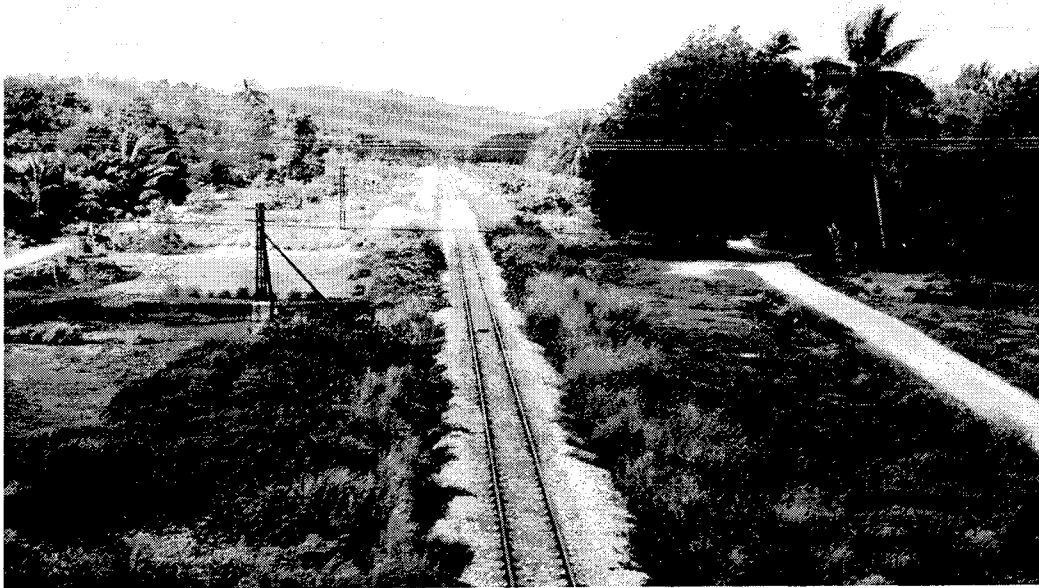


PARSONS BRINCKERHOFF

Feasibility Study for the Development of Inland Container Transport Systems Final Report



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submitted to

**Kingdom of Thailand
Ministry of Transport and Communications
State Railway of Thailand**

submitted by

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in association with
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Booz Allen & Hamilton Inc.**

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Executive Summary

INTRODUCTION

The SRT objectives for this study were to survey Thailand's market potential for containerized rail freight, examine the existing rail network in terms of capacity and facilities, and recommend improvements and investments in priority order that will accommodate anticipated cargo handling and rail traffic. In addition to these tasks the desk study developed for the sponsoring agency, the U.S. Trade and Development Agency (USTDA), said that the "focus needs to be on Customers, Competition, Costs and Profitability."

The study scope consisted of four major efforts: Market Analysis, Terminal Location and Conceptual Design, Railroad Operational Analysis, and Economic and Financial Analysis.

Chapter V (Summary and Recommendations) provides a full summary of the project findings, but the following is a summary of the most significant results:

EXISTING SRT SITUATION

Despite the fact that the SRT does not enjoy the geographic advantages of other rail systems (i.e., transportation distances in Thailand are relatively short), there are still considerable opportunities for increasing its intermodal market share. The following are the pertinent issues with regard to SRT's existing situation:

- *Historical Investment.* Investment by the government of Thailand in the transportation infrastructure has overwhelmingly focused on the highway network, and continues to do so. This lack of infrastructure investment on the SRT system has placed it at a disadvantage with regard to competing against its highway competitors, combined with the fact that enforcement of the weight and loading restrictions on trucks is very lax in Thailand
- *Rail Infrastructure.* The SRT system has a hub-and-spoke design that reaches most major areas of the country, but does not provide adequate coverage into many of the newly industrialized areas, such as the Eastern Seaboard. The overall capacity of the railroad is low, given that most of the system consists of single track territory with outdated signal systems. In addition, the railroad presently serves its customers only through sidings at its stations, and does not have any direct access into industrial estates or the manufacturing facilities.
- *Competitors.* The dominant carrier of freight in Thailand is the trucking industry, with most of the trucks being ten wheelers. ISO containers are standard for the international port trade, while that is not true for the domestic market, where goods are loaded typically by pallet onto the ten wheelers. The trucking firms provide generally reliable service at relatively low cost, with next day delivery being the norm throughout Thailand.
- *Perceptions of shippers and receivers.* In general, the shippers interviewed as part of this study did not view the railroad as a serious competitor for transporting manufactured goods, probably the largest market for intermodal service. Reasons cited were unreliable service, price, and loss and damage problems. It should be stressed, however, that many of these firms have never used the SRT's services and they were speaking of their perceptions, rather than their experiences. It is these perceptions that the SRT must change if it is to successfully compete in the intermodal transportation market.

INTERMODAL MARKET ANALYSIS

The analysis of freight flows examined two areas of potential intermodal freight for SRT:

- International port traffic. This traffic involves primarily the containerized international freight now moving to and from LC Port. Movement of containers between that port and the Lat Krabang ICD is currently the most important intermodal container market for SRT, and this part of the analysis focuses on the potential to develop Lat Krabang ICD to its full capacity, as well as developing additional ICDs when Lat Krabang ICD is no longer able to handle the expanding container volumes. An additional market for SRT in international containers will be between LC Port and the provinces where, as the flows of containers grow, it is likely that containers will be delivered directly to warehouses and distribution facilities in these regions.
- Domestic traffic. The second area of growth is the domestic container market, which could be used for moving manufactured goods and some agricultural commodities within Thailand. This method of transportation is growing rapidly in countries such as the U.S. and India, and there is potential in other countries to expand containerization beyond the uses for international cargo.

Based on market projections made for each of these two areas, the following conclusions were reached:

- For international traffic, the current Lat Krabang ICD will reach capacity by 2006 (current capacity for this ICD is defined as 1,000,000 TEU/year, given certain improvements to the existing facility). To meet growing demand, by 2006 either the existing Lat Krabang ICD needs to be significantly expanded, or a new ICD needs to be constructed (recommended site is Ongkharak). By 2010, a second ICD will be needed at one of those two locations, and then demand after that time will be shared between Lat Krabang ICD and Ongkharak ICD.
- A system of Container Terminals (CTs) could be developed by the SRT for the domestic traffic, but traffic demand at the CTs will be small in the early years (less than 8,000 TEU/year), growing as the use of containers in the provinces increases. The projected market share for the new CTs is highly dependent on the implementation of reliable next-day service by SRT from each of these facilities.

RECOMMENDATIONS

The following recommendations are made with regard to developing an inland container transport system.

INFRASTRUCTURE

- A top priority is the implementation of the changes recommended by the PB team to make the existing Lat Krabang ICD more efficient. This would involve increasing its overall (ground-based) capacity to 1 million TEU/year, and making improvements to the track system to raise its rail capacity to at least 750,000 TEU/year. The initial ground-based system improvements would be operational, but the rail capacity improvements would require changes in infrastructure.
- Steps should be taken for the privatization and development of Ongkharak ICD, as well as the expansion of Lat Krabang ICD, in the two stages recommended in this report. Property should be acquired for each of the facilities, and a process begun for their privatization and development. With regard to which facility should be developed first, from an economic standpoint it would appear that Ongkharak would be the better choice, and also from a rail

operations viewpoint, considering the scope of the track improvements which are necessary to increase Lat Krabang's rail capacity.

Another reason for the development of Ongkharak ICD as soon as possible is the dual nature of the proposed facility. A CT is recommended for Ongkharak in the short term (2001), in order to handle the domestic traffic from the provinces. Until an ICD is constructed at Ongkharak, however, the international traffic from the provinces would need to be shuttled through Lat Krabang ICD, making this an inefficient and costly operation in the short term. An ICD and CT together at Ongkharak would provide a significant focus and cost-efficient operation for the SRT.

The BOOT concept is recommended as the contractual arrangement for the development of these ICDs, considering the significant traffic volumes which are expected.

- The double tracking program from LC Port to Lat Krabang ICD should be completed as soon as possible, but no later than 2006 (in anticipation of the expanded Lat Krabang ICD). This initiative is critical for increasing the rail capacity in this corridor, which is necessary to supply both the Lat Krabang ICD and Ongkharak ICD.
- Another high priority is the development of a phased program for the CTs, similar to the conceptual designs in this report. The facilities should be developed under the BOOT scenario, with consideration given to the PB privatization recommendations given in this report. Despite the financial projections in the initial years, the CTs should be viewed as "engines" of regional economic development, and as necessary starting points for the SRT intermodal services.

The CTs at Lamphun, Phitsanulok, Ubon Ratchathani, and Hat Yai should be the first constructed. CTs at Khon Kaen, Korat, Ongkharak, and Ban Phachi, whose financial summary was less favorable, should be reviewed for their particular circumstances:

- Khon Kaen. The single factor which influenced the financial projections for this site was the cost of the land. Since this was an early real estate price given to PB by the SRT, this price should be evaluated to see if it can be reduced, in which case the CT should be developed since it is the only location serving the Upper Northeast region of Thailand.
- Korat. The CT site at Korat was explored with the goal of it being an intermediate point where trains from the Upper and Lower Northeast Lines would be combined, in addition to collecting further container traffic from the Korat area. If the traffic projections at Korat do not warrant a CT, then at least the infrastructure necessary to reliably and efficiently combine the intermodal trains from Khon Kaen and Ubon Ratchathani should be in place.
- Ongkharak. The CT site at Ongkharak is the termination point for the container traffic from the Northeast Line. This traffic will have both international and domestic containers, and a CT at Ongkharak is intended to be the distribution point for the overnight domestic traffic. In addition, the future ICD would become the focal point for all international traffic from the provinces. If the Customs Department regulations can be modified, such that a single facility could be built with separate sections for the two types of traffic, then there would be a considerable savings in capital costs.
- Ban Phachi. The important issue for the Northern Line was next day service to and from Bangkok. Ban Phachi, or a CT in an area close by, was considered critical to that goal. If it is possible, therefore, to provide next day service without Ban Phachi, then it does not need to be developed, but otherwise not constructing this CT may mean that the traffic projections for Lamphun and Phitsanulok may be somewhat less than anticipated in the market forecast.

The financing of these sites could follow a number of scenarios, such as the SRT directly subsidizing the construction and contracting the operation. Alternatively, future development of these CTs could be made optional as part of the BOOT contract or contracts for the CTs at Lamphun, Phitsanulok, and Ubon Ratchathani. Linking the development of these more profitable

CTs to the less profitable interior CTs may be justified and could be taken up by developers to the extent that the latter expand the market share of the former.

RELIABLE SERVICE

In line with developing the ICDs and CTs, the SRT should take the steps necessary to establish reliable train service to the facilities:

- **Train Schedules.** Develop specific train schedules which take advantage of the nighttime windows for moving intermodal freight to and from the provinces.
- **Rolling Stock.** Evaluate the SRT rolling stock required for the increased services, particularly the flat cars and locomotives. In addition, a preventative maintenance program should be established to increase the reliability of the fleet.
- **Operating Costs.** An evaluation should be made of the SRT internal costs as they relate to freight service. Certain cost reduction measures may be necessary in order to begin controlling costs and being price-competitive with trucks.
- **Work Rules.** If it is considered necessary for providing reliable service, the daily working hours and reporting locations of the Traffic and Mechanical Departments should be unified.
- **Operating Philosophy.** The greatest challenge here will be the orientation of the SRT personnel toward the importance of the new intermodal service. Accordingly, training programs should be started to engage the crews who will actually be operating the trains, station masters for understanding the importance of efficient movements on a daily basis, and other training as required.
- **Customer Interface.** Policies and guidelines should be developed for the new service, particularly with providing real time information on shipments to customers. Information system improvements should be implemented as necessary to supply such information.
- **New Technology.** The SRT should strongly consider the use of end-of-train devices (EOT) for the elimination of brake vans on intermodal trains. The issue is not so much reducing labor costs, as it is increasing the efficiency of the train movements in the new CTs and ICDs.

COMPETITIVE PRICING

It is recommended that the SRT adopt a pricing level similar to that suggested in Chapter IV.B the Economic Analysis. It is further recommended, however, that the SRT perform significant research into the competitive pricing levels of various trucking firms, both regionally and locally, and create a database with this information, which can be regularly updated to evaluate their pricing levels. Another aspect of pricing that may need to be reevaluated is short haul rates applicable to service between LC Port and Lat Krabang ICD (and in the future, between LC Port and Ongkharak ICD). While the shorter distance means that rail costs and thus rates will be higher than for longer hauls, this market is also subject to intense competition from trucks. Providing discounts for larger volume customers, or special pricing for full service contracts from LC Port to point-of-delivery, may provide one way for the SRT to compete with trucks, which are subject to greater competitive pressures and excess capacity within the industry.

CUSTOMER BASE

Comments were provided in the MDP with regard to the target customers for the SRT intermodal service, and what actions the SRT should take to attract their business. It is recommended that these actions be taken.

The highest priority should be given, however, to the SRT staff adopting a new approach to the marketplace and its future customers. Customer forums should be held in order to help the SRT staff understand the needs of potential customers, and then a marketing strategy for each industry needs to be developed, targeted to their specific transportation requirements. The SRT

needs to change perceptions of the shippers and show that it can add value to their distribution system.

In addition, the SRT should form strategic partnerships with the Customs Department, Port Authority of Thailand and the IEAT. With this partnership, the planning for new facilities can be achieved in a coordinated effort, and the resolution of institutional issues (barriers between agencies or departments) can be addressed efficiently. These partnerships are considered critical for building an improved inland container transport system.

Finally, it is also recognized by the PB team that the privatization of the entire SRT is being discussed, as with most other nationalized railroads. While this larger issue was not specifically evaluated by PB, it is worth noting that the increase in revenues from a successful intermodal operation, and the changes to a more customer-focused service, will benefit the SRT in many ways, including enhancing the privatization potential of SRT services.

The two most important tasks facing the SRT management, as with any other business, will be controlling its costs while increasing revenues, and this will be true whether the railroad system is privatized or not. While the PB effort primarily concerned the development of a strategy for increasing revenue through the new intermodal services, it is recommended that the SRT should seriously address the issue of controlling costs if it is to be successful in the long term.



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List of Abbreviations

Abbreviation	Description
AEI	Automatic Equipment Identification
APL	American President Airlines
B/C	Benefit/Cost Ratio
BA&H	Booz Allen & Hamilton, Inc.
BMA	Bangkok Metropolitan Area
BOI	Board of Investment
BOO	Build, Own, and Operate
BOOT	Build, Own, Operate, and Transfer
BOT	Build, Operate, and Transfer
CFS	Container Freight Station
COFC	Containers on Flat Cars
CONCOR	Container Corporation of India
CT	Container Terminals
CY	Container Yard
DLT	Department of Land Transport
DP	Data Processing
ECT	Evergreen Container Terminal (Thailand) Co.
EDI	Electronic Data Interchange
EIRR	Economical Internal Rate of Return
EOT	End-of-Train
ESCO	Eastern Sea Laem Chabang Terminal Co.
FA	Ferrocarriles Argentinos
FCL	Full Container Load
FY	Fiscal Year
GPS	Global Positioning System
GRP	Gross Regional Product
ICD	Inland Container Depots
IEAT	Industrial Estate Authority of Thailand
JARTS	Japan Railway Technical Service
JICA	Japan International Cooperation Agency
JWD	Jordan Woodman Dobson
LC Port	Port of Laem Chabang
LCL	Less-Than-Container Load
MDP	Market Development Plan
NESDB	National Economic and Social Development Board
NPV	Net Present Value
OTP	On-Time Performance
P&G	Proctor and Gamble

Abbreviation	Description
PAT	Port Authority of Thailand
PB	Parsons Brinckerhoff
ROI	Return on Investment
ROW	Right-of-Way
SRT	State Railway of Thailand
SSS	Siam Shore Services
TDRI	Thailand Development Research Institute Foundation
TEU	Twenty-foot Equivalent Units
TGS	Twenty-foot Ground Slots
TISP	Terminal Inventory Simulation Program
TOT	Telephone Organization of Thailand
US	United States of America
USTDA	United States Trade and Development Agency

Feasibility Study for the Development of Inland Container Transport Systems

I. INTRODUCTION

It is the goal of the government of Thailand and the State Railway of Thailand (SRT) to reduce the traffic congestion on the national highway and roadway network, and increase the economic opportunities that will arise from a projected growth in container throughput at the port of Laem Chabang (LC Port). SRT believes that improvement of the rail network, as well as consolidation and containerization of domestic freight at strategically located loading/distribution centers (rail-based inland container terminals), would significantly improve freight handling and movement. For SRT, development of these terminals would foster greater efficiency, productivity and competitiveness.

The SRT objectives of this study were to survey Thailand's market potential for containerized rail freight, examine the existing rail network in terms of capacity and facilities, and recommend improvements and investments in priority order that will accommodate anticipated cargo handling and rail traffic. In addition to these tasks, the desk study developed for the sponsoring agency, the U.S. Trade and Development Agency (USTDA), said that the "focus needs to be on Customers, Competition, Costs and Profitability."

The Parsons Brinckerhoff (PB) team recognized the dual nature of the objectives stated above. Developing a significant intermodal market share for the SRT is not a matter of infrastructure alone, since there are significant organizational and systemic issues which need to be addressed also. As a result, in this report there is considerable emphasis placed on winning new customers, controlling costs, and other issues which must be addressed by the SRT organization before it can successfully compete in the intermodal marketplace. The report contains both a Market Development Plan (MDP), and a specific strategy for implementing the MDP.

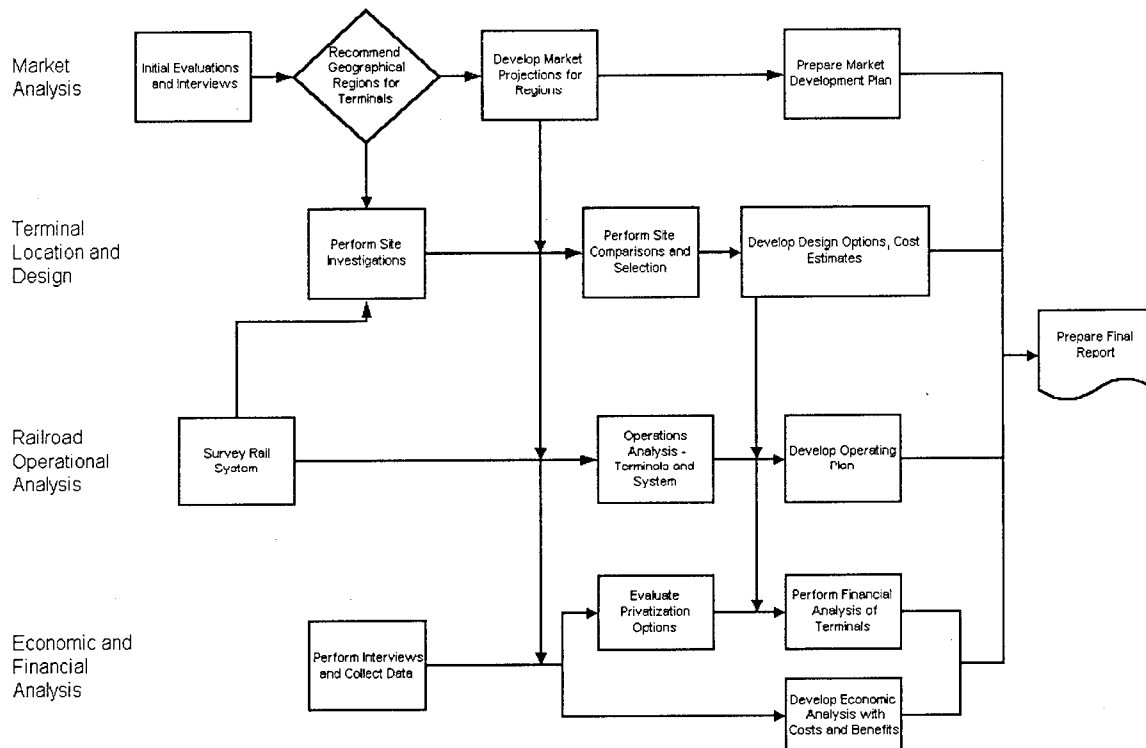
The study scope consisted of four major efforts:

- **Market Analysis:** Review of existing studies, survey of the potential intermodal market, analysis and forecast of potential traffic, and preparation of an MDP.
- **Terminal Location and Conceptual Design:** Survey of existing stations, yards and other potential sites, selection of the most suitable container terminal sites, ranking of the proposed sites, evaluation of the various modes of terminal operations, and production of conceptual designs and equipment requirements for the terminals.
- **Railroad Operational Analysis:** Preparation of an SRT operating plan, recommendation of service lanes and rolling stock requirements, rail operational analysis of the Lat Krabang ICD facility, estimation of capital and operating costs, and recommendation of options for participation of the private sector.
- **Economic and Financial Analysis:** Recommendation for a rail tariff structure, comparison of socioeconomic costs and benefits, assessment of financial viability, and preparation of pro forma financial statements for the new terminals.

