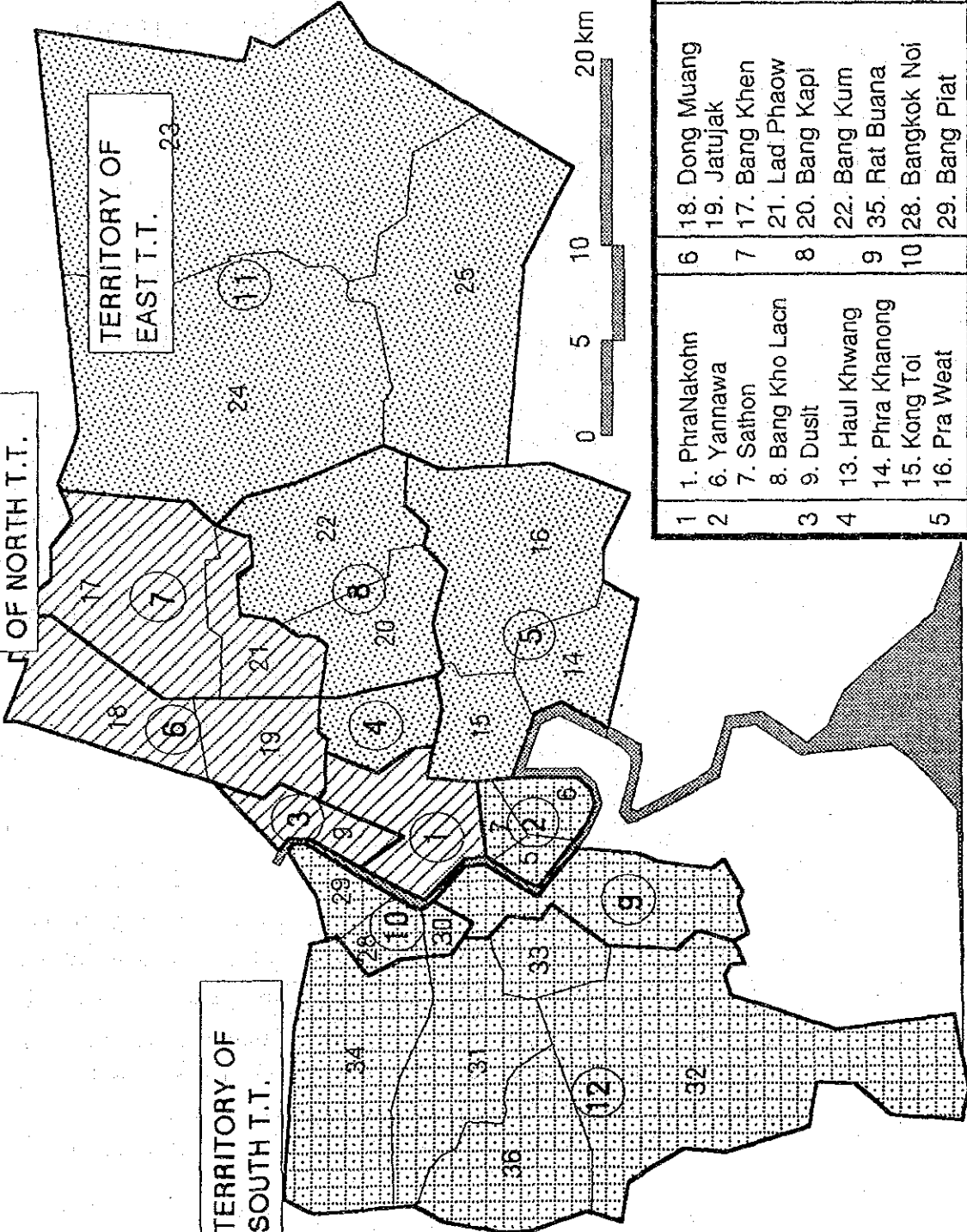
Fig. 5 Traffic Zone out of Bangkok

Fig. 6 Territory of Each Truck Terminal

TERRITORY OF NORTH T.T.

TERRITORY OF EAST T.T.

TERRITORY OF SOUTH T.T.



1. Phra Nakohn	6	18. Dong Muang	11	30. Bangkok Yai
2. Yannawa	7	19. Jatujak	12	23. Nong Chok
3. Sathon	8	17. Bang Khen		24. Min Buri
4. Bang Kho Laem	9	21. Lad Phaow		25. Lad Kra Bang
5. Dusit	10	20. Bang Kapi		31. Past Charoan
6. Haul Khwang		22. Bang Kum		32. Bang Khun Thian
7. Phra Khanong		35. Rat Buana		33. Jom Thong
8. Kong Toi		28. Bangkok Noi		34. Thaling Chan
9. Pra Weat		29. Bang Piat		36. Nong Khae

Table 1 Commodity Movement at the Year 2000

Item	(unit; 1,000 ton)		
	Inflow	Outflow	Total
Construction Materials	75,600	3,000	78,600
Mining Products	700	5,700	6,400
Agricultural Products	13,900	4,300	18,200
Manufactured Goods	3,600	10,900	14,500
Total	93,800	23,900	117,700

Note: Mining Products" includes petroleum products.

#### 8. Traffic Control for Heavy Truck in Future

Utilization of the truck terminal is dependent of the future traffic control for heavy truck in metropolitan region. Therefore, the following three alternatives are examined.

- Traffic Control 1 : Current rush hour traffic restriction.
- Traffic Control 2 : 24 hour heavy truck restriction for the present truck restriction area (proposed by the Land Transport Policy Committee)
- Traffic Control 3 : 24 hour heavy truck restriction for the central business district only (proposed in the SPURT)

Traffic Control 3 is applied as the pre-condition of this study since this is the most easy and practical one to implement. This area is shown in Fig. 7.

#### 9. Commodity Volume of Public Truck Terminal

Inbound trucks to Bangkok carrying construction materials or mining products rarely use a truck terminal. Although agricultural products have constant volume inflow, exporting products such as rice and tapioca are directly transported to the port. Industrial products for import, especially when containers are used, are directly transported to the inland container depot. 25% of manufactured goods-packaging systematization will be necessary to use a truck terminal.