The subtasks involved in each of these major efforts are shown on Figure 1, the Flowchart for Work Effort. The project began with initial meetings with the SRT staff in order to understand their specific goals and expectations for the project, followed immediately by interviews with a significant number of shippers, freight forwarders, trucking firms, and other governmental departments. A complete summary of these interviews is provided in Table A-1 (Appendix A),

followed by Table A-2 (Appendix A) which summarizes all the material received during the course of the PB investigation. SRT was provided with complete notes on all the interviews as they were conducted.

Figure 1
Flowchart for Work Effort



The first deliverable for the project was a report (Subtask B.1 Report) which summarized the market data gathered to that point, and recommended specific geographical regions for the development of new container terminals by SRT. The recommendations from this report were essential to the site investigations and the railroad analysis, which proceeded shortly thereafter.

Once the site investigations were completed, and the market projections were developed for each of the regions and terminals, all the essential elements were in place for developing the conceptual designs of the terminals and a railroad operational analysis. It is important to note that two very different types of terminals are contemplated in the report: Inland Container Depots (ICD), and Container Terminals (CT). The different concepts are fully explained in the report but, in general, an ICD is a major terminal which acts as an extension of LC Port for the Bangkok area, and a CT is a smaller facility, located in a province, which serves as a collection and distribution terminal for container traffic in that region.

After the development of the capital and operating costs for both the terminals, and the SRT railroad service to those terminals, the economic and financial analyses were then prepared. A financial statement was prepared for each of the new terminals, and the economic analysis evaluated the larger issues involved with the SRT increasing their intermodal market share.

II. MARKET ANALYSIS

A. INTRODUCTION

The objective in the market analysis was to examine the potential market in Thailand for containerized rail freight, evaluate the ability of the existing rail network to handle the demand, and recommend operational and strategic improvements that will enable the railroad to effectively secure and serve this market.

This chapter provides background on the current freight market in Thailand, projects the future rail freight demand, and provides a market development strategy designed to help SRT realize this potential demand by capturing more domestic and international intermodal traffic.

The development of market projections and a marketing strategy consisted of three primary steps:

- First, the PB team developed an understanding of the current transportation market. This included:
 - Examining the existing freight transportation infrastructure in Thailand
 - Investigating current transportation providers, including modal market shares and service characteristics
 - Interviewing local shippers and freight forwarders, as well as railroad and government officials, to provide insight into the domestic transportation market, the decision making process of the shippers, and the market presence of the railroad and other modes of ground transportation.
- Next, the PB team forecasted the future freight market for rail in Thailand, focusing primarily on the intermodal container market. These forecasts, which assumed the implementation of a successful SRT market-focused service strategy, were developed by:
 - Reviewing available port, rail and highway freight traffic data and reports, in order to establish a baseline of existing traffic, market share and capacity by region
 - Reviewing current and projected economic data for Thailand and the major regions of the country
 - Examining international trade and port projections
 - Applying potential freight diversion and capture rates based upon the characteristics of specific commodities and trade lanes.
- Finally, lessons learned in the creation of intermodal systems in the U.S. and developing nations, such as India, were applied to formulate a market strategy designed to capture freight currently moving by truck.

The result of this process was a comprehensive review of the existing and future freight transportation market, and the development of a marketing and investment strategy for the SRT.

B. INLAND TRANSPORTATION NETWORK OF THAILAND

The first step in assessing the future of rail in Thailand's intermodal market was to examine both the physical and service characteristics of the existing transport network.

1. General Infrastructure

Figure 2, Existing Highway Network in Thailand, and Figure 3, Existing Rail Network in Thailand illustrate the existing highway and rail networks within Thailand, respectively. As can be seen, highways dominate the transportation infrastructure, with more than 98,000 lane-km operated by the Department of Highways, and another approximately 15,000 lane-km operated by other governmental departments. This is compared against the 4041 route-km in the SRT system, only 90 km of which is currently double tracked. Based on these figures, the size of SRT's existing infrastructure is, in comparison, only about 3.5% that of the highway network.

In addition to the current dominant position of the highway infrastructure, future planned highway construction spending overwhelmingly exceeds planned rail construction. Planning and investment for highway construction appears, in fact, far more comprehensive and focused on the long term as shown in Table 1 below – suggesting a continued reliance in Thailand on highways for the movement of goods and people well into the future.

Table 1
Infrastructure Development Projects in Thailand
(Billions of Baht)

	Highway	Rail
Planned Spending	B705	B7
Existing Infrastructure	113,000 lane-km	4131 track-km
Planning Horizon	20 years	5 years

*Source: Infrastructure Development Plan for Thailand, Office of the
National Economic and Social Development Board (NESDB), June 1997*

2. Governmental Investment

Historically, transportation infrastructure development in Thailand has been oriented to individual projects funded primarily by the national government, since the first National Economic and Social Development Plan in 1961. During the first and second plan, between 1961 and 1971, primary highways increased from 8,500 km to 22,124 km. Four types of infrastructure development were stressed in this plan: roads, electricity, water and telecommunications. As can be noted, there was no particular emphasis on railroads.

During the fifth plan (1982-1986) the government pursued a policy of attempting to ease the congestion in Bangkok by encouraging development in the other regions of the country. The Eastern Seaboard Development Plan in the Eastern Region of Thailand was initiated in 1981 to make this area the country's new economic base, and to open up Thailand to international marine trade by building a new marine container port (LC Port). The project used infrastructure investment to concentrate industry in the area, and to create economic activity which was intended to move some of the industrial focus out of Bangkok, but still within close proximity to the economic activity and population of the metropolitan region.

Development of the Eastern Region included plans to build more highways, as well as additional air and maritime facilities, but again there was limited consideration of rail, except for a high speed rail link to serve a second international airport for Bangkok.

The current Eighth National Economic and Social Development Plan places emphasis on the social rather than the economic aspects of development, and attempts to plan for the "coordination and integration of all transport modes into a unified system."

As a result of this investment over the past three decades, Thailand has built a modern, comprehensive highway system which connects all of the major cities, as can be seen from Figure 2. The point being made is that the railroad system has not received a similar level of

Figure 2
Existing Highway Network in Thailand

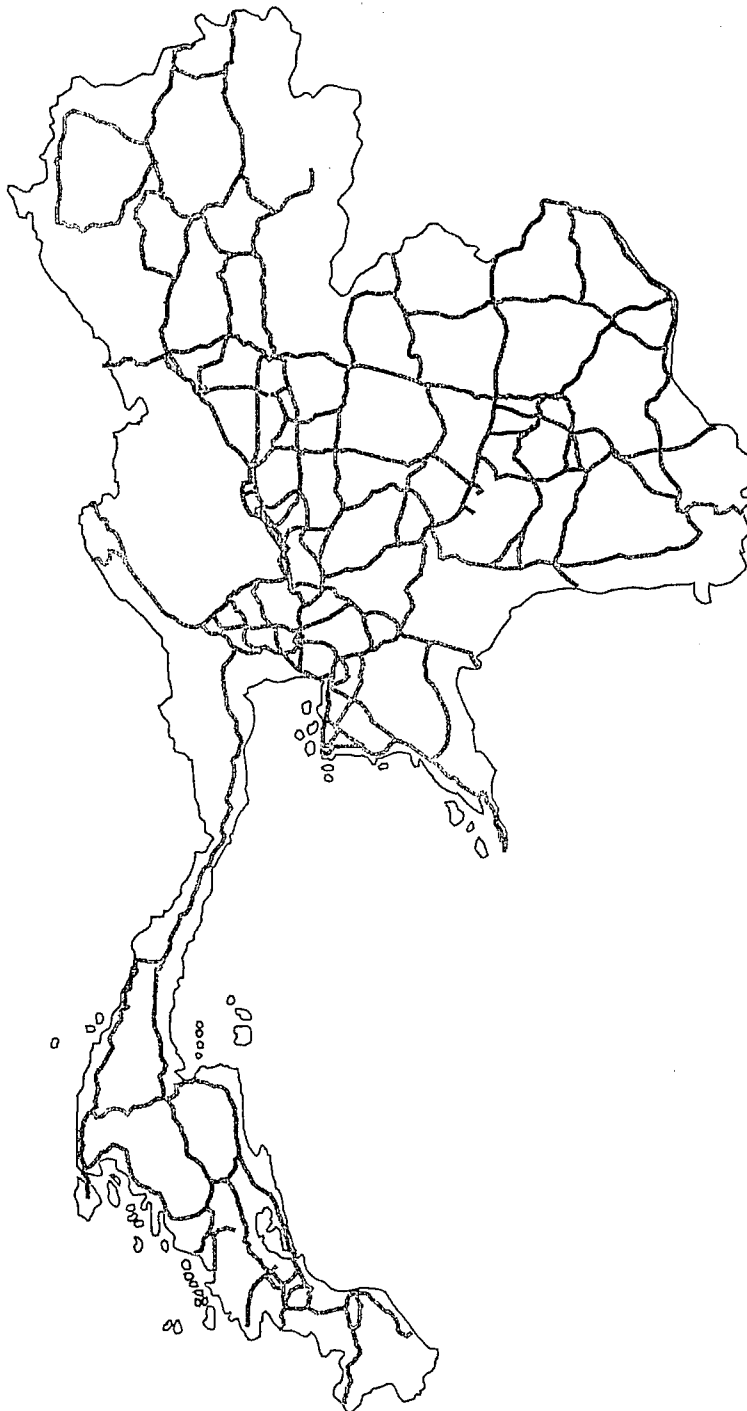
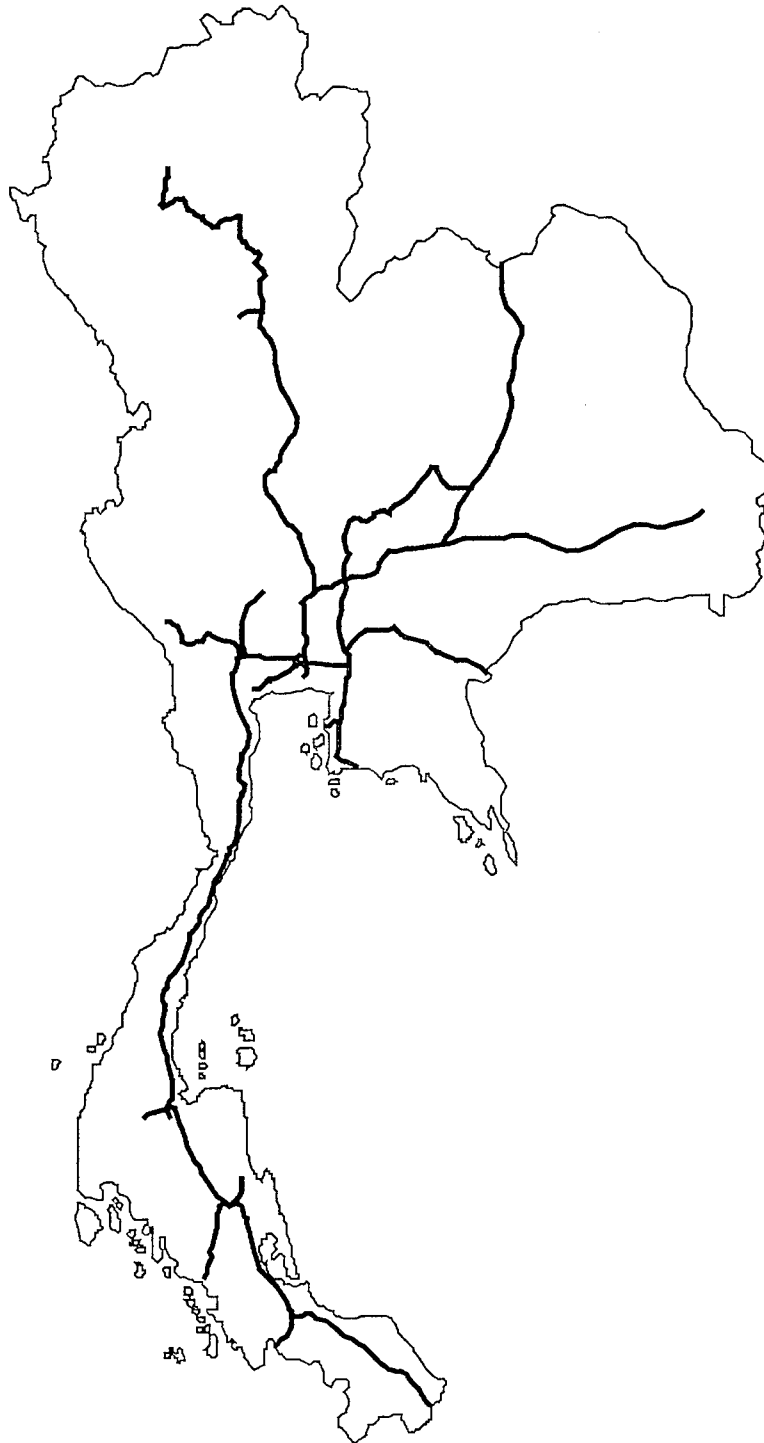


Figure 3

Existing Railway Network in Thailand



investment and priority during this time period, but it has nonetheless continued to play a significantly improving role in the transportation system of Thailand, for both passenger and freight modes.

3. Rail Infrastructure

The rail infrastructure in Thailand is not as comprehensive as the national highway system. The structure of the railroad network is a "hub and spoke" design with Bangkok as the hub, and while this provides an adequate route structure between the regions and Bangkok, it provides only indirect access between city pairs in the regions outside of Bangkok. In addition, the existing network does not provide adequate access into developing industrial areas such as the Eastern Seaboard.

The majority of the rail lines are single track rights of way (ROW) with outdated signal systems, which limits the overall capacity of the railroad. The rail network also has numerous grade crossings, especially in the urban areas, which cause delays and have led the government to restrict the times of day and the numbers of freight trains that the railroad can operate. Even during times of the day when the railroad is allowed to operate in the cities, the movement of traffic on these lines is very slow.

Passenger service is a primary focus for the SRT, and must be considered when discussing the overall capacity of the railroad. Passenger trains dominate the rail system in and near Bangkok during the daylight hours, and consequently any freight train movements during these time periods are difficult to schedule. Since increasing the amount of passenger trains is also a priority for the SRT, as well as additional freight trains, the rail infrastructure around the Bangkok metropolitan region is a significant issue in scheduling reliable intermodal freight service.

Even with the restrictions and issues mentioned above, the SRT has been able to increase the overall amount of revenue train kilometers over the last five years, but any significant increases in capacity will require investments in the infrastructure.

4. Rail Investment

As has been noted above, until recently there has been relatively little new investment in the rail network since the first National Economic and Social Development Plan in 1961. Consequently, the ability of SRT to serve developing markets in the regions, and in the Bangkok metropolitan area, is constrained by a route structure which was developed to meet the needs of the country before the rapid growth of the last 15 years.

The most significant investment being made in the rail system is for double tracking of existing rights of way, shown on Figure 4, SRT Double Tracking Program. The figure shows the extent of the SRT double tracking construction program which has been approved by the Thai government, and the focus clearly is to expand capacity in the Bangkok metropolitan area. The increase in trackage which will result from this program is absolutely essential, both for the addition of passenger trains and intermodal trains, as is discussed later in this report.

Some new routes or route extensions are being built in the Eastern Seaboard region, but the SRT route structure is generally located on the fringes of this area, and does not provide any meaningful service into the heartland of this rapidly growing region. Currently, there is a new rail line extension being planned to Trat, but this is being driven by the need to carry passengers.

It should be noted that, while the planning horizon for highway development is the next twenty years, the railway program includes only projects which have been developed at the current time, and does not yet constitute a long range strategy. This report is intended as a first step in the development of that strategy for SRT, at least with respect to the intermodal freight market.

SRT Double Tracking Program

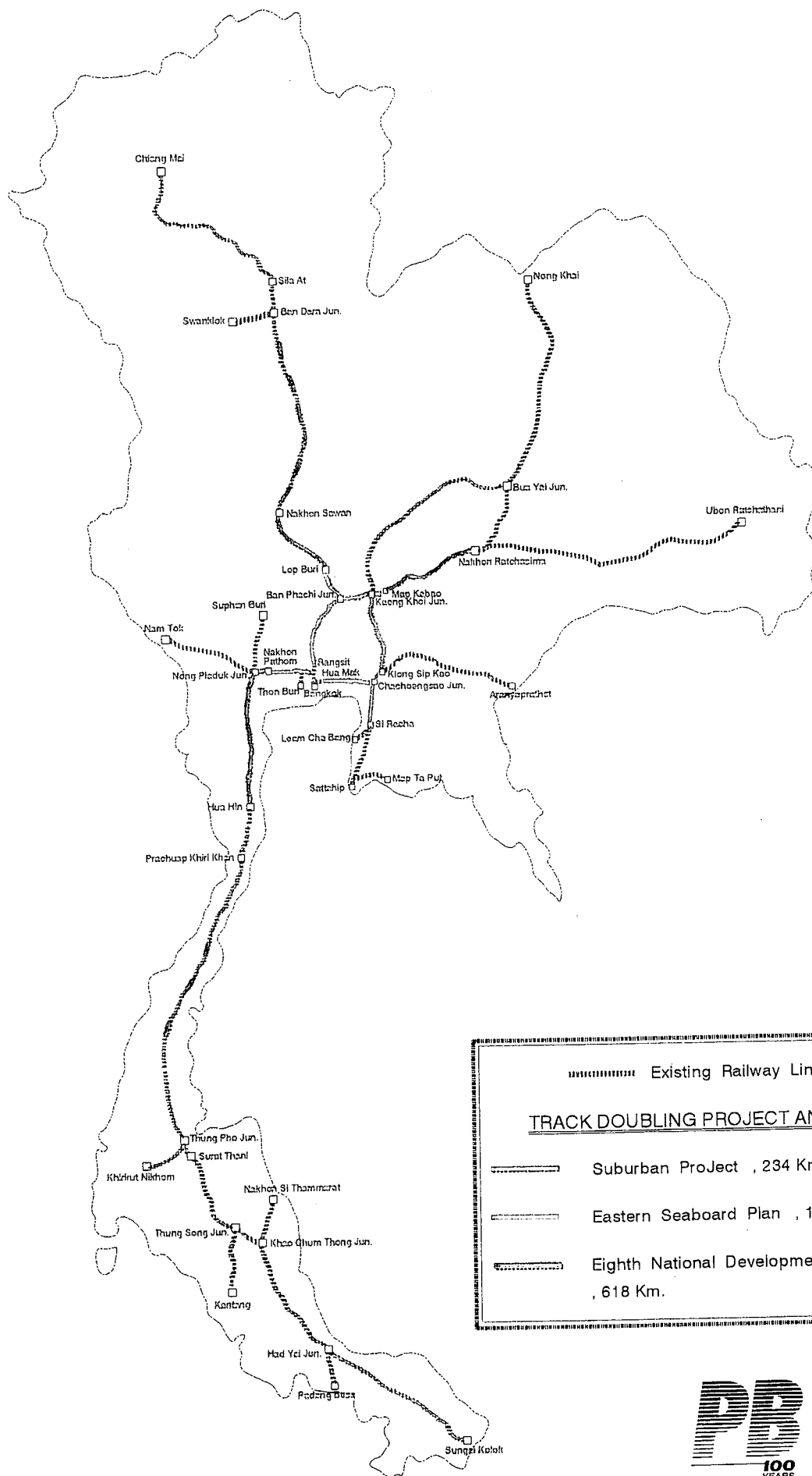


Figure 4

C. TRANSPORTATION PROVIDERS

1. General

In evaluating the economy of Thailand and the current system of transportation providers, an overriding issue is that most of the economic activity is in the Bangkok metropolitan region. This is illustrated in Table 2 below:

Table 2
GNP in Thailand
(Billions of Baht)

Area	1991	1996
Bangkok	814	1206
Bangkok suburbs	270	437
Subtotal	1084	1643
All Thailand	2111	3102
Bangkok % of Total	51.3	53.0

*Source: Thailand Development Research Institute Foundation
(TDRI) Transportation Master Plan (1997)*

As a result of this economic concentration, transportation distances in Thailand tend to be relatively short. While the provinces are increasing in their manufacture of goods and purchasing power, at the present time the majority of goods are still produced and consumed in the Bangkok metropolitan region. As will be discussed later, this economic relationship of Bangkok to the provinces should change considerably in the future. However, given the extensive and expanding highway network, and the relative small size of the country, it is not surprising that the freight transportation market in Thailand has been controlled primarily by trucks for decades.

Since the mid 1980s, trucks have carried more than 89 percent of the total freight moved in Thailand while rail's share has declined from 3% to just under 2%. This is shown in the figures presented below in Table 3. Considering that the SRT system possesses an infrastructure which amounts to only 3.6% that of the highway network, and that the passenger service dominates the rail system during half the day, a 2% market share is still a noteworthy accomplishment.

Ocean carriage has also grown dramatically in the ten years since 1986, from 0.9% market share to 2.3%. The prevalence of containerization in ocean shipping has helped to increase the transport of containers by SRT (primarily to Lat Krabang ICD), as a result of inland shipping of these containers. It is not apparent from any of the data provided that there is yet any significant volume of domestic containers moving within Thailand.

Table 3
Thailand Transport Market Share by Mode (1986 to 1996)

Mode	1986	1996
Highway	90.2%	89.5%
Rail	3.0%	1.9%
River	5.9%	3.8%
Ocean	0.9%	2.3%
Air	nil	0.01%
Pipeline	nil	2.4%
Total	100.0%	100.0%

*Source: TDRI Transportation Master Plan (Aug 1997),
and Updated Transportation Master Plan (Oct 97)*

Freight transportation has evolved into an extremely competitive business in the recent past, not only in Thailand but globally, and the following comments are intended to highlight the current positions of the trucking and rail industries in Thailand.

2. Trucks

Competition to rail for the intermodal freight market is currently provided primarily by ten wheel trucks, which are the backbone of the long haul heavy truck fleet in Thailand. Ten wheel trucks comprise 45% of the truck volume, on surveys taken by the Department of Land Transport in the 1980s and 1990s, according to a 1992 Study on Greater Bangkok Truck Terminal In The Kingdom Of Thailand, by the Japan International Cooperation Agency (JICA). This study was commissioned by the Kingdom of Thailand's Department of Land Transport (DLT).

These trucks are used in the carriage of almost all commodities in Thailand, from manufactured commodities to bulk goods. They are so plentiful that the government has found it necessary to restrict their operation in the cities, to times of the day that do not conflict with heavy travel times for other types of traffic. Access to the cities is generally unrestricted for smaller trucks.

In discussions with shippers, it was found that ten wheel trucks particularly dominate the movement of long-haul manufactured commodities which are hauled to central warehouses. From these warehouses, further distribution is then made by six wheel and four wheel trucks (which are generally not restricted in the times of day that they can operate).

Notable advantages of the trucking industry in Thailand include:

- Next day service throughout Thailand. Delivery of goods on the next business day is the standard in Thailand, with very little double handling required.
- Low user fees (taxes) for operating trucks. The typical user fee is approximately 4,350 Baht/year, which is relatively low in light of the construction and maintenance costs of the national highway system.
- Ability to overload trucks. It is common in Thailand to overload trucks to approximately 28 gross tons, according to companies interviewed during the study. This is in excess of the legal load limit of 21 gross tons for ten wheel trucks, but it is apparently rare for truckers to be penalized for overloading. When they are caught and fined, it is viewed as a relatively minor additional cost of doing business.
- Strong customer interface ("one stop shopping"). Shippers in Thailand typically have close relationships with the trucking companies. For example, Colgate Palmolive uses only one trucking company in Bangkok, Union Strong Trucking, which has a fleet of over 1,000 trucks. Colgate characterizes their transportation rates as very low, so they are not aggressively seeking alternatives.
- Wider logistics function. Trucking firms also appear to be taking on a much wider freight management role for companies. Manufacturers interviewed by the PB team use the trucking companies for warehousing and distribution services, not just for transportation. The role of the trucking companies is similar to what is becoming known in the United States as logistics management. This has come to mean management of the entire supply chain, including the inventory and distribution of goods, not just the flow of goods from one place to another. Comments from these interviews focused on the ease of dealing with the truckers, the reliability and convenience of the services they provide, the availability of their equipment, their flexibility with regard to adapting to the shipper's transportation needs, and low cost. In general, manufacturers were satisfied with the service and prices they were receiving from the trucking companies.
- Low administrative costs. The use of a single truck or fleet from origin to destination keeps administrative costs for shippers very low, and typically only a single bill of lading is required.

- Use of national highway system. The highways are constantly being improved and expanded, which enhances the competitive position of the trucking industry. For example, the Lat Krabang ICD has enjoyed good success since its opening in 1996, but with the anticipated opening of a new highway which will parallel the railroad in this area, it is unclear whether some percentage of future container traffic will be lost to trucks.

Although there are some large trucking companies in Thailand, the structure of the industry is similar to that of the U.S. where there are many small trucking companies and individual owner-operators. These owner-operators are generally believed to be profitable in Thailand, although this was not able to be confirmed, as truckers were unwilling to share financial figures. Representatives of the Transportation Association, a national trucking industry group, noted in a meeting with PB that there was a current (2/98) overcapacity of 30 to 40% in the trucking industry, as a result of the recent downturn in Thailand.

The barriers to entry in trucking are small, and limited only by the ability of an individual to buy or lease a truck. It can be assumed, therefore, that trucks will continue to be a very cost competitive transportation option, as they are in the U.S., because large profits will attract more competition and drive down prices. This situation is likely to be exacerbated in the near term by the existing oversupply of both trucks and labor in Thailand, which may well lead to prices lower than long term operating cost levels until the economy stabilizes.

3. Rail

In evaluating the competitive position of SRT as a transportation provider in Thailand, it must be stressed that the freight transportation market has changed considerably in the recent past. Shippers, particularly global firms, are evaluating every step of their supply chain and expect that transportation providers will know and understand their business, add "value" to their business, and respond to their transportation needs with a full package of services. This is the environment that the SRT must compete in.

In general, the historical market advantage for rail systems worldwide has typically been in long haul, heavy commodities, or commodities moving in unit train quantities such as intermodal containers. The overall size of Thailand, and the short distances involved in transporting goods, means that conditions for this historical advantage are not in place, and that the SRT must overcome this situation in order to increase its market share.

From discussions with numerous shippers, competitors, and SRT officials, the following are major issues which summarize the existing situation with regard to SRT and its future in the intermodal market:

- SRT's infrastructure for handling general freight consists mostly of public loading and unloading tracks, which require loading of the shippers' goods from a truck into a rail car for delivery to another location, where the goods are unloaded into a truck for final delivery.
- Each of the shippers interviewed in this study cited the double handling involved in this current SRT procedure as one of the primary reasons for not using the railroad for the transportation of their goods. From the perspective of the shippers and receivers, this double handling adds cost, results in more loss and damage, and adds two time-consuming steps to the transportation and distribution process. Consequently, the firms interviewed by the PB team viewed SRT to be strictly a bulk commodity transportation company.
- In addition to the use of public loading tracks, SRT maintains the practice of running their freight trains on a schedule, which requires stopping at every station on the route where freight is ready to be picked up or dropped off. Since there are no express freight trains, this causes travel time for most freight to be much longer than the time it takes for trucks to transport goods, and further undermines the perception of shippers that SRT can compete with trucks.

- SRT's primary traffic at the present time is bulk goods, and the intermodal market will require a significant change to time-sensitive cargo and extremely competitive pricing.
- There is a lack of coordination among some governmental departments, in some cases preventing an increase in SRT market share. One example is the development of public industrial estates in areas which are not conveniently served by rail.

D. CURRENT PERCEPTIONS OF SHIPPERS/RECEIVERS

The PB team's approach to this study focused not only on evaluating the SRT freight operation, but also determining the perceptions of the shippers who are the ultimate customers for the freight truck and rail industries. In order to understand these perceptions, the PB Team interviewed large shippers/receivers and truckers, each of which were selected because they could be potential customers or partners to SRT for domestic and international intermodal container transportation.

In general, the shippers interviewed did not view the railroad as a serious competitor to trucks for manufactured goods. In fact, it can be said that most major shippers of manufactured goods do not even consider using the SRT or its services at the present time. This attitude does not necessarily come from bad experience, but rather a general perception that the rail system cannot meet their transportation needs.

The manufacturers and other people interviewed by PB were asked questions about how decisions were made related to their freight transportation needs, and they continually stressed three key criteria which they use to determine how they transport freight: Price, Service and Reliability, and Loss and Damage.

1. Price

Despite the efforts of transportation service providers to add value and differentiate their service offerings, transportation is most frequently viewed as a commodity. Consequently, obtaining the lowest possible price is the most frequent objective in securing transportation service, although most shippers will also stress that they demand reliable service before price can even be discussed. For ground transportation, trucks set the standard which all other options are measured against in Thailand, particularly for relatively shorter distances in which they excel. In general, shippers stressed that trucks were cheaper and more flexible in their rate structure than SRT. There is no apparent dissatisfaction with the rates or pricing policies of truckers among the businesses interviewed by the PB Team.

It is very difficult to obtain specific pricing information for any truck freight movements, since trucking companies set their rates through negotiation, and these rates tend to be viewed as competitive information. The PB team was able to obtain, however, some general freight transportation pricing information from large shippers in Thailand. This information is presented in Table 4 below, and the distances were developed only as approximate highway distances between the cities and Bangkok.

Table 4
Average Costs for Freight by Truck between Bangkok and Various Cities

	km	Cost Baht/Case	Cost Baht/Truck	Cost/km
Chiang Mai	696	11	11,000	15.8
Phitsanulok	377	7	7,000	18.6
Korat	259	6	6,000	23.2
Udon Thani	564	10	10,000	17.7
Ubon Ratchathani	629	8	8,000	12.7
Hat Yai	840	12	12,000	14.3
Ratchaburi	100	4.1	4,125	41.2
Chon Buri	81	2.5	2,415	29.8
Samut Sakon	36	3.2	3,200	88.8
Nakhon Pathom	56	3.2	3,200	57.1
Surat Thani	644	11.5	11,500	17.9

Note: Assumes that there are 1000 cases per truck on average

Source: Proctor & Gamble Manufacturing (Thailand) Ltd., and BA&H Analysis

The costs above, when converted to dollars per mile for the sake of comparison, and when the very short distance destinations are removed, range from about 65 cents to 96 cents per mile. In the U.S., trucking costs usually range around one dollar per mile on average, and so it is believed that these costs are reasonable, given the lower cost of Thai labor.

As order of magnitude costs, the rates shown above were also confirmed through interviews with the Transportation Association, a trucking industry trade group. The Association noted that it was difficult to give even a range of trucking rates, due to the tough competition and the relationships that truckers have with their clients, as well as seasonal variations in rates and other reasons. However, they tried to provide a range, and provided the prices shown in Table 5 below, where average price is a calculation based on a distance assumption.

Table 5
Average Trucking Costs in Thailand

Distance	Price	Average Price
Less than 200 km	4,000 Baht	20 B/km (200 km)
200 to 400 km	5,000 Baht	17 B/km (300 km)
More than 400 km	7,000 Baht	14 B/km (500 km)

Source: The Transportation Association of Thailand, BA&H Analysis

These rates appear slightly lower than those provided by Proctor & Gamble, but are considered within a reasonable range. Since the rates provided by P&G are more detailed, and likely to be more market-based for a large manufacturing company, these rates were used as the basis for the pricing evaluation in the Market Analysis.

2. Service and Reliability

According to Thai shippers that were interviewed, truckers are also adept at offering flexible and reliable service that meets shipper needs. Truckers have operated in a very competitive market environment for many years, and have developed the skills to maintain a very close relationship with their customers. They have also turned this close relationship into a vehicle for expanding their scope of services. The majority of the manufacturers interviewed by the PB Team are using truckers to provide a wide range of services in addition to transportation, including logistics and warehousing as previously discussed.

The primary consideration for SRT in this category is that truckers offer reliable next-day service throughout Thailand. This is the standard against which the SRT service is and will be judged. As a result, the firms interviewed by PB felt that the SRT could not meet their transportation requirements for service and reliability. There were several reasons cited for this:

- Double handling. This was noted as the primary deterrent, since it was not considered an acceptable service alternative.
- Unreliable and slow rail service. In one interview, a shipper described a move from one of the northern cities in Thailand to a point in the south as taking four weeks on SRT, while on trucks they receive overnight or second morning service. While this appears to be an aberration or unreasonable comparison, it must be remembered that the issue here is perceptions, not necessarily reality.
- A perception that SRT was not interested in their goods. Many of the transportation executives interviewed have never had a sales call from SRT to explore either their concerns or how to get their business.

In addition to the comments on these service areas, there was one other significant service-related concern, which was loss and damage.

3. Loss and Damage

It is unclear the degree to which loss and damage issues factor into the overall cost of transportation, but all of the shippers interviewed cited increased loss and damage as another reason for not using the railroad. In their opinion, double handling leads to increases in loss and damage. Even if the SRT would bear this cost, and it was noted by the PB team that SRT does not appear to have a policy that deals with loss and damage, the inconvenience and administrative burden on shippers of dealing with lost or damaged items appears to be a further disincentive to using the railroad.

These three criteria, price, service and reliability, and loss and damage, are essentially identical to those of shippers and receivers in countries with more developed intermodal transportation systems. For instance, at the recent Railway Finance Conference in New York City, in two separate presentations by U.S. Class I railroad executives, reliability was rated as the number one priority of their intermodal customers. These comments from this conference should be viewed in the context that, in the last twenty years in the U.S., considerable progress has been made in the area of preventing loss and damage to goods shipped by rail. Nevertheless, intermodal rail has succeeded in positioning itself as an attractive option in the U.S. because railroads have responded to their customer's needs.

Later in this chapter marketing initiatives for the SRT are discussed in more detail, and they are intended to help develop a competitive rail intermodal system and change the current shipper perceptions regarding the rail network.

E. PROJECTED TRANSPORTATION MARKET

1. General

Projecting the potential intermodal market for SRT in the future is the key to all the remaining work in this project. To accomplish this task, a considerable effort was made by the PB team to gather accurate traffic flow information for Thailand, both existing and projected. In general, however, there was a lack of data on this subject, and any available information was developed prior to the economic turmoil which began in the summer of 1997. As a result, the PB team used the following approach:

- Base traffic data was taken from regional flows, produced in a 1992 study performed by JICA, which detailed traffic flows between Bangkok and six outlying geographic regions by commodity. These flows included both domestic and international movements, as the JICA Study specifically included movements to/from Bangkok's ports in the Bangkok movement data.
- These flows were then updated to current volume levels using historical growth rates (Source: Thailand Development Research Institute Foundation (TDRI) and SRT).
- Updated freight flows were compared to available current traffic flow data to determine the reasonableness of the assumptions (Source: TDRI). Growth rates were then adjusted as required to reflect actual current freight flows, especially for the growth in petroleum products which has increased much faster than the overall economy.

This database then represented the baseline of commodity flows to and from Bangkok, by region, for 1997.

- The overall future growth rates for economic activity in Thailand were then developed, based on the most recent projections (Source: NESDB).
- The base volumes were then increased by the regional growth factors (Source: TDRI). The elasticity of transportation growth, resulting from Gross Regional Product (GRP) growth, was taken from the study by JICA in 1992 and used to estimate transportation growth.
- To determine container and bulk freight capture rates, U.S. rail and intermodal capture rates (Source: BA&H assignments for Class I U.S. railroads) were applied by length of haul and commodity class.
- Port volumes were derived from historic Port Authority of Thailand (PAT) figures, PAT projections through the year 2000, and Thailand-specific projections from a 1996 report entitled "World Containerport Market" by Ocean Shipping Consultants (OSC) for the years thereafter.

Once these market projections were developed, they formed the basis for defining the traffic to each potential ICD and CT, and hence the capital and operating costs needed to support that traffic. To repeat a point made in the previous section, however, the projections are based on the understanding that the SRT will take measures to respond to the concerns of the potential customers, particularly in providing a reliable, cost competitive service. Without these actions by SRT, the rail projections will most likely not be realized.

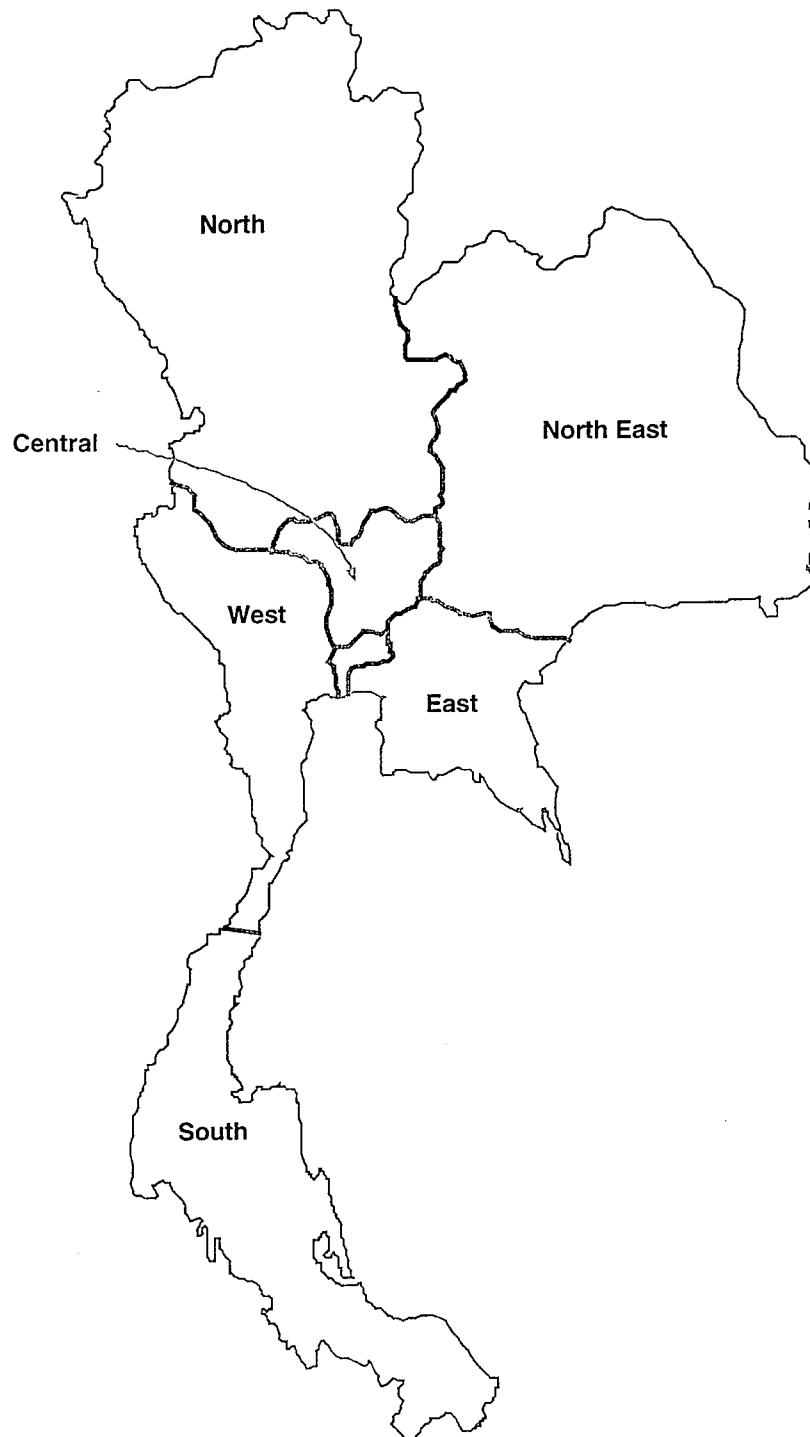
The overriding fact to be kept in mind for the market projections, is that the existing major ground transportation corridors in Thailand are oriented to moving freight in and out of Bangkok. It is not surprising, however, that Bangkok should play such an important role in the transportation infrastructure in Thailand, since it is a major international port, and the geographic center of the country. More than half of the economy of Thailand is generated in the Bangkok Metropolitan Area (BMA), as was shown in Table 4, and Bangkok has traditionally been the focus of development and investment in Thailand.