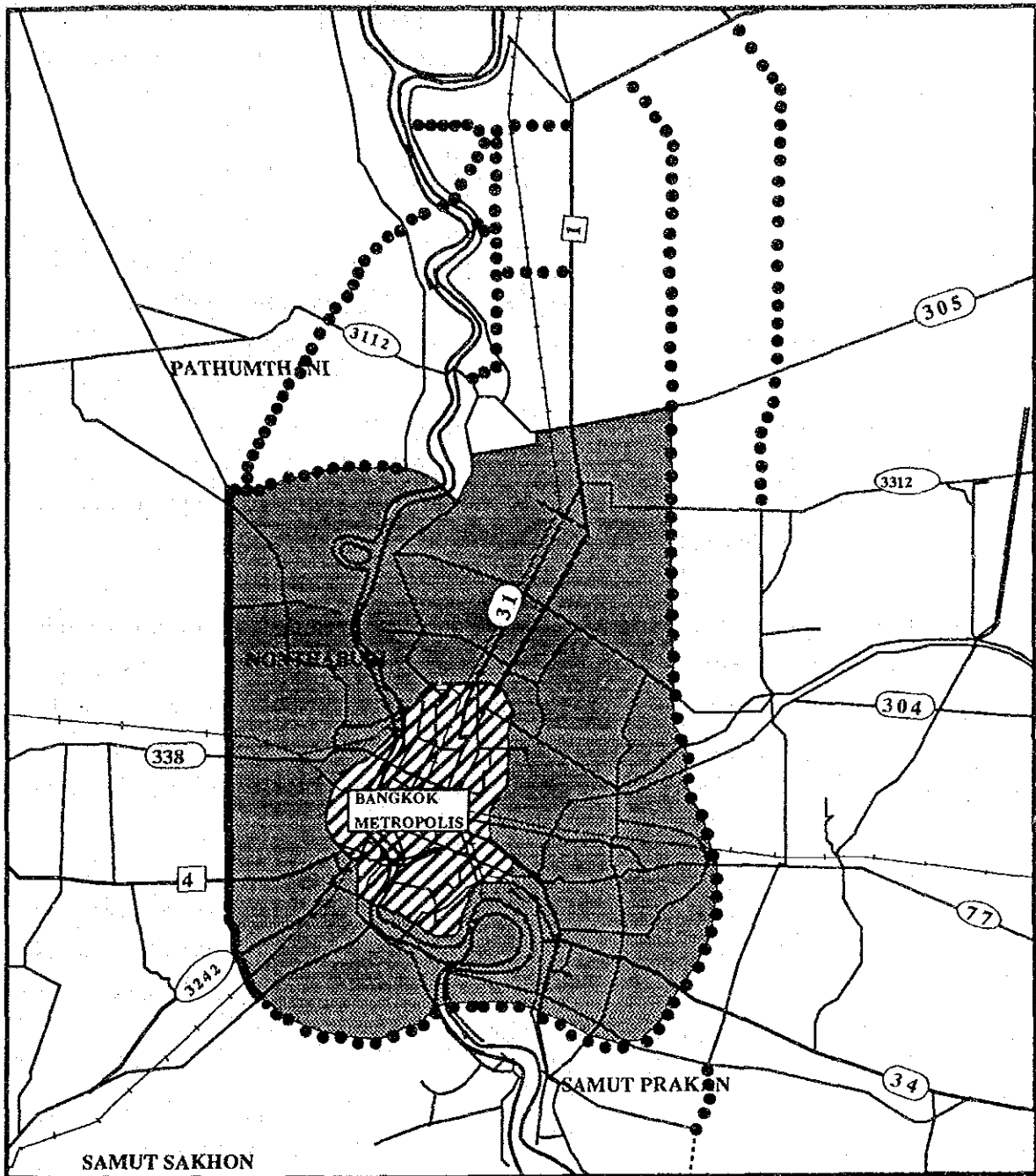




Fig. 7 Whole Restriction Area Proposed by SPURT an LTPC

Legend

-  LTPC Restriction Area
-  SPURT Restriction Area

Commodities are divided into 23 groups, and their truck terminal utilization rate were determined. The results is that truck terminals will have the volume of 25,938 tons per day (i.e. 6.6% of total volume of in/out cargoes).

#### 10. Forecast of Cargoes Handled at Public Truck Terminal

Cargo volume handled at public truck terminals in future is obtained by multiplying cargo O-D table by commodity and utilization ratio of public truck terminal by commodity together.

Utilization ratios of public truck terminal by commodity is obtained from (1) Freight-related company interview survey, and (2) actual figures of Tokyo metropolitan area. Table 2 shows truck terminal utilization ratios under the condition "Traffic Control C" for the heavy truck.

Table 2 shows that mining products and construction materials are not suitable items for truck terminal, and their utilization are set almost zero. As for the agricultural products, rice and tapioca for export is directly transported to the seaport and are not handled at the truck terminal. Manufacturing products for export, especially container, are used to send from the inland container depot to seaport.

Total volume of cargo handled at the public truck terminals are summarized in Table 3. It shows that the estimated cargo volume handled at terminals reaches 25,938 ton (= 9,530 + 6,517 + 9,891) per day, which is equivalent to 6.6% of the total cargo volume of in-/out-flows in BMR.



Table 2 Utilization of Public Truck Terminal by Commodity

(Inflow to BMR)

Type of Commodity	Composition ratio (%) 1989	Suitability	Suitable Facilities	Use Ratio of the Truck Terminals
1. CONSTRUCTION MATERIALS	100.0%			0.34%
2) SAND & GRAVEL	90.7%	NO		
3) CEMENT & PRODUCT	6.7%	YES(4.8%)	Terminal	
4) STEEL	0.8%	YES(2.8%)	Terminal	
5) OTHER CONSTRUCTION	1.9%	NO		
2. MINING PRODUCTS	100.0%	NO		0.00%
8) PETROLEUM PRODUCTS	26.1%	NO		
9) MINERALS	73.9%	NO		
3. AGRICULTURAL PRODUCTS	100.0%			12.79%
1) RICE	37.7%	NO		
6) TIMBER	9.1%	NO		
7) FIREWOOD	2.0%	YES(100.0%)	Terminal	
10) VEGETABLE & FRUIT	3.9%	NO		
11) TAPIOCA	5.6%	NO		
12) MAIZE	4.1%	NO		
13) SUGAR	13.7%	NO		
14) BEANS	1.6%	NO		
15) JUTE & PRODUCTS	0.7%	YES(100.0%)	Terminal	
16) BEVERAGES	1.0%	YES(100.0%)	Terminal	
17) PROCESSED FOODS	8.8%	YES(100.0%)	Terminal	
18) ANIMALS	2.0%	NO		
19) FISH	4.5%	NO		
20) FERTILIZER & ANIMAL F	5.4%	YES(4.8%)		
4. MANUFACTURED GOODS	100.0%			57.86%
21) PERSONAL EFFECTS	30.6%	YES(100.0%)	Terminal	
22) MISCELLANEOUS GOODS	26.1%	YES(100.0%)	Terminal	
23) ALL OTHERS	43.4%	YES(2.8%)	Terminal	

(Out flow from BMR)

Type of Commodity	Composition ratio (%) 1989	Suitability	Suitable Facilities	Use Ratio of the Truck Terminals
1. CONSTRUCTION MATERIALS	100.0%			4.18%
2) SAND & GRAVEL	4.7%	NO		
3) CEMENT & PRODUCT	44.6%	YES(4.8%)	Terminal	
4) STEEL	42.5%	YES(4.8%)	Terminal	
5) OTHER CONSTRUCTION	8.2%	NO		
2. MINING PRODUCTS	100.0%	NO		0.00%
8) PETROLEUM PRODUCTS	98.3%	NO		
9) MINERALS	1.7%	NO		
3. AGRICULTURAL PRODUCTS	100.0%			22.21%
1) RICE	4.5%	NO		
6) TIMBER	11.3%	NO		
7) FIREWOOD	1.0%	YES(100.0%)	Terminal	
10) VEGETABLE & FRUIT	4.7%	NO		
11) TAPIOCA	0.6%	NO		
12) MAIZE	0.5%	NO		
13) SUGAR	0.4%	NO		
14) BEANS	0.3%	NO		
15) JUTE & PRODUCTS	0.6%	YES(100.0%)	Terminal	
16) BEVERAGES	13.8%	YES(100.0%)	Terminal	
17) PROCESSED FOODS	4.1%	YES(100.0%)	Terminal	
18) ANIMALS	0.7%	NO		
19) FISH	1.4%	NO		
20) FERTILIZER & ANIMAL F	56.0%	YES(4.8%)		
4. MANUFACTURED GOODS	100.0%			84.92%
21) PERSONAL EFFECTS	7.2%	YES(100.0%)	Terminal	
22) MISCELLANEOUS GOODS	77.2%	YES(100.0%)	Terminal	
23) ALL OTHERS	15.5%	YES(2.8%)	Terminal	

Table 3 Cargo Volume Handled at Each Truck Terminal

		(Unit : ton/year)			
		Total	Construction Materials	Agricultural Products	Manufactured Goods
North Truck Terminal	Inbound	841,747	72,306	348,780	420,661
	Outbound	2,017,312	35,282	192,645	1,789,385
	Total	2,859,059	107,588	541,425	2,210,046
West Truck Terminal	Inbound	604,348	72,008	234,971	297,369
	Outbound	1,350,765	35,137	136,832	1,178,796
	Total	1,955,113	107,146	371,803	1,476,164
East Truck Terminal	Inbound	906,916	101,208	357,875	447,833
	Outbound	2,060,305	49,385	205,842	1,805,078
	Total	2,967,221	150,593	563,717	2,252,911

		(Unit : ton/day)			
		Total	Construction Materials	Agricultural Products	Manufactured Goods
North Truck Terminal	Inbound	2,806	241	1,163	1,402
	Outbound	6,724	118	642	5,965
	Total	9,530	359	1,805	7,367
West Truck Terminal	Inbound	2,014	240	783	991
	Outbound	4,503	117	456	3,929
	Total	6,517	357	1,239	4,921
East Truck Terminal	Inbound	3,023	337	1,193	1,493
	Outbound	6,868	165	686	6,017
	Total	9,891	502	1,879	7,510

11. Necessary Number of Berths

Necessary number of berths for each public truck terminal is estimated by dividing the total cargo volume handled at each terminal by cargo handling capacity per berth. Table 4 summaries the results, and Fig. 8 presents these figures in relation with traffic control for heavy truck.