The accompanying map on Figure 5, Major Regions in Thailand, shows the location of the major regions in Thailand that were used for the transportation analyses in the remainder of this chapter.

The analysis of freight flows examined two areas of potential intermodal freight for SRT:

- International port traffic. This involves primarily the containerized international freight now moving to and from LC Port. Movement of containers between that port and the Lat Krabang ICD is currently the most important intermodal container market for SRT, and this part of the analysis focuses on the potential to develop Lat Krabang ICD to its full capacity, as well as developing additional ICDs when Lat Krabang ICD is no longer able to handle the expanding container volumes. An additional market for SRT in international containers will be between

Figure 5
Major Regions in Thailand



LC Port and the provinces where, as the flows of containers grow, it is likely that containers will be delivered directly to warehouses and distribution facilities in these regions.

- Domestic traffic. The second area of growth is the domestic container market, which could be used for moving manufactured goods and some agricultural commodities within Thailand. This method of transportation is growing rapidly in countries such as the U.S. and India, and there is potential in other countries to expand containerization beyond the uses for international cargo. In other countries, the domestic intermodal container market began as a backhaul for empty international containers, and developed into an independent market segment as volume and service improved. In Thailand, it is similarly expected that this market will start very small and grow as the intermodal system, both domestic and international -- proves its value to shippers and receivers.

Gradually converting the domestic market, dominated by 10-wheel trucks, to a container-based intermodal operation, will obviously take time. This conversion is critical, however, to the success of a new inland container transportation system for Thailand, and to achieve the goals of the Eighth National Economic and Social Development Plan. The bed of a standard 10-wheel truck is approximately 8 m long, and could readily be adapted to carry a standard 20-foot (6.1 m) ISO container. The approximate loading volume of the 10-wheel truck is 54 m³, while the loading volume for the 20-foot container is approximately 34 m³, due to the longer length of the truck.

These two areas are not mutually exclusive and the analysis included both types of traffic, but they are discussed separately in the following explanation due to the volumes and types of facilities involved.

2. International Port Traffic

Due to the importance of international cargo, this area will be examined first. While Khlong Toey (Bangkok Port) and LC Port currently both handle significant volumes of imports and exports, LC Port has been developed and will be expanded as the principal container port in Thailand for the next two decades. This shift in cargo has been part of a planned effort by the Thai government which recognized the capacity and operating concerns at Khlong Toey. The growth in container movements in the recent past is shown in Table 6 below.

Table 6
Movement of Containers by Port in Thailand - 1992 to 1996
(Thousands of TEUs)

	1992	1993	1994	1995	1996
Khlong Toey	1,285	1,286	1,394	1,464	1,295
Private Port (BKK)	138	155	171	180	244
LC Port *	9	167	326	489	710
Songkhla	NA	NA	NA	NA	55
Phuket	NA	NA	NA	NA	5
Total	1,477	1,608	1,891	2,133	2,309

* Includes inland waterways

Source: TDRI Transportation Master Plan, Aug. 97

The volume of containers at Khlong Toey, and the private terminals associated with it, is now at the projected maximum capacity of 1,200,000 annual twenty-foot-equivalent units (TEUs) for Khlong Toey, and 400,000 annual TEUs for the private ports (according to PAT). As mentioned before, all further international container growth in the Bangkok area will be at LC Port. For purposes of this analysis, LC Port is assumed to have adequate capacity (or can be expanded) to handle all of the volume growth estimated for the next twenty years in this study.

To project the growth of LC Port, two sources were used. Near term projections through the year 2000 by the Port Authority of Thailand (PAT) were used to reflect the most current volume expectations, following the economic and currency crises of 1997. For growth beyond that point, the PB team used a 1996 report by OSC projecting volumes at container ports around the world. Table 7 below shows the expected percentage growth of container throughput in Thailand.

Table 7
Forecast of Percentage Growth in Thailand Container Port Throughput
1995 to 2018

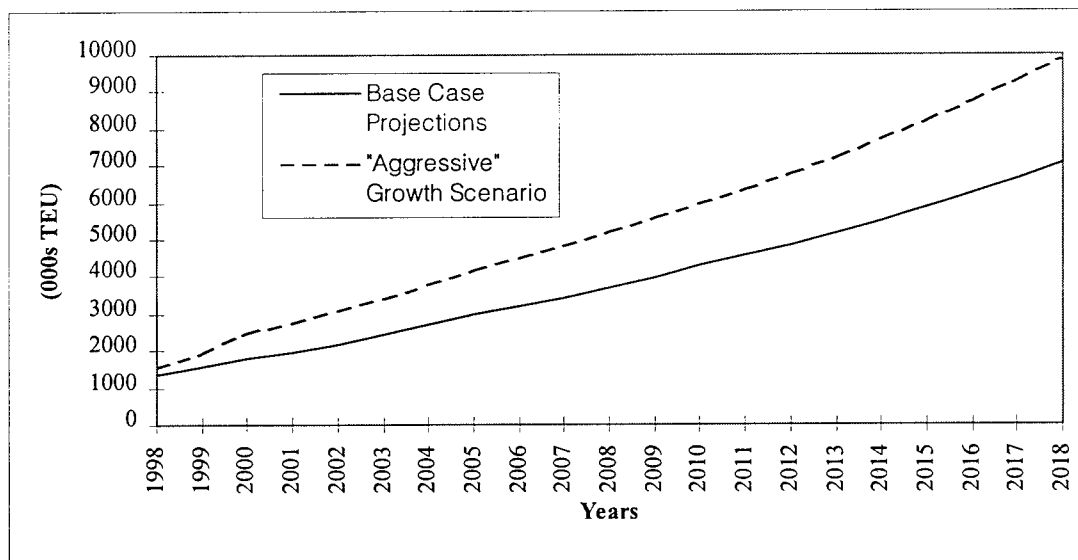
	1995	1996	1997	1998	1999-2000	2001-2005	2006-2010	2011-2018
Percent Growth	12.8%	8.3%	12.3%	8.1%	8.2%	10.9%	7.4%	6.5%

Source: Port Authority of Thailand, Ocean Shipping Consultants, BA&H Analysis

Given this rate of growth, the forecast of the number of containers handled by the major ports in Thailand is shown in Figure 6, Forecast of Containers Handled at LC Port 1998 to 2018 below.

This graph also shows a more aggressive case, which assumes that international trade is not significantly affected by the recent economic downturn. Should these aggressive volumes materialize, ICD expansion would need to occur at a quicker rate than that described below.

Figure 6
Forecast of Containers Handled at LC Port
1998 to 2018
(Thousands of TEU)



Source: BA&H analysis

Current figures obtained from Lat Krabang ICD show that it is currently capturing approximately 33% of LC Port's volume. Of the volume which is coming to Lat Krabang ICD, the SRT is capturing roughly 60% of the containers with its shuttle train service, while trucks are capturing the remaining 40%. The remainder of the containers moved through LC Port (67% of the total port volumes) are handled by truck without visiting the Lat Krabang ICD.

This balance is not expected to change significantly over time, depending on whether the SRT can continue to expand its rail capacity at Lat Krabang ICD (the limitations on this expansion are discussed in the Railroad Operations Analysis). In addition to port traffic to/from Bangkok, it is expected that the ICD will serve as a gateway for transporting international containers to/from their ultimate destinations and origins in the provinces. It is anticipated, however, that international rail volumes to/from the provinces will make up only a very small percentage of ICD volume (less than 5 percent).

Table 8 below shows the growth in container flows at LC Port, and the resulting volumes which will seek a rail-based ICD near the port (Lat Krabang ICD or an alternative). As Lat Krabang ICD reaches capacity, the additional traffic is shared with a second ICD, whose location is recommended as Ongkharak (which is discussed in detail in the following chapter).

Table 8
ICD Container Flows at LC Port 1998 to 2018
(Thousands of TEUs)

	1998	1999	2001	2003	2006	2008	2010	2013	2016	2018
LC Port Volume	1,380	1,550	1,974	2,428	3,207	3,699	4,267	5,154	6,226	7,061
Rail Capture	276	310	395	486	641	740	854	1,025	1,195	1,362
Truck Capture	190	214	272	335	442	510	588	716	909	1,024
Total ICD Capture	466	524	667	821	1,083	1,250	1,442	1,741	2,104	2,386
LK ICD Rail Capacity	500	500	500	500	750	750	750	750	750	750
LK ICD Truck Capacity	500	500	500	500	1250	1250	1250	1250	1250	1250
Expanded Lat Krabang ICD:										
LK ICD Rail Volume	276	310	395	486	641	740	667	750	750	750
LK ICD Truck Volume	190	214	272	335	442	510	448	514	633	691
Total LK ICD Volume	466	524	667	821	1,083	1,250	1,115	1,265	1,383	1,441
Second ICD (recommended as Ongkharak):										
New ICD Capacity							500	500	1,000	1,000
New ICD Rail Volume							187	275	445	612
New ICD Truck Volume							140	202	276	333
Total New ICD Volume							327	477	721	945

Assumptions:

- Lat Krabang ICD is expanded as recommended to 1,000,000 TEU/year by 2000, with a further expansion to 2,000,000 TEU/year overall capacity
- The capacity of the second ICD will begin in 2010 with 500,000 TEU/year, and be expanded to 1,000,000 TEU/year
- Expansion and new terminal development are assumed not to be constrained by availability of funds.

An important assumption made for the table above is that the expansion of Lat Krabang ICD and the second ICD will not be constrained by rail capacity. Existing rail capacity is limited, however, as will be discussed later in the section on Railroad Operations Analysis. The first constraint is the apparent lack of additional train capacity on the rail line from LC Port to Lat Krabang ICD, and until that capacity is increased, the rail flows into Lat Krabang ICD will have a ceiling of approximately 750,000 TEUs. The second rail capacity issue is the lack of a rail storage yard at Lat Krabang ICD, which will limit the efficiency of the facility as the volumes increase. This is discussed in detail in the Rail Operations Analysis.

The important point to be made here is that the Lat Krabang ICD facility as a whole can expand its capacity faster than the rail capacity, and that the percentages of rail and truck traffic into and out of the Lat Krabang ICD will vary, depending on the capability of the rail system. While the double tracking program will improve the existing capacity situation, the date for completion of that program was not known. As a result, it has been assumed for the purposes of this report that the rail capacity of Lat Krabang ICD will stay at the 750,000 TEU level for the foreseeable future,

and that any remaining capacity in the LC Port to Chachoengsao line segment will go to serving the second ICD facility. (As an example of incremental increases in capacity, it is noted that the original train schedules for this segment had 10 daily round trip trains to Lat Krabang ICD, and 10 daily trains to Bang Sue ICD, which is five more than the current schedule. These additional train slots could be used for supplying the second ICD proposed for Ongkharak).

From the table above it is apparent that Lat Krabang ICD is in need of expansion by the year 2006, in order to handle projected traffic. Even this date assumes that the capacity of the existing facility can be improved to 1,000,000 TEUs. BY 2010, a second ICD will need to be on line, and once it is ready to receive cargo, the anticipation is that it will actually reach considerable volumes (nearly 300,000 TEUs) within a year, as it diverts containers from Lat Krabang ICD and absorbs continuing growth. This new ICD facility, recommended for Ongkharak, is also intended to play a significant role in the traffic to the provinces, since a significant portion of the provincial traffic will be international containers (a separate facility at Ongkharak will serve the domestic traffic). The diversion of container traffic from Lat Krabang ICD will allow for the more efficient splitting of container traffic between the second ICD and Lat Krabang ICD, as each handles cargo to and from their natural trade lanes.

It should be noted that if Thai port growth actually follows the more aggressive near term growth projections of OSC, three ICDs (i.e., another ICD in addition to Ongkharak) would be required instead of two.

3. International Traffic to the Regions and Domestic Traffic

Current detailed freight flow data between the regions in Thailand was not available for this analysis. However, the extensive data on regional freight flows produced in the 1992 JICA study, mentioned earlier, was used as a basis for the PB analysis. It is worth noting once again that these freight flows included both domestic movements and cargo flowing in and out of Bangkok's ports to the regions. The traffic flows from that study were broken down into four key commodity groups: Construction Materials, Mining Products (which includes petroleum and petroleum products), Agricultural Goods, and Manufactured Goods. Figure 7, Major Freight Flows in 1997, and Figure 8, Projected Major Freight Flows in 2018, on the following pages, show the overall regional freight flows that were obtained from this study.

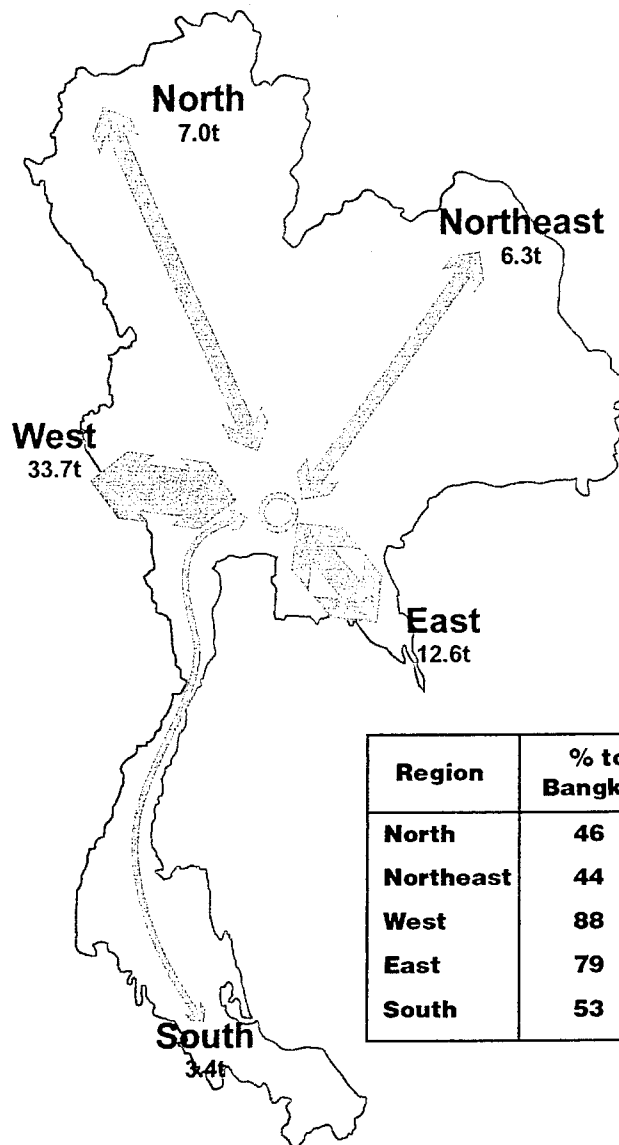
Freight flows originating in Bangkok to the provinces also include bulk commodities such as petroleum products, although Bangkok is not the ultimate source of these goods. These products are either imported into Thailand through ports near Bangkok, or imported and refined in the Bangkok area and then distributed to the provinces. In addition to the bulk commodities, manufactured products are one of the major freight commodities moved from Bangkok into the regions. This is based on Bangkok's current position as the site of most manufacturing in Thailand. In addition, these freight flows reflect the movement of goods brought in through Bangkok's ports to the regions.

The flow of goods into two of the regions is worth noting:

- The Western Region appears to be the dominant source and destination for the total amount of goods moving to and from Bangkok. The Western Region accounts for 51% of the inbound cargo and 43% of the outbound cargo for Bangkok. However, this freight appears to be predominately construction materials, primarily cement. The tonnage involved in bulk cement movements, and the frenetic construction activity which has taken place in Bangkok over the past decade, explains this emphasis.
- The Northern Region shows the largest flows of manufactured goods, and thus represents one of the primary areas for manufacturing and distribution outside of Bangkok. This area is consequently one that SRT should focus on when considering where to develop intermodal service and terminals.

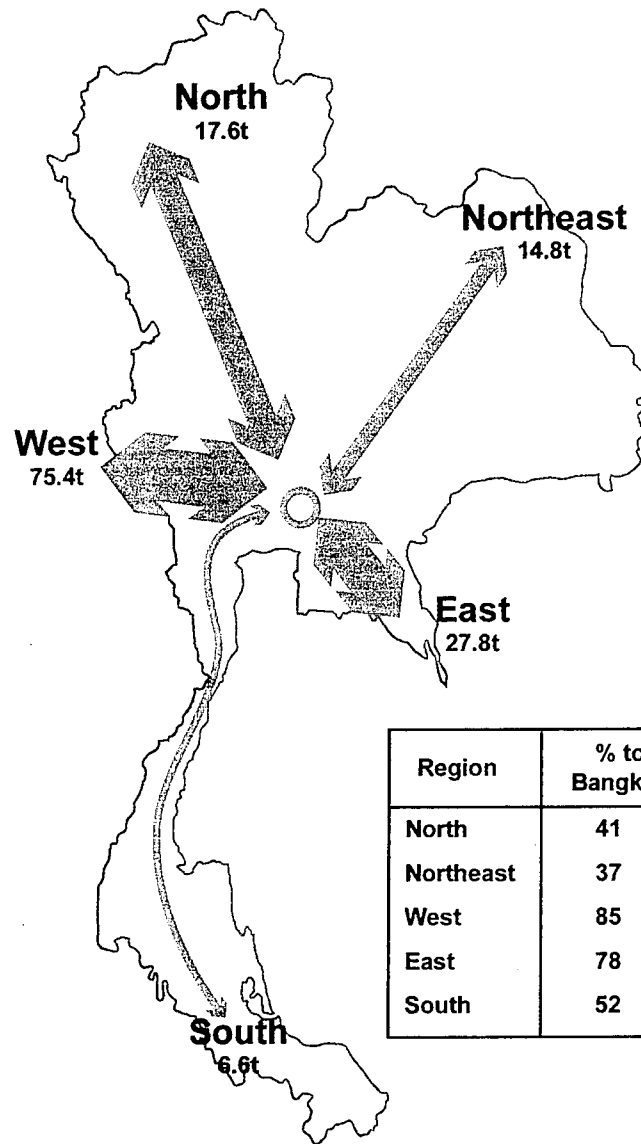
Figure 7

Major Freight Flows in 1997
(Millions of tons)



Region	% to Bangkok	% from Bangkok
North	46	54
Northeast	44	56
West	88	12
East	79	21
South	53	47

Figure 8
Projected Major Freight Flows in 2018
(Millions of tons)



Region	% to Bangkok	% from Bangkok
North	41	59
Northeast	37	63
West	85	15
East	78	22
South	52	48

Using this database as a baseline, the PB team then updated these flows to current levels. This comprehensive, updated set of freight flows was then compared to available current traffic flow data to determine the reasonableness of the assumptions. Assumptions were adjusted as required to reflect known freight flows in Thailand, especially for the growth in petroleum products, which increased much faster than the overall economy. This adjusted data base thus represents the baseline of commodity flows to and from Bangkok by region for 1997.