Table 4 Necessary Number of Berths

Item	Cargo Handled at Terminal	Necessary Number of Berths
North bound	9,530 ton/day	480 berths
West bound	6,517 ton/day	320 berths
East bound	9,891 ton/day	480 berths

In general, 20 to 26 tons of cargo can be handled at one berth in the advanced countries in terms of physical distribution. Minimum level of this range (= 20 tons) is adopted to calculate the necessary number of berths in this study. The calculation results are presented below:

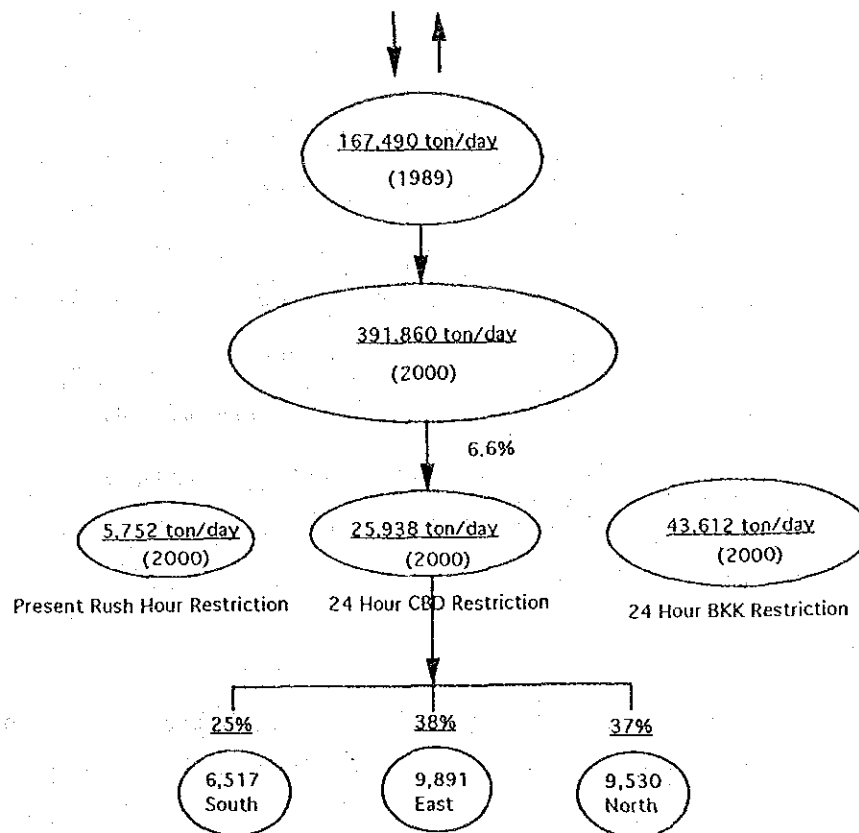


Fig. 8 Estimation of Cargo Volume Handled at Truck Terminal

## CHAPTER 5 Selection of Truck Terminal Location

### 12. Summary of Public and Private Truck Terminal Project Proposals

There are ten proposed truck terminal projects. They are shown in Table 5.

### 13. Priority of Construction of the Truck Terminal

In the initial stage of the research, development priority for the each proposed projects was supposed to be ranked by using the sauce-economic indicators; however, comparison was not possible because of unreliability of data from proposed sites. For these reasons, the following steps are taken to establish guidelines:

Table 5 Proposed Truck Terminals

Location (Distance from CBD*)	Status	Area (rai)
1 50 km North	Application from Trucking Association being processed	403
2 43 km North	Application from MSH (private corporation) being processed	200
3 41 km North	Government Owned	169
4 21 km East	Adjacent to the ICD construction site	N/A
5 35 km East	Application from Trucking Association being processed	215
6 37 km East	Application from MSH (private corporation) being processed	200
7 40 km East	Application fro Viriya (private corporation) being processed	320
8 20 km Southwest	Application from Trucking Association being processed	211
9 25 km Southwest	Application from MSH (private corporation being processed	200
10 Eastward	Opportunities searched by the government	N/A

\* Central Business District

- A. Choose the suitable regions by direction for terminal development.
- B. Set ideal pilot truck terminal at a special locations in the regions.
- C. Use socio-economic indicators to pilot truck terminal development projects, and prioritize.
- D. Conduct feasibility study (pilot study) to highly prioritized projects.
- E. Establish guidelines based on the information above.

#### 14. Ideal Location of Truck Terminals

Ideal locations of public truck terminal are shown in Fig. 9.

The following five criteria were used to determine suitability for truck terminal development.

- Collection/delivery distance limitation region
- Land acquisition possibility limitation region
- Major arterial network crossing region
- Freight movement concentration region
- Effective land use region

A. Collection/delivery distance limitation region:

Line-haul trucks arrive at Bangkok in early morning; cargoes are delivered in the morning; collected cargoes in the afternoon are loaded in line-haul trucks and leave for the countries. The truck terminals must satisfy the part of the daily cycle, and planned to a suitable location accordingly. The result of calculation tells that area within 30 to 35 km. would be the best locations.

B. Land acquisition possibility limitation region:

If income and expenditure was predetermined and limited, the budget for land acquisition is limited, also. The amount that can be spent for the construction of a truck terminal on 100 Rai land has its limit at 4,000 to 5,000 million Baht. Land price map indicates the areas of which price reach at an expenditure limitation.

C. Major arterial-ring road junction region:

The movement of line-haul trucks on the major arterial roads, and the movement of connecting trucks, pick-up and delivery trucks on the ring roads in Bangkok, are affected by the road network. The best locations, where each truck's travel distance becomes minimum, are the intersections of the outer ring road with the radial major arterials.

D. Freight movement concentration region:

The pattern of flow of freight is from the north along the route one, and from the east bay-area industrial complex along the route 34, and from southeast - Prachin Buri, and Ratchaburi - along the route 4.

E. Effective land use region:

From urban planning point of view, near from the physical distribution centers, industrial complex, but far from residential development region; that is, undeveloped area would be the best location to move physical distribution facilities from urbanized area.

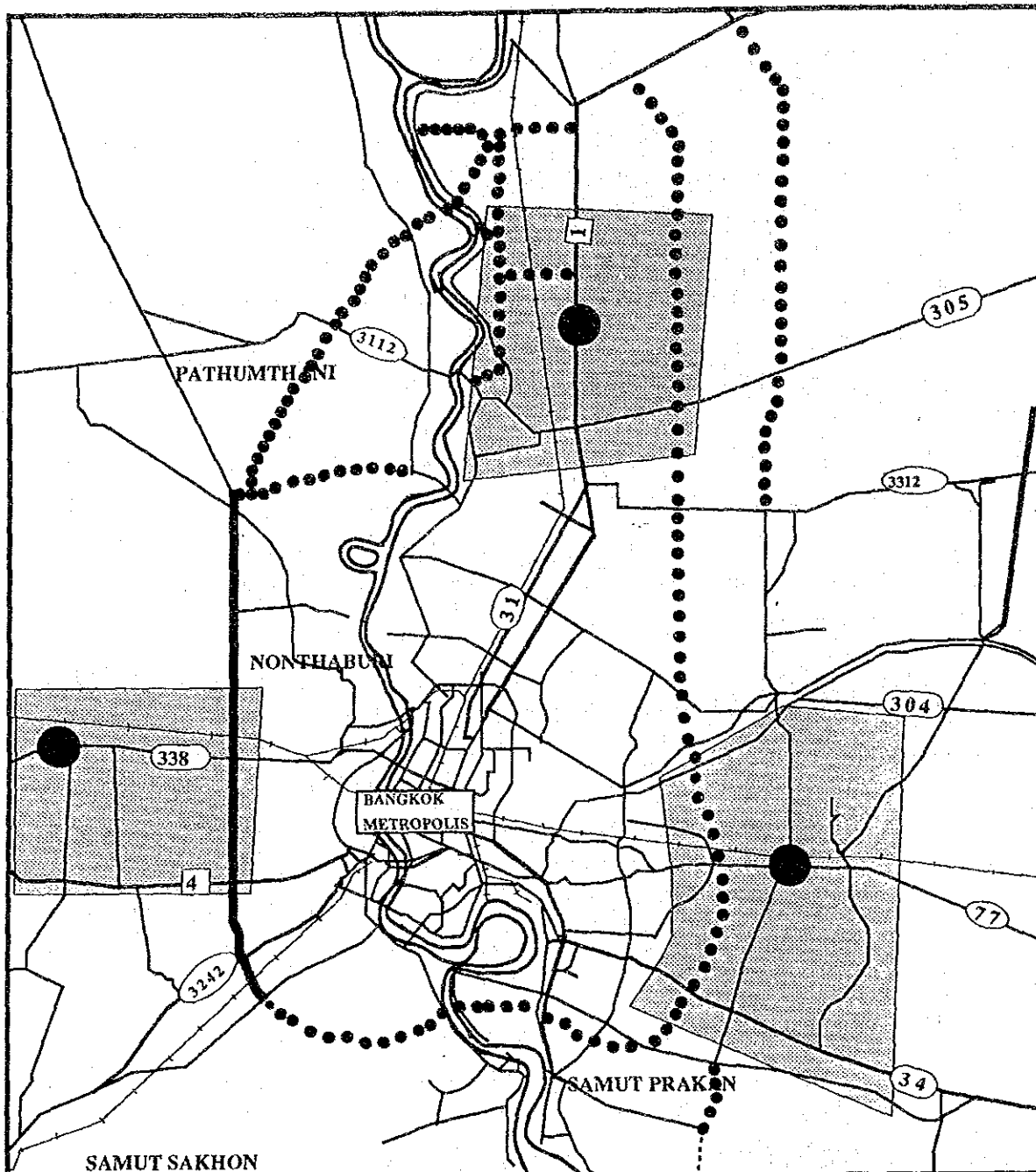


Fig. 9 Ideal Location of Public Truck Terminals

Legend  
 Desired Area

After examining the five criteria described above, we selected the areas, at northward, eastward, and westward, relatively close to the outer ring road for the truck terminal development. Those are shown in Fig. 4.

## CHAPTER 6 Selection of the Highest Priority Truck Terminal

### 15. Size and Location of Truck Terminals

In order to prioritize, one has to decide the expecting truck terminal locations within the suitable regions, and compare the terminals. The details of the truck terminals according to the calculation are the followings:

Northward:	- Location	32 kilometer away from the CBD; along the route one
	- Size	9,530 ton/day 500 berths 180 rai
Eastward:	- Location	20 to 25 kilometers away from the CBD; intersection of the route 3119 and 3256 and Sukhumvit Soi 77
	- Size	9,891 ton/day 500 berths 180 rai
Westward:	- Location	20 kilometer from the CBD; along the route 4
	- Size	6,517 ton/day 350 berths 140 rai

### 16. Socio-economic Indicators and Priority

Socio-economic indicators are adopted to evaluate priority of three ideal terminals. They cover a wide range of aspects such as cargo flow rationalization effect, traffic congestion relieving effect and so on. The ordinary method with internal rate of returns is not used at this stage.

As for the socio-economic indices, the following seven indicators are selected to give the priority order to three ideal public truck terminals, i.e., North, the East and West.

- Cargo flow rationalization index
- Transport cost saving index
- Transport congestion relieving index (1)  
(Delivery and collection related)
- Transport congestion relieving index (2)  
(road capacity-related)
- First year revenue/cost index
- Land acquisition cost index
- Urban development index

A. Cargo Flow Rationalization Index

It is possible to rationalize and accelerate distribution process by improving routes, delivery, and connecting freights. Achievement level of rationalization and acceleration is high when the multiple of terminal hinterland's line-haul trucks' route demand in terminal hinterland and kilometer (total ton-kilometers) is high. It is lower as the tonnage of small trucks, that are in charge of collection, delivery, and transferring in Bangkok, becomes larger. The indices are in targeted, and guided to the conclusion that in BMR, the East terminal has the highest priority, and on fixed routes, the North terminal which has 25 provinces in the back has the highest priority.

B. Transport Cost Saving Index:

The rush-hour restriction on trucks delays. The time lost increases the transport costs. Each truck terminal's total waiting hours are compared by estimating the waiting hours and the number of truck terminal users. The north terminal will save time relatively less.

C. Transport Congestion Relieving Index:

The traffic conditions of three terminal regions differ; however, creation of the truck terminal give positive effects on the existing conditions. The volume of the collection/delivery trucks increase from 1.6 ton to 3.5 tons because of the truck terminal development. If the total volume is unchanged, the truck trips decreases. Based on the assumption, the rates of



congestion decrease per unit area was calculated. Relative positive effects on congestion to the north terminal is high, but it is not remarkable.

D. Transport Congestion Relieving Index (road Capacity Related):

Road capacity overflow distances in north, east, southeast terminal collection/delivery areas are 39 km, 49 km, and 69 km respectively. The distances are divided by areas to find traffic congestion levels with respect to the area. The north terminal area has the highest traffic congestion per unit area. Therefore, the first truck terminal shall be urgently built in the most congested area-the north truck terminal.

E. First Year Revenue/Cost Index:

This index is important to prioritize the locations; however, detailed calculation cannot be done at the current study stage. The profit rate per unit construction cost was calculated. Large development attracts area's economic activities; therefore, large development is prioritized. The differences are minimal.

F. Land Acquisition Cost Index:

This index could determine the specific implementation possibility. The weakness is that enumeration process must deals with uncertainties. For the purpose of calculation, the number of application forms is considered as possibility of land acquisition. The land prices are multiplied to the number, and locations were compared. The east terminal has the best possibility as a result.

G. Urban Development Index:

CBD's urban redevelopment effect suitability as a physical distribution center, and future distribution net-work possibilities are enumerates. The east terminal's development effect is relatively large.

17. Result of Evaluation

Indexes are aggregated and scored. The north terminal is the first; the west terminal is second; the east terminal is the third.

Table 6 Results of Evaluation

Index	North Terminal	East Terminal	West Terminal
1. Cargo flow rationalization index	1.30	0.53	1.18
2. Transport cost saving index	1.33	0.47	1.20
3. Traffic congestion relieving index (1)	1.31	0.70	0.99
4. Traffic congestion relieving index (2)	1.98	0.37	0.65
5. First year revenue/cost index	1.02	1.06	0.93
6. Land acquisition index	0.89	1.66	0.45
7. Urban Development index	1.0	1.20	0.80
Total	8.83	5.99	6.20

18. Integrated Evaluation

Since the importance of the indexes varies, the results should be weighted according to the levels of policy significance. When the data is weighed, the order of the second and the third was reversed; the west terminal become the second and the east terminal became the third.

Table 7 Weighted Index

Index	Weight	North Terminal	East Terminal	West Terminal
1. Cargo flow rationalization index	0.20	0.260	0.106	0.236
2. Transport cost saving index	0.10	0.133	0.047	0.120
3. Traffic congestion relieving index (1)	0.10	0.131	0.070	0.099
4. Traffic congestion relieving index (2)	0.10	0.198	0.037	0.065
5. First year revenue/cost index	0.20	0.204	0.212	0.186
6. Land acquisition index	0.20	0.178	0.332	0.090
7. Urban Development index	0.10	0.100	0.120	0.080
Total	1.00	1.204	0.924	0.876

## CHAPTER 7 Design Standard of Truck Terminal

19. The Study prepared a list of facilities, suitable size and layout plan, which are designed applicable for any public truck terminal. Standard line-haul truck and collection/delivery truck are 13-16 ton truck and 2-4 ton truck respectively. These are shown in Fig. 10.