Table B-1 in Appendix B shows the updated summary freight flows which resulted from the analysis described above.

4. Future Freight Transportation Market

After establishing a baseline for current traffic, projections of future freight flows were made. The methodology for determining these freight flows involved a three-step approach.

- First, the overall future growth rates for economic activity in Thailand were developed, based on the most recent projections. Because of the current economic uncertainty in Asia and Thailand, some of the growth estimates were adjusted downward, based on recent projections of growth rates from the National Economic and Social Development Board (NESDB), but it was assumed by the NESDB and the study team that Thailand will resume strong economic growth in 2001.
- Second, base volumes were increased by the regional growth factors developed in TDRI studies. The elasticity of transportation growth resulting from GRP growth was taken from the study by JICA in 1992, and used to estimate transportation growth.
- Third and last, assumptions were made for various rates of capture of these freight flows by SRT. Rates of capture were developed independently for the various commodity groups. For intermodal cargo, which is the primary focus of this study, capture rates were developed based upon the potential to containerize the underlying type of freight, the length of the haul, and the likely penetration pattern for rail to win cargo. These intermodal capture rates were also based upon recognized patterns in U.S. intermodal markets, using similar measures (cargo type, length of haul, etc.) taken from data in previous BA&H intermodal studies for U.S. Class I railroads. The result of this step was flows for both bulk and containerized freight, between each of the regions and Bangkok, for five-year increments from 1998 to 2018.

These steps are explained in greater detail below.

a. Estimate of Economic Activity

Overall freight demand was based on projections developed by JICA in 1992, which presented the most comprehensive and current data available on overall freight flows to and from the regions. The JICA study produced freight flows by major commodity group to and from the regions.

Updating this data to reflect current economic conditions was the critical first step. First, the relative relationships of the regions to one another in terms of the size of freight flows was examined, between the JICA study period and overall regional freight flow data for the current period. It was determined that while there has been significant growth in each of the regions, the relationships in economic activity (i.e., the volume of freight generated) among the regions in Thailand has remained relatively stable. Therefore, these numbers were considered valid as a starting point for the analysis.

The next step was to inflate traffic flow data to reflect future growth in the economy, in order to evaluate the potential in each of the possible markets. Due to the current currency valuation and economic problems in Thailand and other Southeast Asian countries, it was considered prudent to temper the near term economic growth forecasts.

The NESDB released revised growth rate projections for the GNP of Thailand in December 1997, and the most significant change from previous projections was the growth rates for 1997 and 1998. Table 9 summarizes those projections.

Table 9
Growth Rate of the GRP in Thailand 1997 to 2018 (Percent)
(Based on Adjusted Economic Growth Rates, December 1997)

	1997	1998	1999	2000	2001	2001- 2006	2006- 2011	2011- 2018
Bangkok	0.64	0.00	4.24	4.56	4.66	5.84	4.00	4.00
Central	0.91	0.00	6.06	6.51	6.66	6.70	5.80	5.80
East	0.60	0.00	4.00	4.30	4.40	5.80	4.80	4.80
North	0.56	0.00	3.71	3.99	4.09	5.00	5.00	5.00
Northeast	0.47	0.00	3.14	3.38	3.46	5.00	4.50	4.50
South	0.46	0.00	3.09	3.32	3.39	4.80	4.00	4.00
West	0.58	0.00	3.89	4.18	4.27	5.60	5.10	5.10

Note: 1997-2001 numbers are the product of the ratio of the revised economic targets/old country targets, and the percent growth rates of the regions. Assumes that economic growth rates return to the trend for 2001-2006

b. Projected Freight Flows

Using these regional growth rates, the total movement of freight between Bangkok and the regions for five year periods from 1998 to 2018 was estimated, as shown in Tables B-2 and B-3 in Appendix B.

From these tables it can be seen that the most significant growth is expected to occur within the Central region. This growth, however, is primarily inbound movements of construction materials. The Eastern region also shows a similar growth in construction materials. In neither case are these considered target markets for the new intermodal service, due to both the commodities themselves and the proximity to the consuming market (Bangkok). There is, however, growth occurring in the more attractive agricultural products and manufactured goods sectors, particularly in the North and Northeast regions which would be more competitive for train service.

Of these total freight flows, rail can expect to capture a share which will move in containers. This is largely dependent upon the type of commodity and length of haul as further described below.

c. Containerized Freight

The next step in the analysis was to estimate what portion of the commodity flows had the potential for containerization. In addition to international goods already in containers, a portion of the domestic freight flows within Thailand also may be containerized. All of this containerized traffic is eligible for capture by rail, if the SRT pursues a series of service-enhancing initiatives which are described later in this chapter. For use in these projections, it was assumed that the SRT will increase its capture rate over time as service improves and customers become confident that the rail service will meet their needs. However, the assumptions in the early years of the analysis are that manufactured goods will most likely continue to move in ten wheel trucks, due to the overcapacity of these vehicles in the current economy and the existing attitudes of shippers.

A detailed summary of the final assumed percentages is shown below in Table 10. It should be noted that this table estimates the conversion to containers only.

Table 10
Assumed Container Penetration by Commodity
Percent of Total Freight Movement

	2003	2008	2013	2018
Construction Material	0	0	0	0
Mining Products	0	0	0	0
Agricultural Products	0.5 to 1.0	0.5 to 4.0	1.0 to 5.0	1.0 to 6.0
Manufacturing Goods	0.5 to 1.0	0.5 to 3.0	1.0 to 7.0	1.0 to 10.0

Source: BA&H Analysis

It was assumed in this analysis that industrial products and some agricultural products had the potential to be containerized, but not bulk products such as construction materials and mining products. The majority of construction materials moved in Thailand are cement, and the majority of mining products are petroleum products, fuel and LPG. In general, it is very difficult to economically move bulk commodities such as these in containers, and it is not likely that SRT will generate much interest in containerizing this type of business during the term of these projections. As a point of reference, U.S. railroads have been trying to convert bulk commodity freight to intermodal rail transportation for at least ten years, but with very little success to date.

In Thailand, the largest agricultural product is rice, and the capture rates assumed in this study for this commodity are fairly modest, based on the assumption that rice will continue to move in bags or on pallets, but primarily on trucks as is the case today.

d. Rail Freight Capture

Next it was necessary to estimate how much of the predicted containerized freight would be captured by rail as opposed to trucks.

Assumptions concerning rail freight capture of the total freight moving in these corridors were made based on BA&H experience with rail freight movement in the U.S. and across the world. For each commodity and region, the length of haul was analyzed along with the suitability of that cargo for rail transport. In general, long haul heavy bulk, and less valuable or time sensitive cargoes, are more likely to be captured by rail carriers. Rail freight capture rates were estimated independently for both containerizable freight, which was primarily manufactured goods, and bulk commodities, which were primarily petroleum products and cement. Capture rates were also reflective of current rates of commodity capture by SRT, and the analysis assumed that capture rates would increase slightly over time if service and marketing improvements were made, based on the changes outlined in this study.

Table 11 shows the results of this analysis, a summary of the rail capture rates by commodity and region.

Table 11
Estimated Rail Container Capture Rates
Percent of Predicted Containerized Freight

		1998	2003	2008	2013	2018
Central	Const Mat'l	0.0	0.0	0.0	0.0	0.0
	Mining Prod	0.0	0.0	0.0	0.0	0.0
	Ag Prod	0.5	0.5	0.5	2.0	3.0
	Mfg Goods	0.5	0.5	0.5	3.0	4.0
North	Const Mat'l	0.0	0.0	0.0	0.0	0.0
	Mining Prod	0.0	0.0	0.0	0.0	0.0
	Ag Prod	1.0	1.0	4.0	5.0	6.0
	Mfg Goods	1.0	1.0	3.0	7.0	10.0
Northeast	Const Mat'l	0.0	0.0	0.0	0.0	0.0
	Mining Prod	0.0	0.0	0.0	0.0	0.0
	Ag Prod	1.0	1.0	4.0	5.0	6.0
	Mfg Goods	1.0	1.0	3.0	7.0	10.0
East	Const Mat'l	0.0	0.0	0.0	0.0	0.0
	Mining Prod	0.0	0.0	0.0	0.0	0.0
	Ag Prod	0.5	0.5	0.5	2.0	3.0
	Mfg Goods	0.5	0.5	0.5	3.0	4.0
South	Const Mat'l	0.0	0.0	0.0	0.0	0.0
	Mining Prod	0.0	0.0	0.0	0.0	0.0
	Ag Prod	1.0	1.0	4.0	5.0	6.0
	Mfg Goods	1.0	1.0	3.0	7.0	10.0
West	Const Mat'l	0.0	0.0	0.0	0.0	0.0
	Mining Prod	0.0	0.0	0.0	0.0	0.0
	Ag Prod	0.5	0.5	0.5	1.0	1.0
	Mfg Goods	0.5	0.5	0.5	1.0	1.0

Source: U.S. experience from prior BA&H studies. Assumes rates will approach USA rates over time, but not reach them during the 20 year study period

The results of Table 11 were used to make projections for the potential rail containerized tonnage for the four major types of commodities. Finally, Tables 12 and 13 below show the total number of containers projected to move daily between the regions and Bangkok.

Table 12
Daily Container Flows (By Rail) into Bangkok From the Regions
2001 to 2020
Units: Containers per day

Origin Region	2001	2005	2010	2015	2020
North	9	21	51	80	119
Northeast	8	20	50	76	110
South	6	14	33	54	81
West	8	9	15	28	33

Note: Assumes 250 day operation per year

Table 13
Daily Containers Flows (By Rail) From Bangkok Into the Regions
2001 to 2020
Units: Containers per day

Destination Region	2001	2005	2010	2015	2020
North	9	15	37	69	107
Northeast	8	14	34	59	88
South	5	9	21	39	59
West	4	4	7	10	13

Note: Assumes 250 day operation per year

The Central and East regions have been excluded from these last tables, since they will largely be served by the previously described existing and planned ICD facilities at Lat Krabang and Ongkharak.

This analysis shows that the intermodal service lanes with the greatest potential would be the North, Northeast, and potentially the South. Services to these regions, and potential ICD locations within these regions, will consequently be highlighted.

Based upon this analysis, the initial volumes of containers that the SRT will capture, even in the regions with the most potential, will be small. In some cases, to begin service the SRT will likely need to combine blocks of containers and bulk cargoes. As a result, the PB team estimated the capture of bulk commodity cargoes in a similar fashion to the analysis for containers, and the results are shown in Tables 14 and 15 below.

Table 14
Bulk Commodity Flows (By Rail) from the Provinces to Bangkok
2001 to 2020
Units: Full Carloads per day

Origin Region	2001	2005	2010	2015	2020
North	52	66	112	152	219
Northeast	10	12	35	44	67
South	17	20	24	36	42

Table 15
Bulk Commodity Flows (By Rail) from Bangkok to the Provinces
2001 to 2020
Units: Full Carloads per day

Destination Region	2001	2005	2010	2015	2020
North	198	256	386	537	741
Northeast	188	242	364	504	692
South	26	32	44	65	87

Using these volumes, it is apparent that mixed-use trains can be built and run on the necessary schedules if the SRT desires to do so.

F. SRT MARKET DEVELOPMENT PLAN

1. Introduction

The successful marketing strategy from SRT's perspective must satisfy a number of criteria, and its focus should be on the priorities mentioned in the opening section of this report:

- Building a larger customer base
- Controlling costs
- Pricing competitively while still making a profit

Just as importantly, from a customer's perspective the SRT must achieve the following objectives:

- Provide reliable next day service throughout Thailand
- Provide competitive pricing to the alternative of trucking
- Reduce or eliminate loss and damage to goods

In a larger sense, given the attitudes of manufacturers and other shippers toward the rail system, the SRT must change the perception of the SRT in the minds of the business community. It must be seen as providing value, as being a reliable partner in the transportation chain, and being willing to take the time and understand its customers' business requirements. This change in perception will be harder to accomplish than the infrastructure tasks, such as building the terminals.

The MDP needs to address both the SRT's internal and customer issues in the bullets above, and for both the international and domestic container markets. Without such a plan, it is likely that the SRT will fall short of the projections in this report for both containerized freight and bulk freight capture, as trucks will continue their overwhelming domination of the ground freight transportation market.

2. Elements of the Strategy

To develop a comprehensive MDP, the PB team concentrated on providing recommendations to the SRT which were specific, and intended to address both the short and long term requirements of building the intermodal rail market. The MDP is comprised of the following elements:

- Infrastructure. What changes in the infrastructure of the railroad are required to develop the necessary facilities to handle containers?
- Reliable service. What are the service initiatives necessary to provide truck-competitive service?
- Competitive price. How should service be priced to effectively compete with trucks?
- Customer Base. How can the SRT convince intermodal customers that it can add value to their supply chain? What sales strategies and initiatives are required to achieve the desired results?

Comments are provided on these elements below in this section, but the first three elements are evaluated in significant detail in the next chapter "Implementing the Market Development Plan". In that chapter the components of the terminal infrastructure are evaluated, and recommendations are given for specific actions. Likewise, in the section entitled "Railroad Operational Analysis," a strategy is developed for the SRT to provide reliable service through dedicated trains, new operating procedures, and other initiatives. Finally, competitive pricing recommendations are discussed in the Financial Analysis section.

Addressing each of these elements is critical in order to change the perception of shippers, and to achieve the growth in containerization and market share estimated earlier in this chapter. Marketing strategy should deal with developing infrastructure to meet the needs of the shippers,

but also tailoring the use of this infrastructure to provide the service that adds value to the supply chain of the customer.

Initial comments on each element of the MDP follow.

a. Infrastructure

The existing infrastructure of the SRT needs to change in order to properly support the intermodal container business. The existing SRT stations, particularly in the urban areas, are confined by residential and commercial development, and typically have poor highway access. In addition, the SRT does not provide rail sidings into the major industrial estates or other large manufacturing facilities.

While these are disadvantages, the SRT does have significant opportunities to build on with its existing infrastructure.

- For the international container business, there is the opportunity to capture even more market share than exists now by expanding the Lat Krabang ICD. In addition, there is the opportunity created by the Khlong Sip Kao rail connection, with its availability of land with good highway connections. As will be explained later, these opportunities are dependent on increased rail capacity in the SRT corridor from LC Port north to Chachoengsao (where traffic diverges either west to Lat Krabang ICD or north to the recommended new ICD at Ongkharak), but they are significant opportunities nonetheless.
- For the domestic market, the SRT can take the critical first step and develop CTs in the provinces, which will serve the ten wheel truck market. As the use of containers carried on ten wheel chassis grows, the SRT will be positioned to take advantage of the market shift.

The locations of the new intermodal terminals should be selected based on the geographical areas where the most likely conversion of truck freight to intermodal freight will take place, and the next chapter explores that issue.

b. Reliable Service

Reliable service is critical if SRT is to change perceptions and gain market share. Truck-competitive service (or "truck-like" service) by the SRT will be required, since highway carriers set the current standard. Some parameters of this service should include the following features:

- **On Time Performance (OTP).** For initially targeted customers, OTP must be at least 80 - 85%, although most shippers will consider this performance as minimal.

On time performance is probably the most critical aspect of good service. Modern transportation and logistics services depend on very tight inventories, and arrival of goods when they are expected is critical to keep plants operating and customers happy. Unreliable service will cause shortages and "bunching", and neither of these is likely to be acceptable to the shipping community. Bunching is the delivery of large quantities of the customer's product on one day, and then nothing for several days. This is a problem because it causes unpredictability in the supply chain and excess warehousing costs, and will lead to customer uncertainty and dissatisfaction.

- **Overnight Service.** This type of service from the provinces is essential for most freight, given its importance in managing modern supply chains. Shippers expect overnight service when the distances allow it, as it does in almost all of Thailand.
- **Service Guarantees.** In order to offset some of the risks of the two service issues described above, many customers will ask for service guarantees. That is, for late shipments the transportation company should pay a penalty to compensate the shipper for some of the costs incurred. SRT will find that, in discussing the SRT's service reliability, the customers will feel that there is no historical record to guide them in considering whether to experiment with this service. Special incentives may need to be offered by the SRT, which will not be necessary in the long run if the service performs as desired.

- **Loss and Damage.** SRT should establish a freight claims policy similar to that of some trucking companies. In general, customers expect to be reimbursed for loss and damage if it is caused by the transportation company, or if it occurs while in the possession of the transportation company for whatever reason. In addition, loss and damage may cause shortages of critical products if the losses are significant, and cause a company to lose business and market share.

A very brief review of intermodal transport in the U.S. is appropriate at this point in the analysis. Intermodal transport began in the U.S. primarily as an alternative to moving freight in boxcars, and as a direct response to the significant inroads highway carriers were making at the time. At first, many of the commodities converted to intermodal were actually already being moved by the railroads in boxcars, and the change may have cost the railroads money (moving via carload freight was thought to be more profitable than intermodal, and normally still is). However, highway carriers were converting boxcar freight rapidly, due to deteriorating rail service.

At the outset, most intermodal freight was carried in mixed freight trains, since dedicated intermodal trains did not exist. Although these trains moved on a schedule, they were not very reliable, and tended to carry low value goods which were not time sensitive. Over a period of time, and after improving its service and reliability, the railroads were able to build volume, and establish dedicated intermodal trains that could be run on truck-competitive schedules. The notion of "truck-like service" is still used in many railroad marketing and sales departments, reflecting that truckers still dictate the terms of competition. Indeed, although intermodal transportation in the U.S. has grown rapidly for the past fifteen years, truckers are still estimated to carry more than 90 percent of the intermodal freight.

In light of the U.S. experience, considering that the initial volumes for the CTs are expected to be small, the SRT should consider linking these incremental units with bulk trains which run to and from the provinces. Intermodal containers can be added to these bulk trains for very little incremental cost, and the service will allow SRT to gain access to the intermodal market by pricing the container service very low, perhaps slightly above out-of-pocket cost. This will create the conditions (low prices and regular service) that will allow the SRT intermodal service to grow, and derive the scale necessary to justify dedicated train runs.

c. Competitive Pricing

Pricing competitively is a difficult issue to address, but some general comments are provided here and rates are suggested in the Economic and Financial Analysis section of the report. The SRT will need to regionally and locally perform further investigation in order to better understand the pricing structure of their competitors.

In general, the SRT pricing structure must be set at the market rates, which unfortunately have been established by the truckers as the most important competitive mode of transport in Thailand. Selecting specific prices for service is not considered the best means to win business, but instead the SRT needs to establish a reputation for good service before it can compete effectively with trucks.

Based on this pricing strategy, SRT will probably need to begin soliciting the freight business with a price about ten percent lower than the market rate. This may be enough of an incentive to influence some of the more progressive shippers to try the SRT service. It must be emphasized again that these prices should be used as a starting point in negotiations, and that some shippers will naturally use the price offerings of the railroad as leverage to reduce their trucking rates, with no intention of trying the railroad service.

Establishing an adequate rate of return in the freight transportation business will take a period of time, depending on how successful the SRT is in developing a reliable, market-responsive service. The SRT will need to focus first on tailoring the service to its customers, and this aspect of the marketing strategy is discussed next.

d. Customer Base

Expanding the SRT customer base is perhaps the most important area for the SRT to take serious action. From the interviews performed by the PB team, it is apparent that manufacturing and high value goods firms, in general, do not believe that SRT can benefit their distribution system. Changing these attitudes will happen slowly, and only after the SRT has initiated a service can attract those shippers. Before that time, the SRT does not have a viable "product" which it can sell.