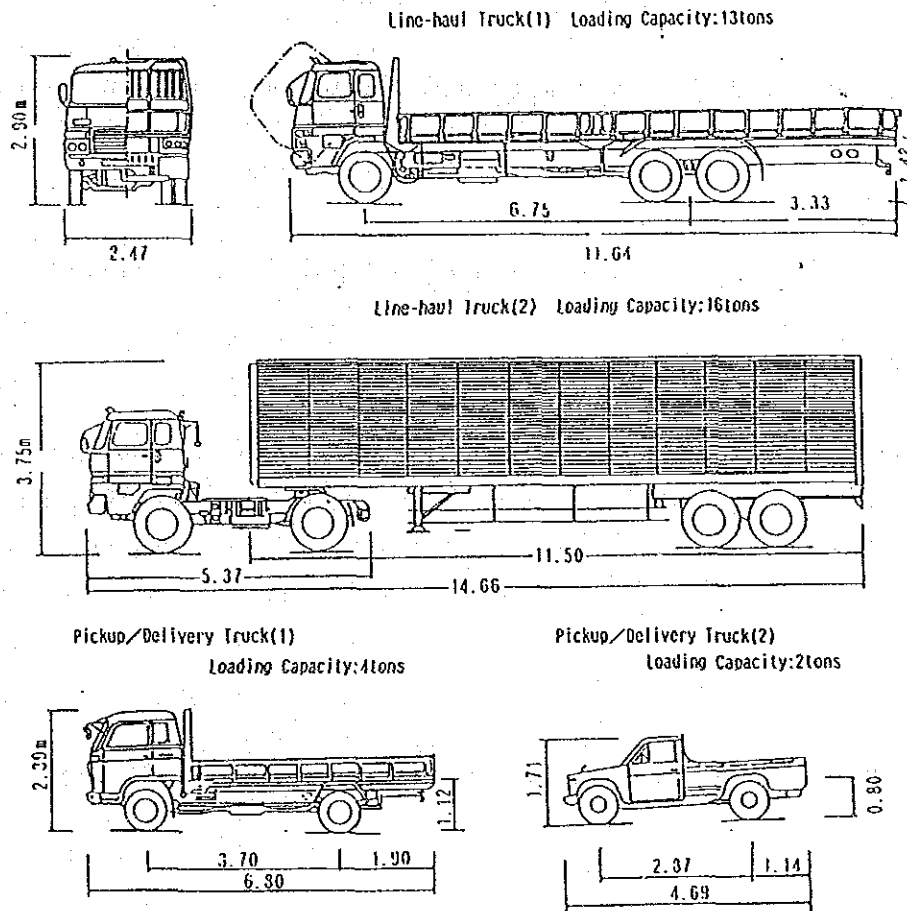


Fig. 10 Dimensions of Line-haul Truck and Collection/Delivery Truck

Public truck terminal has following seven facilities; 1) platform, 2) apron, 3) parking, 4) administration building, 5) service station (repair shop, gas station, car washing facility), 6) green belt, and 7) road.

Of the facilities above, calculation method of appropriate size, layout plan are explained. Design conditions of each facilities, especially design conditions on earth work, pavement, platform, structure, drainage and water supply are described. Fig. 11 shows the design of platform.

This standard of prepared to be applicable to other truck terminal such as west terminal and east terminal.

## **CHAPTER 8      Preliminary Design on North Truck Terminal**

### **20.    Kinds and Size of Necessary Facilities**

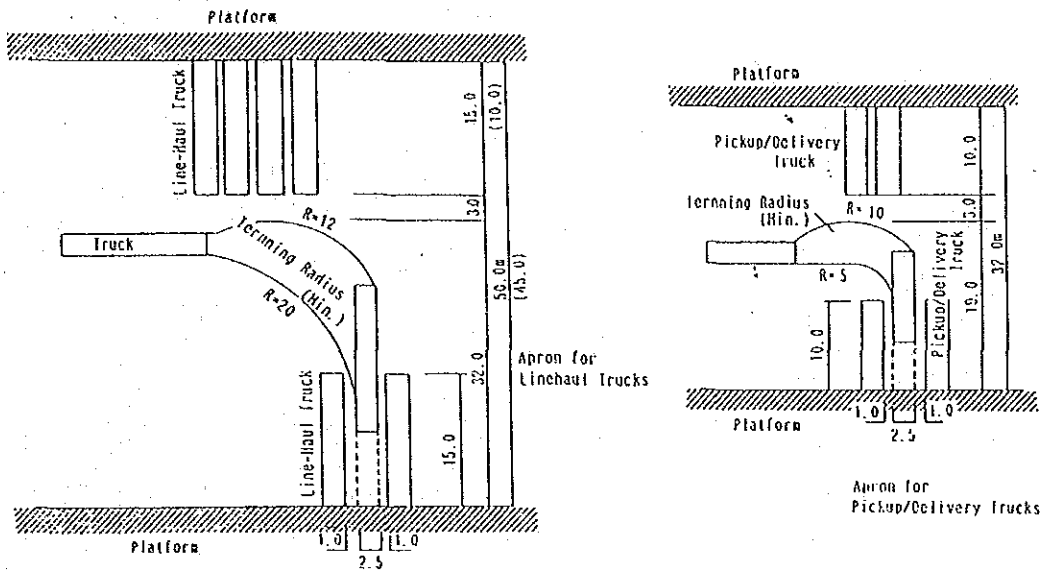
Following seven facilities are installed in the North Truck Terminal; 1) platform for loading and unloading work, and sorting work, 2) apron for parking during loading/unloading , 3) parking for line-haul truck and collection/delivery trucks, and staff use cars, 4) administration building and lodging facilities, 5) service station (repair shop, gas station, car washing facility), 6) green belt for environmental protection, and 7) road.

Table 8 shows the necessary physical area for each facility in Case 2-1.

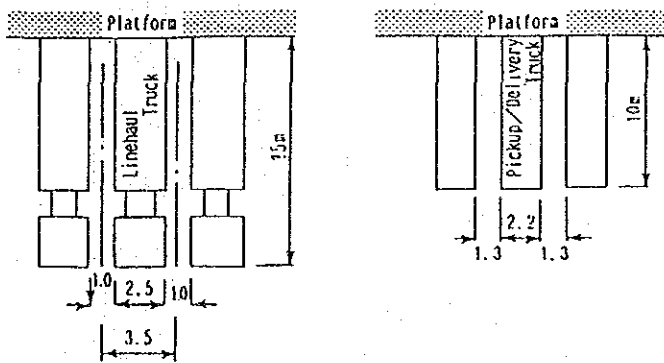
### **21.    Layout Plan**

Three layout plans are examined to select the best layout plan. Each plan is examined in terms of facility area, land area, construction cost, operation and administration.

The best plan is shown in Fig. 12.



General Dimensions of Truck Berth and Spacing between Platforms



Berth Dimensions for Trucks

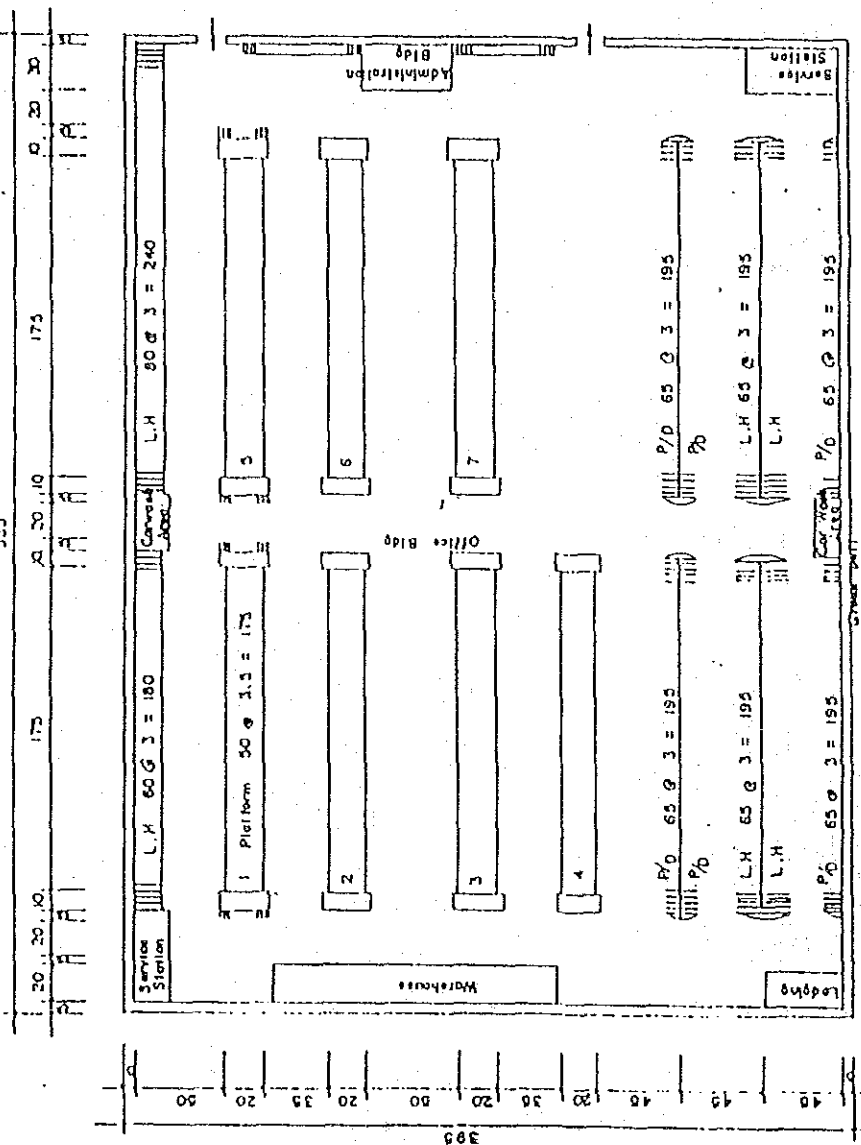
Fig. 11 Design of Platform and Apron

Lay Out of Truck Terminal ( S = 1 / 4000 )

(Alternative - 2 - 1)

Number of Berth 350

Total Area  $335 \times 395 = 21,325m^2$  (132 Rai)      Land Acquisition Area =  $555 \times 415$   
 = 230,325  
 (144 Rai)



Notes : L.H ..... Line-haul Truck

P/D ..... Pickup/Delivery Truck

Fig. 12      Layout Plan of Facilities

Table 8 Necessary Space of Each Facility in Truck Terminal

(unit; sq. meter)

Case	Case 1	Case 2-1	Case 2-2
Platform	35,000	24,500	10,500
Apron	43,750	30,625	13,125
Parking	41,550	32,430	11,325
Linehaul Truck	(18,000)	(18,000)	(6,075)
Pick-up/Delivery Truck	(19,500)	(11,700)	(3,900)
Staff Use	(4,050)	(2,730)	(1,350)
Administration Bldg.	1,500	1,000	600
Office Bldg	6,000	4,200	1,800
Warehouse	5,000	3,000	2,000
Lodging	1,120	800	640
Service Station	4,000	2,800	2,000
Repair Shop	(1,600)	(800)	(800)
Petrol Station	(1,600)	(1,200)	(800)
Car Wash Station	(800)	(800)	(400)
Green Belt	10,150	9,200	5,850
Road & Others	114,080	102,770	40,510
Total	262,150 (164 Rai)	211,325 (132 Rai)	88,350 (55 Rai)

Land Acquisition Area	283,050 m <sup>2</sup> (177 Rai)	230,325 m <sup>2</sup> (144 Rai)	100,650 m <sup>2</sup> (63 Rai)
-----------------------	-------------------------------------	-------------------------------------	------------------------------------

- (Note)
- Figures related to the building indicate the floor area.
  - Road area does not include that of access roads.
  - Construction requires the right of way with width of 10 meters around the terminal site.

## CHAPTER 9 Cost Estimation

### 22. Construct Cost

The construction costs, based on the preliminary design are the followings:

Table 9 Project Cost

Case	Number of Berth	Cost
Case 1	500 Berth	558.26 million Baht
Case 2-1	350 Berth	408.47 million Baht
Case 2-2	150 Berth	192.38 million Baht

The case 1 has two phases of construction schedule: 456,578,000 Baht for 350 berth in 1995, and 101,679,000 Baht for 150 berth in 2000. The berths are added in 2000 to the first location, thus, the total construction cost is lower than the sum of Case 2-1 and Case 2-2. Land acquisition costs are not include, since land is assumed to be leased 1992 price was used for the calculation.

### 23. Contents of Costs

The following example shows the details of Case 2-1 cost estimate:

Table 10 Composition of Project Cost

	(million Baht)
Engineering:	33.20
Construction:	331.96
Supervision:	16.60
Tax (7%) and others:	26.72
<b>Total</b>	<b>408.47</b>



The construction cost is subdivided into the following items:

Table 11 Construction Cost

Item	Cost (million Baht)	Share
Platform	107.31	32%
Paving	61.02	18%
Shell	55.80	17%
Foundation	45.88	14%
Warehouse, Lodge	16.50	5%
Facilities	14.01	4%
Drainage	10.09	3%
Green-Belt	8.3	3%
Earth work	7.61	2%
Access road	3.40	1%
Others	2.00	1%
<b>Total</b>	<b>331.92</b>	<b>100%</b>

#### 24. Operation and Maintenance

The operation and maintenance costs are lower than the construction cost. For example, in Case 2-1, 1995 operation cost is 8,050,000 Baht for 350 berths. The amount includes: labor 57%, electricity 19%, security 11%, water 11%, sewer 2%. maintenance costs includes asphalt over-lay cost of 17,630,000 Baht in every two years, and painting cost of 4,250,000 Baht in every five years. The cost was estimated for the twenty year project period.

## CHAPTER 10 Economic Evaluation

#### 25. Economic Effects

The following items are taken into account as the items of economic effects:

- A. Transport cost reduction
- B. Traffic congestion alleviation
- C. Stable commodity supply

- D. Effective land utilization
- E. Life environment improvement
- F. Limited negative effects on residential environment

26. Benefit Estimate

Among these effects, cost and benefit analysis was conducted on five selected effects listed in the next paragraph. Estimation results are summarized in Table 15.

A. Cost saving on line-haul truck operation rate improvement:

2.5 hours of waiting time due to rush hour truck restriction to CBD and two hours of driving CBD are saved. This reduces the fixed cost per one line-haul truck trip by 0.719 Baht (1992 price). The 0.719 Baht unit price multiplied by the total number of line-haul truck terminal users is the annual benefit. 43% of factual total benefit is in this category.

B. Time saving benefit from the reduction of line-haul truck waiting time:

The total waiting time is calculated by multiplying 1.0 hour for inbound, 1.5 hour for outbound, and line-haul trucks. Base on the waiting time, the benefit is calculated with multiplying the waiting time and an unit driver's cost, which is 41.3 Baht/hour. 19% of factual total benefit is in this category.

C. Saving cost on loading/unloading cargo:

25% of reduction of labor (2 person per hour) is expected to use truck terminal. The saving cost is calculated by multiplying this number of the labor reduction by 27.6 Baht of unit cost of a labor. The benefit is calculated by multiplied this saving cost and the number of line-haul trucks. 10% of the benefit is in this category.