In general, manufacturing and distribution firms will be the primary target customers of the new intermodal container service. Based on the interviews and the study of the marketplace, the target customers should include:

- Industrial and consumer goods companies
- Large trucking companies
- Warehousing and distribution companies
- Freight forwarders who assemble shipments for movement to ports.

i. Industrial and Consumer Goods Companies

These firms are the ultimate owners of the goods that are being moved in Thailand and any other country. The most aggressive and forward thinking of these companies will consider supply chain management and logistics as the ultimate service being provided to them, rather than just transportation. They will consider the cost of inventory, maintaining a tight schedule, and getting the minimum amount of goods in the transportation pipeline, to be the most important variables in the transportation business. They will also be the toughest customers to please.

The most aggressive marketing initiatives should be directed towards manufacturing companies, since they will be the ultimate decision makers in how their goods are moved. They are the ones who have developed the most integral relationships with truckers for the past decade or two, according to the interviews.

To develop an approach to these companies, SRT should first meet with transportation managers of these firms, and develop a thorough understanding of exactly where and how their goods are flowing, and if possible some pricing targets. A detailed proposal from the railroad for moving their freight should then be the next step in this process. The successes for SRT will be incremental, and if they are interested, shippers will divert some trial shipments to the SRT. The shippers will all want to keep their options open, and even if they are extremely satisfied with one mode of transport, they will always welcome another viable mode to keep price pressure on the other suppliers.

Approaching these companies could be done in groups, in an effort to provide education to SRT as well as to get information from the potential customers. "Customer Forums" should be considered to accomplish this. (In the U.S. these are called focus groups, and are used extensively for market research.) These forums would consist of groups of transportation managers from different companies, typically gathered in groups from the same industry, which would help the SRT staff learn the issues that these firms consider critical in their transportation programs.

In these customer forums, SRT should use the opportunity to make a presentation to familiarize the customers with the basic route structure of SRT, with the location of their facilities (especially those which are relevant to the gathering of individuals), and show some examples of their product mix and service schedules. It should develop these presentations with an approach that will provide opportunities for discussion by both sides, since these are the people SRT will need to convince to use its service.

Follow up will also be important. The names and relationships gained in these sessions should be used to set up appointments for further one-on-one discussions, where competitive information could possibly be discussed.

ii. Large Trucking Companies

Trucking companies may be the next most likely market for intermodal services. In the U.S., many of the largest trucking companies are using the railroads for major portions of their transportation services. One firm has designed a totally new container exclusively for rail intermodal service, and ships a large percentage of its freight in these containers.

Intermodal is considered by these firms as a supplement to their service rather than competition. In the U.S., at least, this type of firm needs to supplement its services with long haul rail transportation because it is often having trouble finding qualified drivers, and many of the drivers are no longer willing to devote the long hours on the road and away from home. Short haul transportation to and from rail terminals serves the trucking companies, their employees, and the railroads and benefits everyone in the transportation process. It is also a cost effective way for these companies to provide their product. For long hauls, it is now apparent that the railroad can provide a portion of the move for less money than the trucking company.

It is not clear to what extent the same labor and management conditions exist in Thailand. However, highway congestion is very serious in the Bangkok area, and it is likely that the trucking companies would be interested in alternatives which could save them time and money, but perhaps for not exactly the same reasons.

SRT should approach these firms to try and determine what their level of interest is, and then develop specific plans to meet these needs. The largest trucking companies would be the most likely to adopt alternative transportation methods, based on experience in the U.S. Target companies should include those firms which operate in the regions where the CTs will be located. It appears from the PB interviews that trucking firms are offering more services than just transportation, including warehousing, customs liaison, and distribution to retail outlets. These so-called "logistics solutions" seek to involve the transportation company in solving all of the customers' transportation problems, not just the movement of goods.

iii. Warehousing and Distribution Companies

Although many manufacturing companies and trucking companies offer warehousing and distribution services as part of their business, there are companies which operate exclusively in this area of commerce. Service can also be tailored to meet the needs of these firms.

In addition to providing transportation to and from the provinces and Bangkok, these firms can rely on the railroad to handle freight to a location adjacent to or near the rail terminal for storage and distribution. This combination of services works well in many instances, and has allowed many U.S. railroads to build market share while doing business with firms that might otherwise be seen as competitors.

iv. Freight Forwarders

In many cases, freight forwarders assemble shipments in less than truckload (LCL) quantities, and move these shipments by the most economical mode of transportation. These forwarders generally have only one consideration (price), providing that the transportation service meets their minimum needs. The difference between the price that each of the shippers pays them, and the price they pay for the move, is their profit.

It is recommended that SRT, in partnership with the Customs Department, try to explore opportunities with shipping companies (steamship lines). Such an opportunity might be the shipping of international containers inland to specific destinations without being stripped and stuffed, and then these containers could be used for the backhaul of international or domestic freight. This could be a relatively inexpensive first step in establishing an entry-level intermodal service.

It is understood that this type of operation would not be allowed under current practices at the Customs Department, particularly since that department requires a separate facility for international cargo. Some current practices or requirements may need to change, however, in

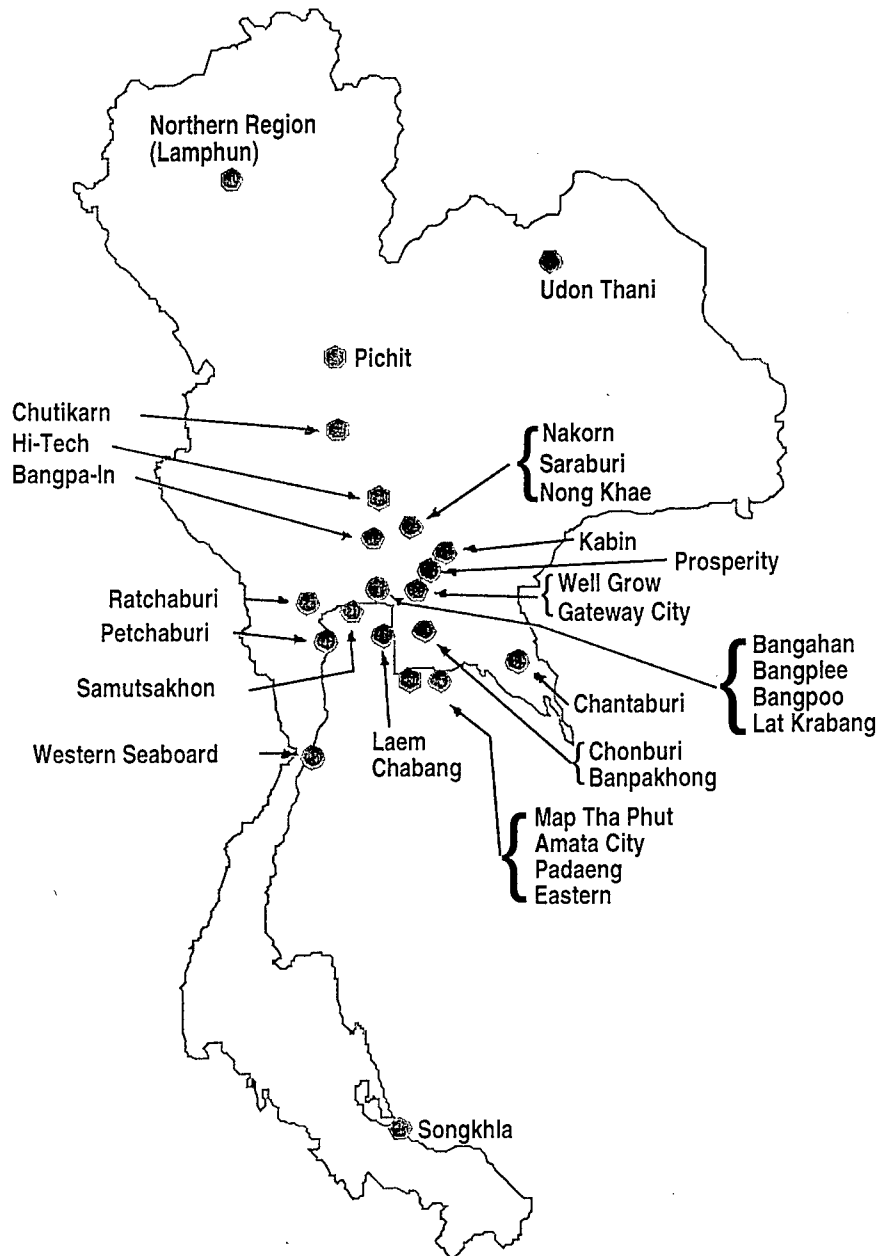
the interest of serving the customers better, attracting more business to the rail lines, and reducing the capital investment for duplicate facilities.

Industrial Development. Industrial development in Thailand is being led by Industrial Estate Authority of Thailand (IEAT), and Figure 9, Public Industrial Estates in Thailand, shows the existing estates that the Authority has developed. From the PB interviews it appears that IEAT does not consider rail access to be an important consideration in locating their industrial estates, and this is a strategy that will hurt SRT in the long run, since it will perpetuate the strong market advantage that trucks have relative to rails.

SRT should consider forming a strategic partnership with the IEAT which, combined with the partnership of the Customs Department, would assemble most of the key players needed for discussing future opportunities. For the advantage of the industries, the development of public industrial estates should include access to rail, and SRT should explore some kind of rate structure to help customers pay for rail sidings. Where there is potential for development of rail infrastructure in existing industrial estates, SRT, IEAT, and the Customs Department should explore this together.

Figure 9

Public Industrial Estates in Thailand



III. IMPLEMENTING THE MARKET DEVELOPMENT PLAN

The previous section of this report concentrated on defining the potential intermodal market in Thailand, and defining the basic components of an MDP to improve SRT's customer base and steadily build market share. This section of the report is concerned with implementing the recommendations of the MDP, that is taking those recommendations in the MDP and providing specific actions for implementation. Where MDP is a broad strategy, the implementation steps in this section are intended to help the SRT move forward with a practical plan, such as choosing the actual sites for SRT terminals, developing conceptual layouts, developing an operating strategy for the railroad, and evaluating the optimum privatization scheme.

A. SELECTION OF TERMINAL SITES

The Market Analysis clearly separated the concept of the ICDs from the CTs, and the function and role of each type of facility for the SRT. As a result of this background, the selection of sites for potential ICD locations naturally focused on the Bangkok metropolitan area, and the CT locations were in the provinces.

The early market analysis by the PB team was summarized in an earlier report submitted to SRT, the Subtask B.1 Report. This report discussed the potential sites for ICDs and CTs, and its results were discussed in a progress meeting with the SRT staff on 1/21/98. From that meeting, some basic decisions were made:

- **ICDs.** The expansion of the existing Lat Krabang ICD, and a new site somewhere along the Khlong Sip Kao rail connection, were the best strategic locations to serve LC Port. PB's field investigations would concentrate on that area.
- **CTs.** The following list of geographical areas in the provinces was agreed upon for the PB field investigations: Chiang Mai, Udon Thani, Khon Kaen, Ubon Ratchathani, Korat, Songkhla/Hat Yai, and Phitsanulok if time permitted. These were the general geographical areas which would be investigated for potential CT sites.

For the CT locations mentioned above, these areas satisfied the initial objective for the new SRT intermodal service: a CT near the end and middle of each SRT line, with next day service to and from the Bangkok/LC Port areas. The only exception was the Southern line, for which traffic projections did not warrant a second CT between Hat Yai and Bangkok. This concept is summarized in the Table 16 below:

Table 16
Possible CT Locations in the Provinces

Line	End	Mid-Point
North	Lamphun or Lampang	Phitsanulok
Upper Northeast	Nong Khai, Udon Thani, or Khon Kaen	Korat
Lower Northeast	Ubon Ratchathani	Korat
Southern	Hat Yai	

The challenge for the PB team was to locate specific sites in those geographical areas which could meet the various site criteria developed by the PB team. This section of the report summarizes that process: the development of site criteria; site investigations; comparison of the sites; and then selection of the preferred sites for conceptual design evaluation.

1. Site Investigations

The PB team performed a field inspection tour which lasted approximately two weeks, with the purpose of investigating each of the geographical areas mentioned above, and defining specific locations along the SRT ROW which appeared to be suitable for supporting an intermodal facility. The criteria for selecting those locations are discussed below, but the overriding consideration was the potential for attracting container traffic, and as a result locations near urban areas, industrial developments, and major highway intersections were the primary sites considered.

For the sake of reference, Table 17 is a summary of the investigations conducted by the PB team during January and February of 1998:

Table 17
Summary of Investigations Conducted by PB

Date	Areas Investigated
1/23/98	• West of Bangkok - construction of new truck terminal
1/24/98	• Saraburi freight station • Khlong Sip Kao rail connection at Highway 2 • Kaeng Khoi station • Korat stations (2 ea.) • Junction of 2 Northeastern lines east of Korat • Smaller highways (3 ea.) west of Korat, and their intersections with the SRT line
1/25/98	• Khlong Sip Kao at Highway 305 (bridge and approaches) • Ongkharak station • New truck terminal being constructed near Highway 37
1/27/98	• Lat Krabang ICD
1/28/98	• Chiang Mai station • Lamphun Industrial Estate and SRT station • Lampang station and Highway 11 on south side of town
1/29/98	• Phitsanulok station • Highway 12 overpass area north of Phitsanulok
1/30/98	• Nong Khai stations, old and new • New rail connection to Laos (in Nong Khai) • Udon Thani station • Udon Thani Industrial Estate • Khon Kaen station
1/31/98	• Highway at Wat Non Rasi north of Khon Kaen (at grade crossing) • Sam Ran station • Highway 208 south of Khon Kaen (at grade crossing) • Highway 24 south of Ubon Ratchathani (at grade crossing)
2/2/98	• Two private industrial estates near Hat Yai • Highway 4 intersection with SRT at Khlong Ngae south of Hat Yai (at grade crossing) • Sala Thung Lung station • Bang Klam station • Southern Industrial Estate (IEAT)

Date	Areas Investigated
2/3/98	• Highway 414 north of Hat Yai (overpass area) • Na Muang station • Highway 43 south of Hat Yai (overpass area) • Highway 408 south of Hat Yai (at grade crossing) • Highway 4 at Phrun (at grade crossing) • Ban Phachi station • Highway 329 south of Ban Phachi (at grade crossing) • Ayutthaya station • Highway 37 - Outer Ring Road (overpass area)

Photographs and complete notes were taken at each site.

2. Site Criteria

The market projections developed previously in this report were for general geographical areas only, and so they were of little use in weighing one particular site in a region against another. The primary criteria for selecting a particular CT location, however, was the potential for generating future container traffic. This potential for future traffic rested on a number of other criteria, which were used for selecting and evaluating the sites:

- Proximity to urban areas and industrial development
- Access to major highways
- Impact on nearby residential areas
- Overall size and capacity for expansion
- Environmental impact
- Configuration of site
- Railroad impact (impact on railroad operations, proximity to stations and other issues)
- Grade differences (with surrounding land)

Capital costs are a major factor, but they were developed later and were not considered in this part of the analysis.

From the investigation mentioned above, notes were taken at all sites and those sites which were considered as presenting the best opportunity for development as SRT terminal sites were selected for the conceptual design stage.

It should be noted that two CT sites were added by the PB team due to their critical locations: Ban Phachi and Ongkharak. For Ban Phachi, since next day service from the Chiang Mai/Lampang area was considered important, a small facility near the Ban Phachi Junction was necessary as a drop off and loading point. The intermodal trains from the Northern Line need to be loaded quickly for the return trip, and the Bang Sue area was considered too busy for reliable daily freight service. For Ongkharak, since Customs Department regulations require a separate facility for international containers, and since the traffic from the provinces will be a mixture of domestic and international traffic, a CT separate from the ICD was needed. There is a further description of this situation on the following page.

3. Conclusion

Table 18 summarizes the sites which were finally chosen as holding the greatest potential for the SRT service, based on the criteria mentioned above:

Table 18
Summary of Final CT and ICD Sites

Type of Site	Location	Comments
ICD	Lat Krabang (expansion of existing facility)	Already a successful operation; land available for expansion
ICD and CT	Ongkharak station	Existing SRT station and good highway access; land available for expansion
CT	Lamphun Industrial Estate area	Good highway access and industrial base
CT	Highway 12 north of Phitsanulok	Mid point for northern line; major highway intersection point
CT	Highway 329 south of Ban Phachi Junction	Considered critical for next day service on Northern Line
CT	Sam Ran station north of Khon Kaen	Good highway access; collection point for traffic from Udon Thani and Nong Khai
CT	Highway 24 south of Ubon Ratchathani	Good highway access near major urban area
CT	Small highway west of Korat	Midway collection point for Upper and Lower Northeastern Lines
CT	Highway 43 south of Hat Yai	Good highway access; long haul distance to Bangkok area

Figure 10, Proposed Container Terminals on SRT System, shows the location of these CTs, and a short description of each site is provided below for general background.

a. Lat Krabang ICD

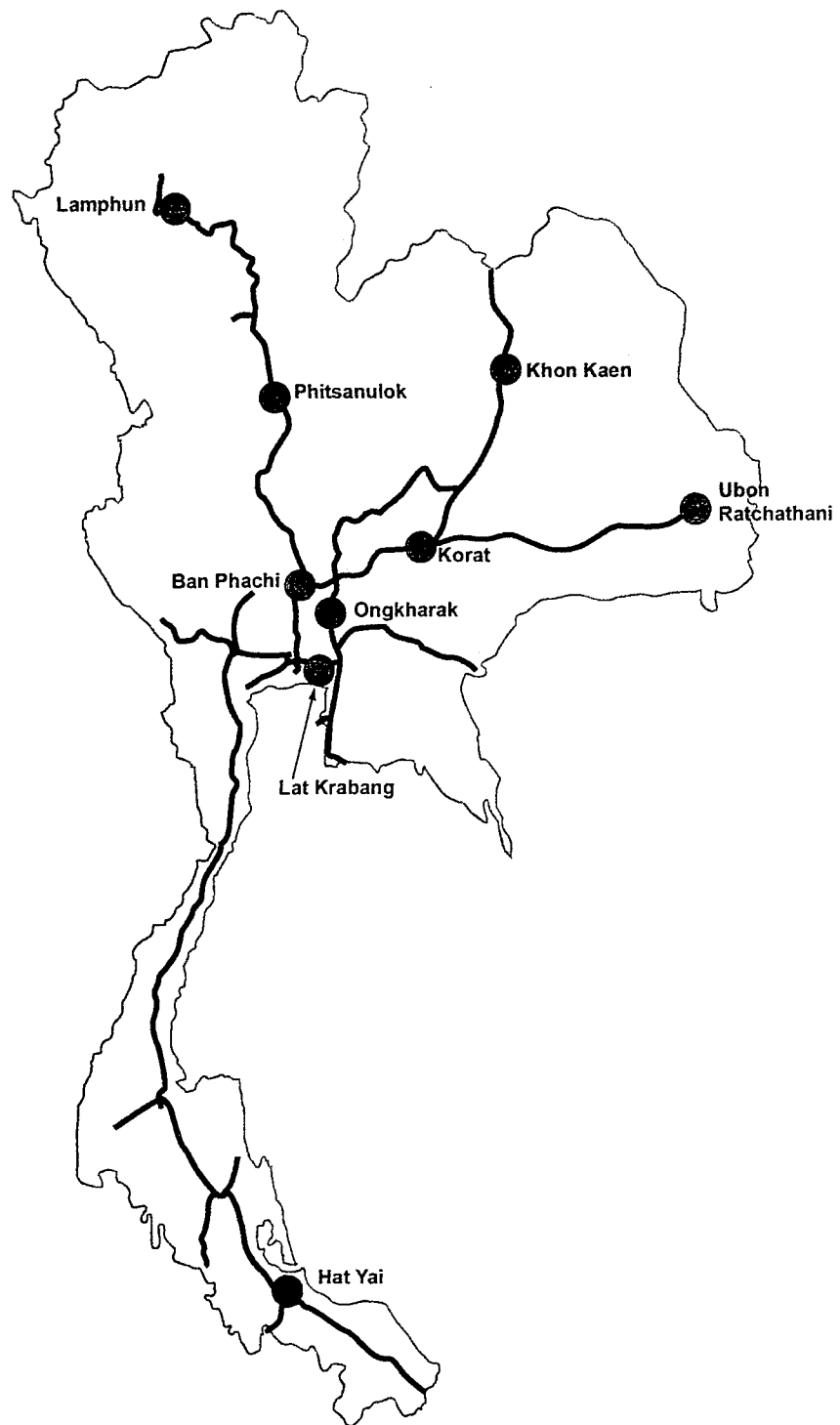
The existing ICD facility at Lat Krabang was the first such facility for SRT, and it is located southeast of Bangkok about 109 km north of LC Port, which is the main focus of its service. The site is described further in the section on Terminal Site Development, but there is sufficient adjacent land to support the construction of an expanded facility.

b. Ongkharak

On the new Khlong Sip Kao rail connection, Ongkharak is the southernmost new station, and has sufficient land for a major rail facility. The existing facility is comprised of a siding track for public freight loading and a new passenger station. This site is advantageous for more development by SRT due to its location next to Highway 305, which provides a good connection for trucks traveling to and from Bangkok.

In addition to an ICD at this location, it is also being recommended that a CT be constructed, for a number of reasons. The first issue is that the projections from the port-related traffic called for an ICD to be constructed in Ongkharak by the year 2010. However, Ongkharak will be the focal point for both domestic and international container traffic from all the CTs, and a facility is needed before 2010 in order to serve the domestic Bangkok market (overnight service from the provinces). Secondly, since the existing requirement of the Customs Department is that international traffic cannot be mixed with domestic, it is necessary for a CT to be constructed at Ongkharak in addition to the future ICD. Without the Customs Department restrictions, a joint facility could be developed, one with separate areas for domestic and international containers.

Figure 10
Proposed Container Terminals on SRT System



It is recommended that the SRT and Customs Department begin to coordinate on this issue, so that duplicate facilities could be avoided, resulting in lower capital costs. However, for the purposes of this report, a CT and a separate ICD are shown at Ongkharak.

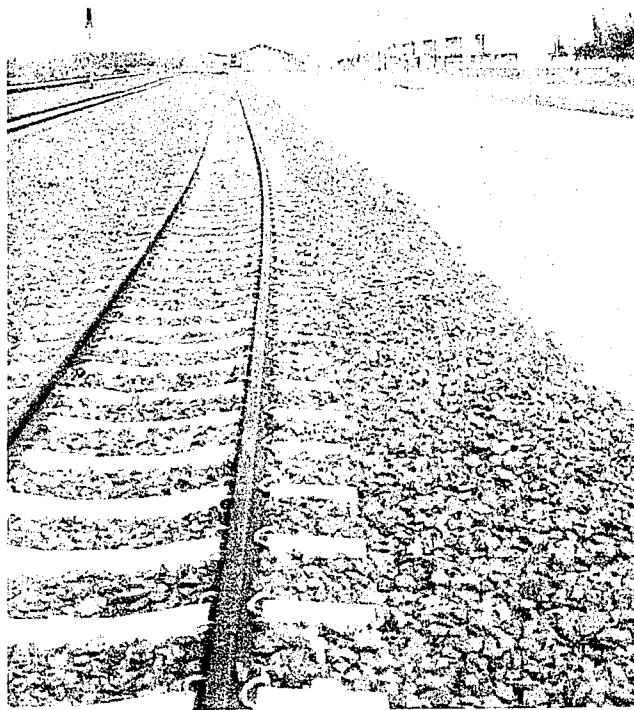


Photo 1
Existing Ongkharak Station
(east side of ROW to right)

c. Lamphun

This site is located southwest of the western portion of the Northern Region Industrial Estate, with the estate being split by Highway 11 into east and west portions. The site is relatively flat, close to grade, serviceable by rail from the southeast, and accessible for trucks by extending the estate road system. It appears to be adequate to receive an ICD equivalent to Lat Krabang in later phases, but the initial phase will be a start-up CT. Current users of the industrial estate do not utilize rail and have expressed no desire for rail service, except to haul hazardous and industrial waste. At this point, there is no rail service into the estate, although the existing Lamphun station lays less than 1 km north of the proposed site.



Photo 2
Lamphun Site
(looking east of railroad)

d. Phitsanulok

Near the intersection of the new Highway 12 and the railroad, there is adequate green-field property north and south of the highway overpass for a new CT. The most likely sites are both east of the railroad. Private dwellings are slowly taking over the property to the south, leaving the property to the north as a more suitable site for the CT. The rail access should be south of where the rail ROW curves to the west.

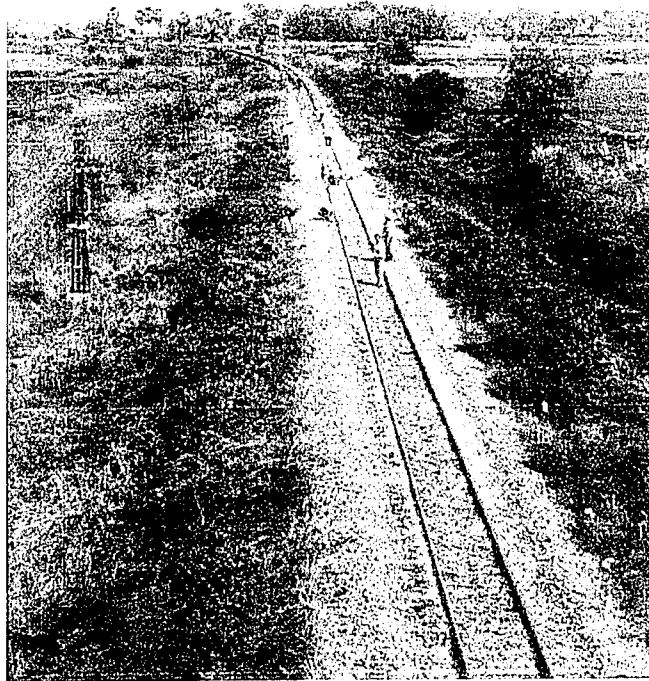


Photo 3
Phitsanulok
(looking north from Highway 12 overpass)

e. Khon Kaen

North of Khon Kaen about 9 km is the existing Samran station, with a rail siding to a recently-constructed PTT plant. A paved road with good highway access ends on the western side of the tracks, while a passenger station lays on the east side. The area west of the tracks, and south of the paved road, is available as a CT site and would be relatively easy to develop. The approximate size is 100m x 700m.

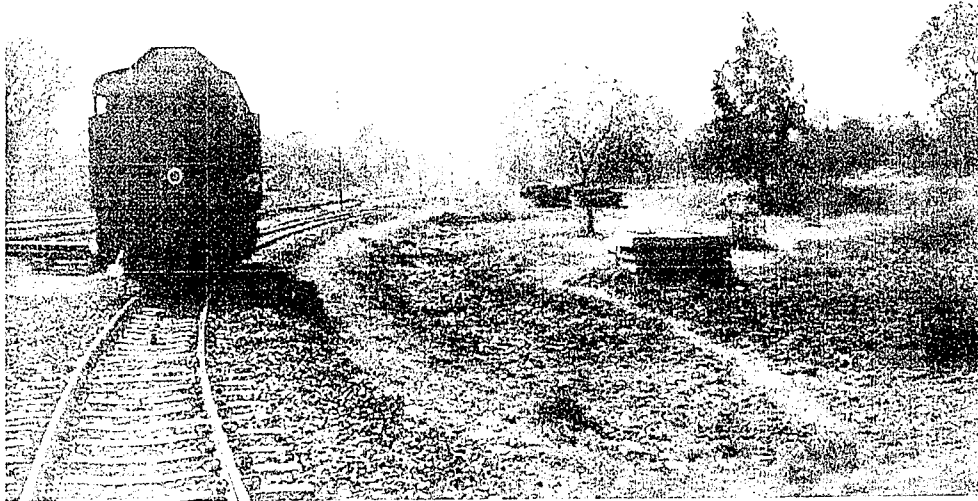


Photo 4
Sam Ran Station
(west side of railroad ROW)

f. Ubon Ratchathani

South of Ubon Ratchathani, there is the crossing of Highway 24 and the railroad at grade level. The highway runs north to south and the rail runs from southwest to northeast. All four quadrants of the intersection are open green-field sites and appear to be suitable for development of a new CT, with the southeast quadrant appearing to be the best site of the four. It is level and approximately 1m below the rail and highway grade.

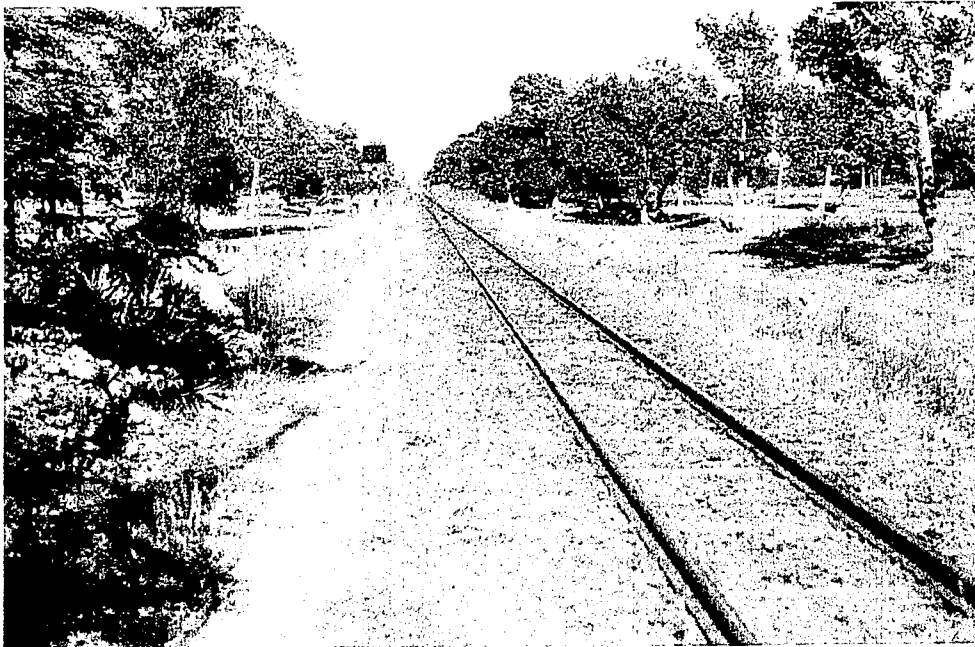


Photo 5
Ubon Ratchathani Site
(looking north from Highway 24)

g. Ban Phachi

Less than 1 km south of the Ban Phachi Junction, the railroad crosses Highway 329 at grade level. At the time of the PB inspection, the west side of the existing track was being graded as part of the double tracking program, and there appears to be less than 1m difference between the railroad and surrounding grade. There is ample space in the southwest quadrant for a CT, with good highway access.

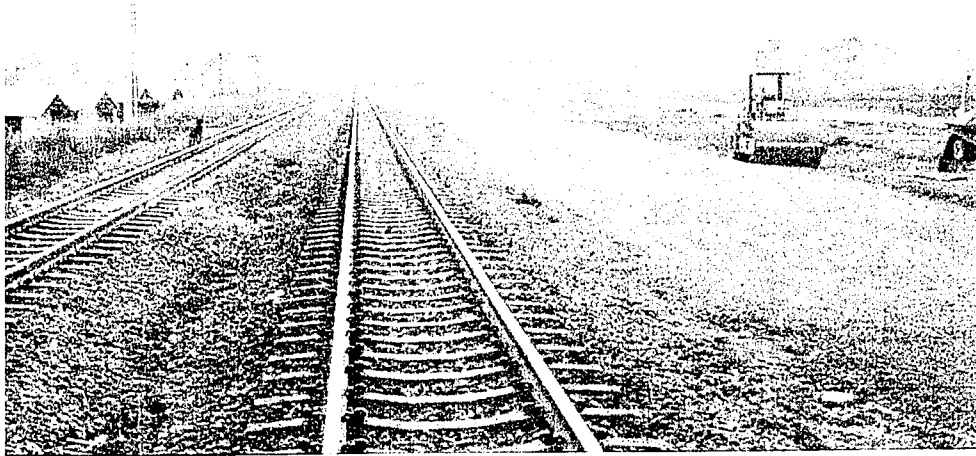


Photo 6
Ban Phachi Site
(looking south from Highway 329)

h. Korat

Approximately 7 km west of Korat there is an unnamed small highway which runs north from Highway 2 and crosses the railroad less than 1 km north of that major highway. The surrounding area is relatively flat with only minor development, and appears to be a good choice for development as a CT.

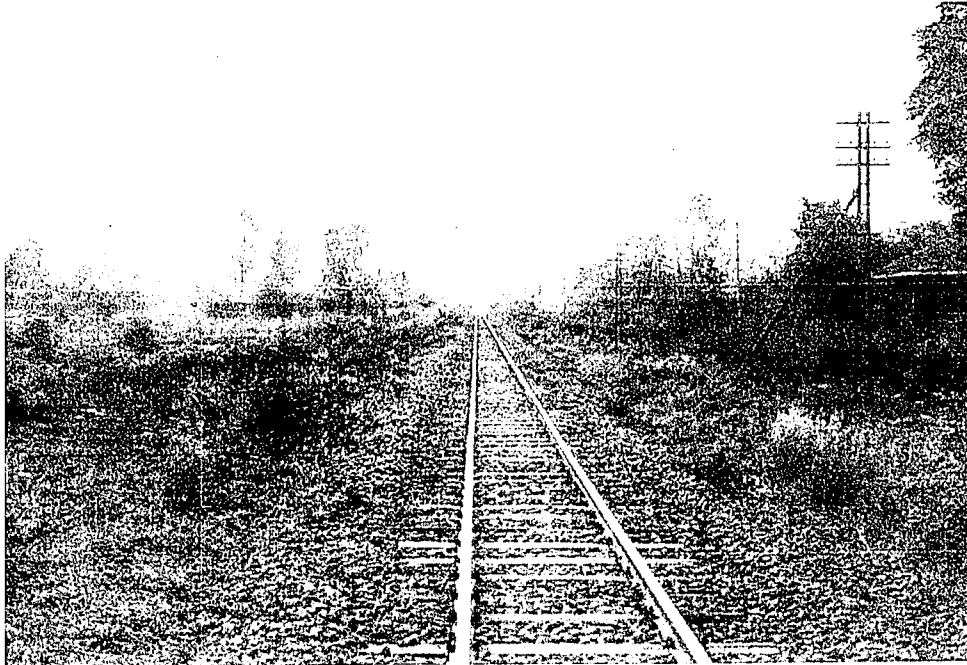


Photo 7
Korat Site
(unnamed road 7 km west of city)

i. Hat Yai

Highway 43 south of Hat Yai runs east to west and crosses over the railroad. The area of this intersection has good highway access to Songkhla and also to the border with Malaysia. Highway 43 already has a lightly used interchange ramp next to the railroad site, saving considerable capital expense for road improvements to the potential CT.

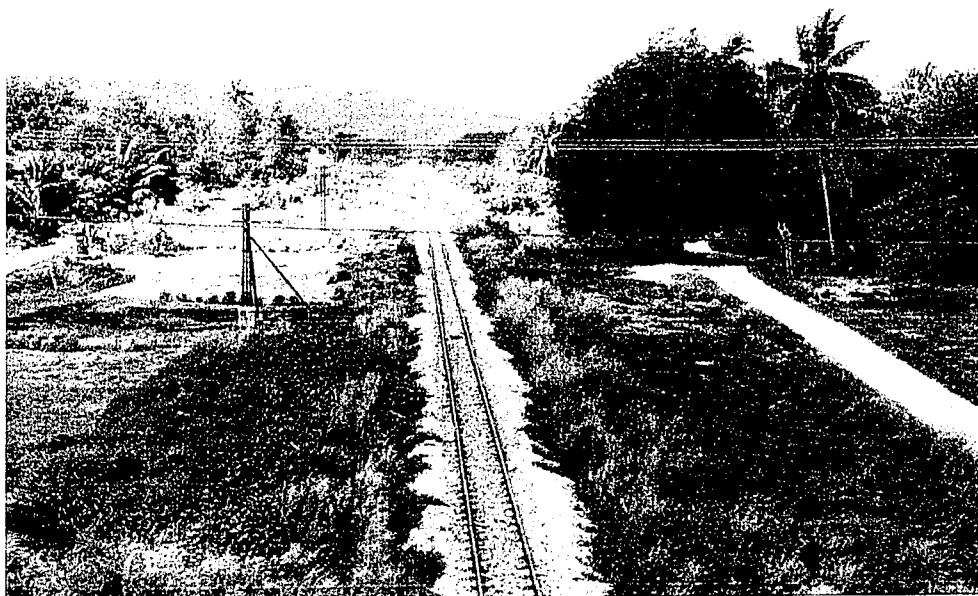


Photo 8
Hat Yai Site
(looking north from Highway 403 overpass)

These sites became the focus of the analysis in the subsequent sections.

B. COMPARISON OF BANG SUE AND OTHER BANGKOK SITES

The criteria used to select sites, and the actual ICD sites chosen for the Bangkok area, were discussed in the previous section. Considering the importance of the Bangkok metropolitan region to the SRT system, and particularly the importance of the existing Bang Sue facility (which was not selected as a future ICD site), this section provides further clarification on the evaluation process and the issues surrounding the Bang Sue facility.

1. Evaluation of Sites

There were four sites selected in the Bangkok metropolitan region, all of which were considered large enough to accommodate a major rail facility. The sites were Lat Krabang, Bang Sue, Ongkharak, and Bang Pa-In. The comparison of those sites, against the criteria described previously, is shown in Table 19 below:

Table 19
Bangkok ICD Site Comparison

Site	Urban Indust. Location	Access to Highways	Overall Size and Capacity	Environmental Impact	Rail Operation
Bang Sue	○	◐	◐	○	○
Lat Krabang	◐	●	◐	●	●
Ongkharak	◐	●	●	◐	●
Bang Pa-In	●	●	●	◐	○

● = Highly Favorable ◐ = Moderate ○ = Not Favorable

Lat Krabang and Ongkharak were ultimately chosen as the preferred sites for locating ICDs in the Bangkok area. The most compelling reasons were their favorable locations with regard to LC Port, their connections to the highway system, and the availability of undeveloped land. The Bang Pa-In site has the available land and highway connections, but its major disadvantage is the distance from LC Port. The Bang Sue site is a special consideration, and more detail is provided below on its situation. The major reasons for not selecting it as an ICD site were its location in a congested area of Bangkok, its distance from LC Port and the difficulty of scheduling many more additional trains to the area, and its inferior highway connections.

Considering the importance of the Bang Sue facility to the existing SRT operation, more discussion is warranted with regard to its situation.