D. Alleviating traffic congestion benefit (1):

Average distance traveled by small collection/delivery trucks is 20 trips with 4 km. trip length. Line-haul trucks run 30 km. of trip length and make one trip per day. After completion of the truck terminal, the former trip is

Table 12 Total Benefits of Truck Terminal

Year	(unit : 1,000 Baht)						(unit : 1,000 Baht)	
	Savings in Line-Haul Truck Operation Costs (Reduction of Fixed Costs of Heavy Truck)	Savings in Line-Haul Truck Operation Costs (Reduction of Waiting Times)	Savings in Handling Costs	Congestion Relief Benefit (Reduction of Truck Trips)	Congestion Relief Benefit (Reduction of Trip Lengths)	Total Benefits	Economic Benefit Accruing to the Trucking Companies (%)	Economic Benefit Accruing to the National Economy (%)
1992	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0
1995	44,629	14,094	7,600	5,257	23,386	94,965	66,322 (69.8%)	28,643 (30.2%)
1996	48,272	16,578	8,936	5,898	25,296	104,779	73,786 (70.4%)	30,993 (29.6%)
1997	51,301	19,161	10,321	6,071	26,883	113,736	80,783 (71.0%)	32,953 (29.0%)
1998	54,518	21,744	11,705	6,468	28,568	123,003	87,967 (71.5%)	35,036 (28.5%)
1999	57,935	24,674	13,274	6,891	30,359	133,133	95,883 (72.0%)	37,250 (28.0%)
2000	61,565	27,999	15,053	7,342	32,261	144,219	104,616 (72.5%)	39,603 (27.5%)
2001	63,502	30,814	16,571	7,566	33,276	151,728	110,886 (73.1%)	40,842 (26.9%)
2002	65,489	32,845	17,666	7,797	34,323	158,131	116,011 (73.4%)	42,120 (26.6%)
2003	67,560	35,010	18,834	8,036	35,403	164,843	121,405 (73.6%)	43,438 (26.4%)
2004	69,685	37,316	20,080	8,281	36,516	171,879	127,082 (73.9%)	44,798 (26.1%)
2005	71,878	39,779	21,408	8,534	37,665	179,265	133,065 (74.2%)	46,200 (25.8%)
2006	74,140	42,399	22,826	8,795	38,850	187,010	139,364 (74.5%)	47,646 (25.5%)
2007	76,473	45,198	24,337	9,064	40,073	195,145	146,008 (74.8%)	49,137 (25.2%)
2008	78,879	48,179	25,948	9,341	41,334	203,682	153,036 (75.1%)	50,675 (24.9%)
2009	81,362	51,355	27,666	9,627	42,635	212,645	160,383 (75.4%)	52,262 (24.6%)
2010	83,923	54,743	29,498	9,921	43,977	222,061	168,164 (75.7%)	53,898 (24.3%)
2011	86,564	58,359	31,453	10,224	45,361	231,961	176,376 (76.0%)	55,585 (24.0%)
2012	89,289	62,213	33,537	10,537	46,789	242,364	185,038 (76.3%)	57,325 (23.7%)
2013	92,100	66,321	35,759	10,859	48,262	253,300	194,180 (76.7%)	59,120 (23.3%)
2014	94,989	70,699	38,129	11,191	49,781	264,799	203,827 (77.0%)	60,972 (23.0%)
2015	97,990	75,368	40,655	11,533	51,348	276,894	214,013 (77.3%)	62,881 (22.7%)

reduced to 16.1 trips with 2.3 kilometers trip length and the latter becomes to 3 trips with 20 kilometers respectively by medium truck. 22% of the benefit is in this category.

E. Alleviating traffic congestion benefit (2):

The total collection/delivery trips is expected to be reduced due to improvement of loading efficiency. 5% of the benefit is in this category.

27. Economic Cost

Economic cost is estimated by the real value of resources. The followings are the economic cost of Case of 2-1 with 350 berths.

Table 13 Economic Cost

1. Total Construction Cost	408.5 million Baht
2. Tax and others	26.7
3. 1-2	381.8
4. Economic cost of land	137.3*
5. 3+4	519.1
6. Modification by shadow prices	468.0

\* Calculated by land productivity

28. Cost Benefit Analysis

The below table indicates the result of the cost benefit analysis:

Table 14 Results of Cost Benefit Analysis

	IRR (%)	NPV (unit: 1000 Baht)	B/C
Case 1	17.39	249,732	1.60
Case 2-1	15.60	131,409	1.28
Case 2-2	16.70	36,196	1.30
Case 3	20.24	316,946	1.54

- A. Each case show the suitability for investment with more than 12% of IRR.
- B. Individual establishment of 350 and 150 berths is more feasible than stage construction at same place.
- C. It is reasonable to construct 350 berths in 1995 and 150 berths in 2000 regarding appropriate use of national resources.

From the sensitivity analysis, which applies 20% increase of construction cost and 20% decrease of benefit, the IRR becomes 11.29% as a result. Early construction is expected.

## CHAPTER 11 Financial Analysis

### 29. Items of Analysis

The primary purpose of the financial analysis is examining a feasibility of the project. Base on the assumption that private enterprises construct and operate the facilities, the analysis is itemized as follows:

- A. Private or a public/private-Joint Venture
- B. Suitable rate of user fees; annual revision of user fees
- C. Land should be lease by the government or not
- D. Appropriate sharing of equity
- E. Possibility of government funding on public facilities such as telephone and roads.

### 30. Conditions of Evaluation

- A. The capital is set at various levels from 10% of total investment to 50 % (excluding land acquisition cost).
- B. Ratio of the capital; the government 49%, private 51%.
- C. The terms of the construction loans are stabilized for five years, 20 year period with 12% interest rate.
- D. Government rents the land for 100 years period utilization.
- E. Various charge levels are examined to make the project feasible. Best Charge system is shown in Table 15.

Table 15 Best Charge System of Public Truck Terminal

Unit Charge of Lease Contract		1992	1995	(1996)	2000	(2001)	2005	2010	2015	2020
Charge 2		3%								
1.	Berth	60	66	68	76	78	88	102	118	137
2.	Parking	33	36	37	42	43	48	56	65	76
3.	Administration Building									
(a)	Meeting Room	99	108	111	125	129	145	169	195	227
(b)	Training Room	99	108	111	125	129	145	169	195	227
(c)	Canteen	96	105	108	122	125	141	163	189	220
(d)	Rest Room <sup>1</sup>	122	133	137	155	159	179	208	241	279
4.	Office	96	105	108	122	125	141	163	189	220
5.	Warehouse	50	55	56	63	65	73	85	99	114
6.	Lodging	120	131	135	152	157	176	204	237	275
7.	Service Station									
(a)	Gas Station <sup>2</sup>	78,822	86,131	88,715	99,849	102,845	115,753	134,189	155,562	180,339
(b)	Repair Shop <sup>2</sup>	78,822	86,131	88,715	99,849	102,845	115,753	134,189	155,562	180,339
(c)	Car Washing Shop									

(Note): \*1. Average of room area is 13 sq. meter per room.  
 \*2. Unit of this charge is set per whole area of one factory.

31. Revenue and Expenditure Comparison

- A. Due to the result of Case 2-1, it is not profitable when a pure private company has to finance full construction cost.
- B. It becomes profitable when the government finances a part of construction cost of truck terminal, namely construction cost of infrastructure, and terminal facilities as well as a land rent for 100 years, equity participation of 49%. The details of each cases are as below:

Case 1:	10.26%
Case 2-1:	14.67%
Case 2-2:	18.11%

Case 2-2 assumes that Case 2-1 will be open prior to Case 2-2.

**CHAPTER 12      Operation and Management Plan**

32. Establishment of Truck Terminal Company

The Study recommends the operation and administration organization as shown in Fig. 13. Fig. 14 shows the second best plan, which can be effective if the implementatin body i.e. Department of Land Transport has enough capability to carry out the project smoothly.

There are three alternatives for the operation and administration body. They are 1) purely private company, 2) purely government company, 3) private company with the government fund. It is judged that the private company with the government fund is the best amongst three. Items of comparison are the followings:

- A. The biggest problem, if the whole project process was carried out by private enterprises, is that equity of users of trucking companies is not guaranteed even with government regulations. This principle of fairness is the most important factor in selecting the best form of operation and administration.

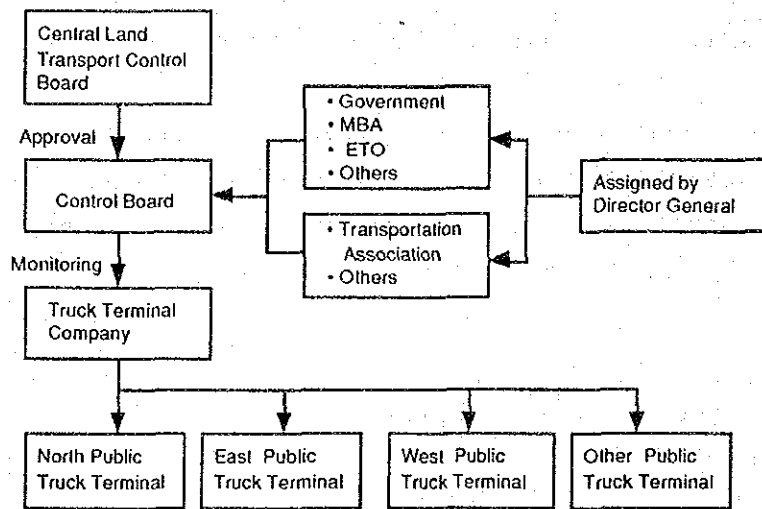


Fig. 13 Best Administrative Organization

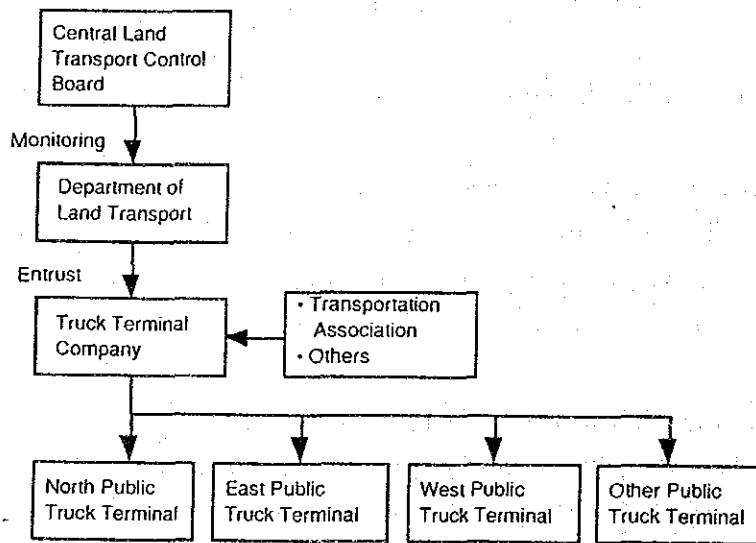


Fig. 14 Second Best Administrative Organization



- B. Development and operation by private enterprises may not be financially feasible (Chapter 11 Financial Analysis).
- C. The government can establish a public corporation and use public land, but the government expenditure for the truck terminal to the full extent is not practical. In addition, the Thai government's fundamental policy restricts establishment of public corporations.
- D. Private company with the government fund is able to loan from commercial banks.

Specific privatization example is in Vol. 5 "Policy and Administration Guideline", for future privatization of the truck terminal corporation.

### 33. Monitoring Board

A monitoring board shall be established for smooth operation and management of the truck terminal. Examples of the board's functions are: construction and expansion of a truck terminal plan implementation, suitability of charges, traffic regulations on line-haul truck, ratio of capital change, and board member change. The board has administration and reconciliation function among public authorities such as Ministry of Transport or Land Transport Department, Bangkok Metropolitan Administration, Police Department, and private sector such as Trucking Association. It enhances lateral ties. Especially government share of the total capital is 49%, which is less than half, signify the private enterprise's management style. "The Truck Terminal Development Acceleration Task Force" shall be establish to accelerate the incorporation, and specify recruitment programs.

### 34. Terminal Operation and Management

The following four departments are established in the truck terminal company. The total number of staff is fifteen to twenty (Security Guards excluded).

Table 16 Organization of the Truck Terminal Company

Section	Responsibilities	Ability
Administration Section	general affairs, legal and legislative matters financial, budgeting and accounting personnel management Secretarial work real and legislative matters	business administration accounting taxation
Supervision Section	property management supervising truck terminal users supervising tenants managing facilities	business administration
Operation Section	supervising berth operation supervision security promotion of truck terminal statistical data	distribution control marketing and promotion
Maintenance Section	utility management building management machine maintenance site and infrastructure maintenance	mechanical engineer civil engineer electrical engineer

35. Facility Use and Rental Method

Facility and rental method is summarized below;

Direct management and charges:	Berth, and Offices
Indirect management and charges:	Parking, gas station, car washing, repair shops, temporary warehouses, doze rooms, lodging

Actual facility management and operation regarding in-/out-vehicle regulations, loading and unloading, sorting, storage and management, machinery facility operation, safety are included in Vol. 4 "Operation and Management Guideline."

## CHAPTER 13 Implementation Plan

### 36. Investment Plan

Investment plan in Case 1 which is stage construction is shown below:

Table 17      Annual Investment  
(Unit : Million Baht)

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Case 2-1	5.9	35.3	299.2	68.0	--	--	--	--	--
Case 2-2	--	--	--	--	--	--	16.7	93.8	81.9
Total	5.9	35.3	299.2	68.0	--	--	16.7	93.8	81.9

### 37. Fund Raising Plan

The recommended fund raising in Cases 2-1 and 2-2 are shown below.

Table 18      Fund Raising  
(Unit : Million Baht)

Item	Amount	Remarks
1. Capital	48.2	
Government	23.6	49% of total capital
Private	24.6	51% of total capital
2. Government Support	118.5	
3. Loan	434.2	
Total*	600.9	

\* Excluding land price

### 38. Land Acquisition

This Study recommends that the government land be rented to the truck terminal company.

144 rai for 350 berths, and 63 rai for 150 berths will be necessary. 350 berths of the truck terminal is scheduled to be completed in 1995 on 169 rai government owned land.

The location is 42 kilometer from CBD. The application to DLT should be completed and accepted as soon as possible. The land is tented to the terminal company for 100 years. The east terminal and the west terminal development projects need to follow the process simultaneously with the north terminal. 150 berths is scheduled to be completed in 2000 on 63 rai of land. The location should not be searched

## CHAPTER 14 Conclusion and Recommendation

### 39. Conclusion and Recommendation

According to the results of engineering, economic and financial analyses, North truck terminal should be immediately constructed among the truck terminals. 350 berths should be completed in 1995 and the remained 150 berths will be constructed in 2000.

The government should rent a land for the truck terminal, construct the infrastructure and the terminal facilities by own budget, and provide 49% of equity of the truck terminal company.

### **III. Contents of "Investors' Guide"**

The following items are summarized in this volume.

- A. Introduction
- B. Concept of Truck Terminal as a Physical Distribution Facility Study
- C. Estimation of Cargo Volume and Selection for Pilot Feasibility
- D. Project Outline of Pilot Feasibility Study
- E. Economic and Financial Analyses
- F. Implementation Enforcement

### **IV. Contents of "Operation and Management Guideline"**

The following items are summarized in this volume.

- A. General Management System of Terminal
- B. Regulation on Users
- C. In-Out Vehicle Regulations
- D. Loading and Unloading
- E. Sorting
- F. Storage
- G. Machinery
- H. Facility Operation
- I. Safety

### **V. Contents of "Policy and Administration Guideline"**

The following items are summarized in this volume.

- A. Guideline for Truck Terminal Law
  - 1. Preface
  - 2. Clarification of the Position of the Public Truck Terminal
  - 3. Regulation Principle of Service Charge
  - 4. Qualification of a Public Truck Terminal Enterprise
  - 5. A Guideline for Truck Terminal Law
  - 6. Some Rules for the Participation of Government Funds
  - 7. Legal Obligation of Line-haul Trucks for Terminal Usage
  - 8. Relation with Physical Distribution Complex
  - 9. Regulation for a Public Truck Terminal Structure
- B. Case Study in Japan
  - 1. Privatization of Public Truck Terminal
  - 2. Line-haul Truck Transport Policy
  - 3. Truck Traffic Regulation Policy
  - 4. Obstacles and Countermeasures in Establishing First Truck Terminal





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