2. Bang Sue Site

The Bang Sue rail facility encompasses a significant area in the northern portion of the Bangkok metropolitan region, and accomplishes a number of functions for the SRT:

- Marshaling yard for the makeup of trains
- Intermodal facility
- General cargo loading/unloading
- Bulk distribution center (primarily cement)

Table 20 summarizes the flow of goods through the Bang Sue facility for the year 1997:

Table 20
Bang Sue Freight Movements for 1997

Type of Goods	Approximate Tonnage (thousands)	% of Total
Rice	2.7	0.1
Lumber and Logs	0.2	--
Bagged Cement	69.9	3.1
Petroleum	0.03	--
Bulk Cement	2,025.8	89.2
Miscellaneous	171.5	7.6
Total	2,270.1	100.0

Source: SRT Freight Marketing Department

There are a number of factors which are currently putting pressure on the Bang Sue facility, and making its future uncertain:

- Prior to the construction of Lat Krabang ICD, Bang Sue was the only intermodal facility on the SRT system, but its traffic has decreased for a number of reasons. As an example, due to its location north of Bangkok, the intermodal trains from this facility to LC Port have narrow operating windows on the main line, and the distance is significantly greater than that of Lat Krabang to LC Port. In addition, the truck traffic generated by this facility must contend with the congestion and clearance restrictions of urban streets.

The intermodal operations at Bang Sue are already being phased out and will most likely be absorbed by Lat Krabang ICD in the near future.

- The only significant traffic currently being generated in this facility is through the bulk cement operation, which is divided between four contractors: Siam Cement, Siam City Cement, TPI Polene, and Jalaprathan. Each of these firms has its own cement silos and generates considerable truck traffic in the surrounding area, which is basically a congested urban setting.
- The marshaling yard is important to the SRT as a location for building and classifying trains which are moving in and out of the Bangkok area. As the SRT starts to migrate toward the use of more unit freight trains, fewer switching moves will be required and the need for these yard classification activities (in the Bangkok area) will decrease.
- The general cargo operation is important, but the tonnage of cargo handled is low when compared to the bulk operation and the size of the facility. According to the latest SRT information, cement in bulk represents by far the greatest share of cargo activity, comprising nearly 90 percent of the total tonnage. Within the much smaller general cargo category, the primary products handled are rice, lumber and logs, and a miscellaneous category which encompasses a wide range of goods.
- The surrounding area has been considerably developed, and the environment of a rail facility (noise, dust from the cement, and other issues) is becoming incompatible with the surrounding urban community.
- There are various plans being developed for the area encompassed by the Bang Sue facility, which call for the rail area to be utilized as a mass transit station or an intermodal complex for transit passengers. While these plans have not yet been finalized, it is clear that there are other uses being contemplated for the area other than a freight rail facility.

While these issues were not the major reasons for discounting Bang Sue as an ICD site, they are important considerations for the SRT senior staff. As a result, they requested that the issue of replacing the Bang Sue facility be briefly addressed in this report. That is, if it is necessary to relocate the SRT functions currently at Bang Sue (due to some of the issues mentioned above), what would be the most advantageous location for that new facility? To satisfy this request, a potential site for the relocation of Bang Sue was considered, as the various sites for ICDs in the Bangkok area were evaluated.

If it were necessary to relocate the Bang Sue facility, the new site would need to be large enough to accommodate the following functions:

- A marshaling yard of approximately 20 tracks and 1000m length.
- Cement distribution facilities (silos, associated space for rail and trucking needs, offices, etc.) of approximately 125,000 square meters, based on the total size of the cement facilities currently at Bang Sue. Within this space, new silos would need to be constructed to replace the 20 to 25 silos currently in use.
- A general cargo area, which could be sized based on the most recent data at the time of relocation. For the purposes of this report, a space of approximately 50,000 square meters was assumed.

To find the space necessary for the construction of these facilities, the Bang Pa-In site was evaluated further. While Bang Pa-In's location is not advantageous as an ICD site, considering its distance to LC Port, it does have significant advantages as a replacement site for Bang Sue:

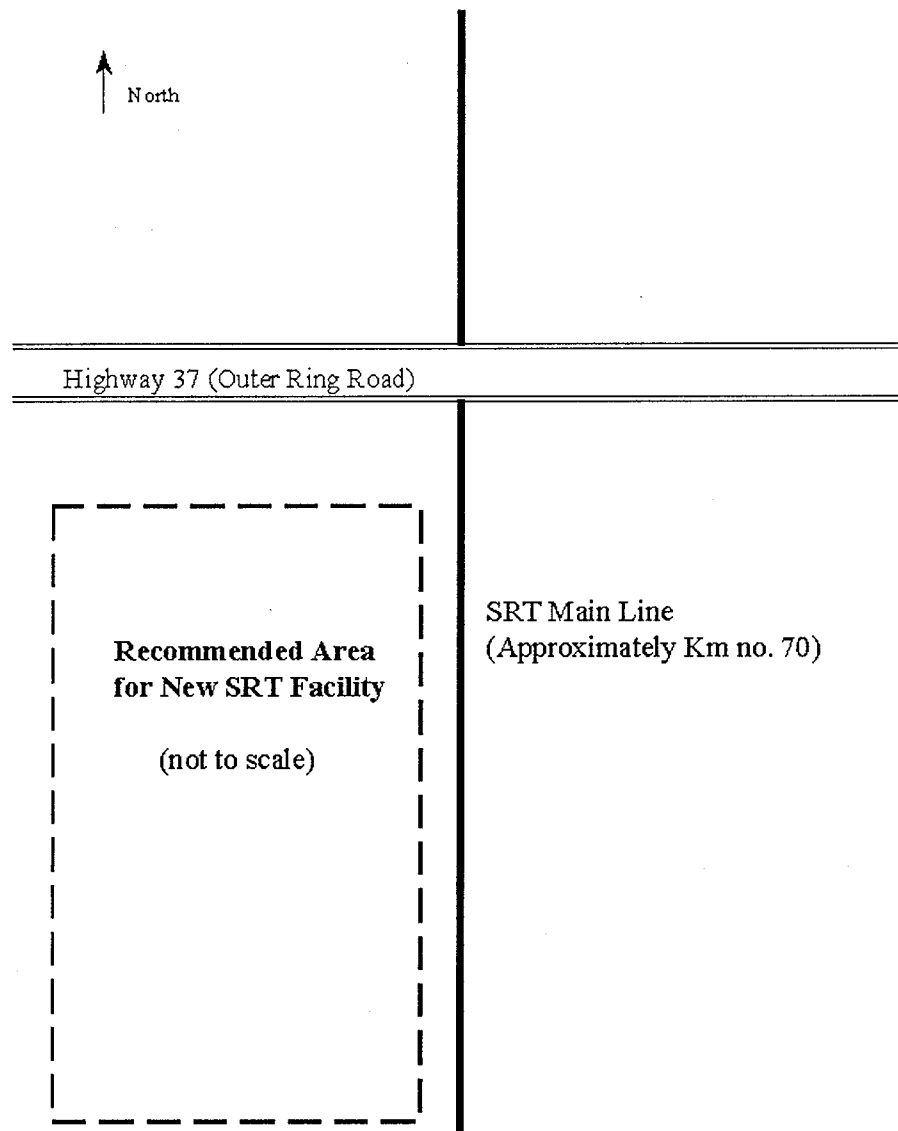
- Large amount of undeveloped land adjacent to the SRT main line
- Relatively undeveloped nature of surrounding community. This would reduce the impact of a rail facility, with its noise, dust, etc.
- Good highway connections
- Favorable location on the SRT system (for domestic products). Since Bang Pa-In is well north of the Bang Sue area, trains from the Northern and Northeastern Lines could be more reliably scheduled. From a rail operations perspective, this has considerable advantages.
- Ability to expand in the future

Given these advantages, Bang Pa-In is recommended as the possible replacement site for Bang Sue, if and when it is necessary to move that facility. Photo 9 shows a view of the site, looking south from Highway 37. Figure 11, Possible Replacement Location for Bang Sue Facility (Bang Pa-In Site), is a sketch intended simply to show the general location of the suggested site south of Highway 37, although all four quadrants of the highway/railroad intersection should be explored further for possible development by SRT. Since the requirements of the future facility are not defined at this time, it is not possible to provide a conceptual drawing (or even to size the facility accurately), so the figure simply shows a block of space adjacent to the track which could be used for the facility.



Photo 9
Bang Pa-In Site

Figure 11
Possible Replacement Location for Bang Sue Facility
(Bang Pa-In Site)



C. TERMINAL SITE DEVELOPMENT

The MDP recommended the development of a system of ICDs and CTs by the SRT, as part of the strategy for increasing its intermodal container business. These new facilities will form the infrastructure necessary to support the rail operations for these new services. Section A of this chapter concluded by describing the eight selected sites for CTs and the two selected sites for ICDs.

This section begins with an evaluation of the existing operation at Lat Krabang ICD, and then develops conceptual designs for all future ICDs and CTs. These designs and cost estimates are then used later in this report, first to evaluate the railroad operating issues and then to develop the financial and economic analyses.

1. Inland Container Depots (ICDs)

a. Introduction

ICDs are extensions of busy container ports, and they are usually located some distance away from the ports in the interior of the country. ICDs are similar to general container ports, except that they receive train calls instead of ship calls, and they function as buffers for the ports by providing additional storage space and enabling better control over inbound and outbound container flows. Containers are transported to and from the ports by rail and trucks. In addition, ICDs facilitate distribution of cargo to and from the communities where they are located.

To prevent single-tenant dominance, the government of Thailand has a policy of leasing an ICD to more than one operator, at least with regard to the first ICD at Lat Krabang. As a result, this ICD is partitioned into several modules, and each module contains its own facility, equipment, and staff, and functions as an independent container terminal. The key components of a module and its functionality are summarized in Table 21.

Table 21
Summary of Lat Krabang ICD Module Components and Functionality

Component	Functionality
Gate	Receive and deliver trucks Exchange cargo information Inspect equipment and container content
Office	House administration staff and clerks
Container Freight Station	Consolidate and distribute less-than-container freight
Container Yard	Store containers
Work Shop	Repair and maintenance
Miscellaneous Area	Auxiliary functions, e.g. parking and cleaning
Rail Track	Load and unload railcars
Access Road	Connect to main highway
Handling Equipment	Load and discharge containers Transport containers within the terminal

Source: Interviews of SSS personnel

b. Lat Krabang ICD

Lat Krabang ICD is located 25 km east of Bangkok and is the first railroad-based ICD in Thailand. It was constructed and opened for operation by the Ministry of Transport and Communications in 1996. The facility consists of six modules, four of which are currently leased and the remaining two are expected to begin operation in 1998.

i. Facility, Equipment, and Operation

At the time of this study, only operational data from Module A was available. Consequently, the equipment and staff information for Module A are shown here as examples and will be used as models for other modules. Table 22 lists the handling equipment in service at Module A:

Table 22
Handling Equipment in Service at Module A

Equipment	Quantity
Reach stackers (41-ton capacity)	3
Empty Pickers (side loaders)	3
Hostler Tractors	6
Yard Chassis (in-terminal use)	12
Tractors (over-the-road)	60
Chassis (over-the-road)	350

The reach stackers are used to load or discharge loaded containers to and from trains and trucks. The empty pickers, or side loaders, are used to handle empty containers. The hostler tractors and yard chassis are for transporting containers within the terminal, and the tractors and chassis are used for drayage (i.e., local delivery and pickup).

The personnel utilized by the contract operator for the 24-hour operation at Module A are shown in Table 23:

Table 23
Personnel Utilized at Module A

Personnel	Quantity
Management (CEO, GM, AGM)	3
Security (6 Day, 6 Night)	12
Gate (2 in, 2 out)	4
Inspectors	14
Container Yard (4 Export, 3 Import)	7
Container Freight Station (10 Export, 11 Import)	21
Equipment Control (Yard)	26
Mechanics	9

Among those personnel, the security service was subcontracted to an outside company. Hence, the number of employees, excluding subcontractors, was 84.

The SRT currently operates shuttle services with four daily trains in each direction between LC Port and Lat Krabang ICD. Each train has one locomotive and 34 railcars carrying 68 TEUs. The original operating schedules allowed up to ten trains in each direction, but this situation is discussed in detail under the Railroad Operating Plan section.

Terminal operations at Module A are performed 24 hours a day, seven days a week. The flows handled here include full-container-load (FCL) cargoes, less-than-container-load (LCL) cargoes, and empty containers. While FCL cargoes are always handled in whole container units, LCL cargoes must be processed in the container freight station (CFS) before leaving the terminal. Gate-borne LCL cargoes are consolidated in the CFS and transported to the port in full containers. Conversely, an LCL container from the port, with cargoes destined for different local clients, is apportioned in the CFS and delivered to respective destinations by trucks. Between the time a container enters and leaves the terminal it is stored at the container yard (CY). The turnaround time for cargoes in Lat Krabang ICD currently runs three days for import containers, and one to two days for export containers.

Empty containers are transported as necessary to balance import and export container flows and for depot storage. All inbound empty containers join the empty storage pool, and the origin of an empty container is not kept once it is put in storage. Outbound empty containers are removed from the same pool upon request. Consequently, an empty container may come in and out either through the gate or the rail, and the average dwell time for empty containers is four days.

The flows of different types of cargoes in the Lat Krabang ICD are shown below:

LCL: Gate ↔ CFS ↔ Rail
FCL: Gate ↔ CY ↔ Rail
MT: Gate/Rail ↔ CY ↔ Gate/Rail

All of the cargoes handled at Lat Krabang ICD are international shipments, and as a result, there are Customs Department officials on-site to perform the inspection and process paper work.

Figure 12, Existing Lat Krabang ICD Plan, is contained in a packet at the end of this report. It shows the general layout of the facility, with the current stowage plan at Lat Krabang ICD.

ii. Throughput

The rail shipments account for about 100% of imported volumes, and about 80% of exported volumes at Module A. It is worth noting that the rail usage was higher than the planned volume, especially for imports. This implies that the demand for rail service was higher than expected at Module A. As is discussed in the Railroad Operating Plan, the SRT needs to examine the capacity of its rail service so that it will not impede the operation at Lat Krabang ICD in the future.

Continuing with the analysis of the example Module A, the planned and actual throughputs and modal splits of Module A in 1997 are summarized in Table 24.

Table 24
Throughput and Modal Split at Module A, 1997

	Mode	Plan (TEU)	Actual (TEU)
Import	Rail	33,176	41,549
	Truck	11,076	495
Export	Rail	27,664	30,092
	Truck	9,204	11,709
	Total	81,136	83,845

Source: SSS records

iii. Analysis

A simulation analysis was conducted by JWD to estimate the storage space requirement at Module A. JWD's Terminal Inventory Simulation Program (TISP) was used in this analysis. TISP takes throughput, cargo mix, terminal operating hours, train schedule, and container storage dwell time as inputs. It then simulates the fluctuation in container inventory in response to these input parameters.

TISP does not simulate depot empty movements, since their dwell times at the container yard do not depend on scheduled operations. Therefore, the inventory of empty containers at the depot needs to be added to the simulation results to compensate for this absence. The throughput and cargo mix used in the simulation are summarized in Table 25.

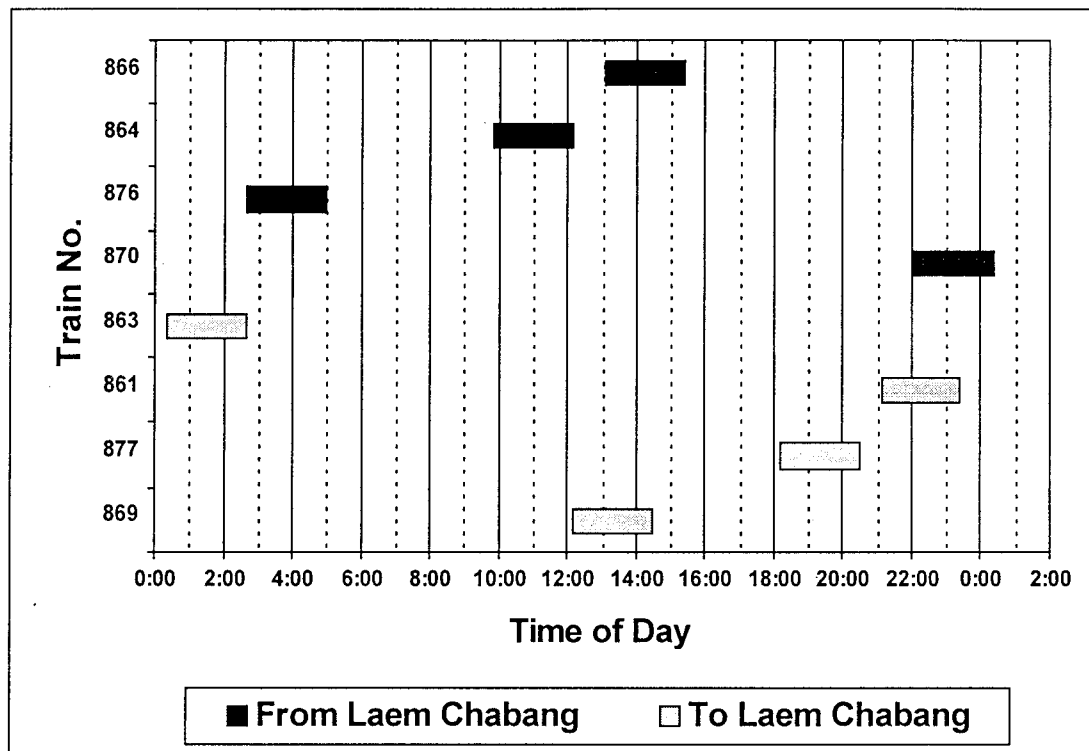
Table 25
Throughput and Cargo Mix Used for the Simulation

		Rail (TEU)	Truck (TEU)
Import	Loads	27,611	495
	Empty	13,938	-
Export	Loads	29,447	11,709
	Empty	-	645

Source: SSS records

With Module A being operated 24 hours a day, seven days a week, the current train schedule is shown in Figure 13, Current Train Schedule at Lat Krabang ICD below, and the bar length represents the sum of the train loading and discharging times.

Figure 13
Current Train Schedule at Lat Krabang ICD



Source: SRT operations records

Three types of storage were defined in the analysis: import loads, export loads, and empty containers. Both FCL and LCL cargo constitute loaded containers and the average dwell times of those storage types were assumed to be as follows:

Import: 3.0 days
Export: 1.5 days
Empty: 4.0 days

The operation at Module A was simulated by JWD for nine weeks, and the results in the fifth week were taken as representative data. Table 26 summarizes the storage capacity and simulation results.

Table 26
Simulated Storage Requirement at Module A (Lat Krabang ICD)

Storage Group	Import	Export	Empty	Total
Storage Capacity (TEU)	1,566	783	2,000	4,349
70% Storage Capacity (TEU)	1,096	548	1,400	3,044
Simulated Average Inventory (TEU)	251	216	176	643
Simulated Peak Inventory (TEU)	301	259	211	772

Source: JWD simulation program

The storage capacity in Table 26 above was based on the current stowage plan of Module A. Due to operational constraints, a container yard rarely reaches 100% of its storage capacity, and it was assumed that the utilization level at Module A was 70%. Table 26 utilizes the adjusted storage capacity.

The simulated results from TISP were based on the average daily throughput in 1997, but in reality daily throughput varies from one day to another. To reflect this peaking effect, it was

assumed that the inventory on a peak day was 20% higher than that on an average day. The simulated peak inventory in Table 26 shows the storage space requirement on a peak day.

The simulated inventory of empty containers only accounted for changes due to scheduled empty container movements. The actual inventory of empty containers was not included since they did not depend on the operating schedule. The average inventory of empty containers was estimated to be 700 TEUs at Module A, and so the overall storage capacity, excluding the empty containers, was 2,344 TEUs. The simulated peak inventory was about one third of this capacity, and this implied that the terminal storage space could sustain a throughput three times that of the 1997 level. The 1997 annual throughput at Module A was about 84,000 TEUs, and so the container yard at Module A could sustain about 250,000 TEU/year. With the size of the CY at Module A being about 25% of the entire Lat Krabang ICD, the expected capacity of the whole ICD is approximately 1,000,000 TEU/year.

The rail capacity of Lat Krabang ICD is discussed in detail in the Railroad Operational Analysis.

iv. Improvements to Current Operation

The SRT asked the PB team to review the current operation at Lat Krabang ICD for potential improvements, and despite its obvious success, five areas were identified for improvements:

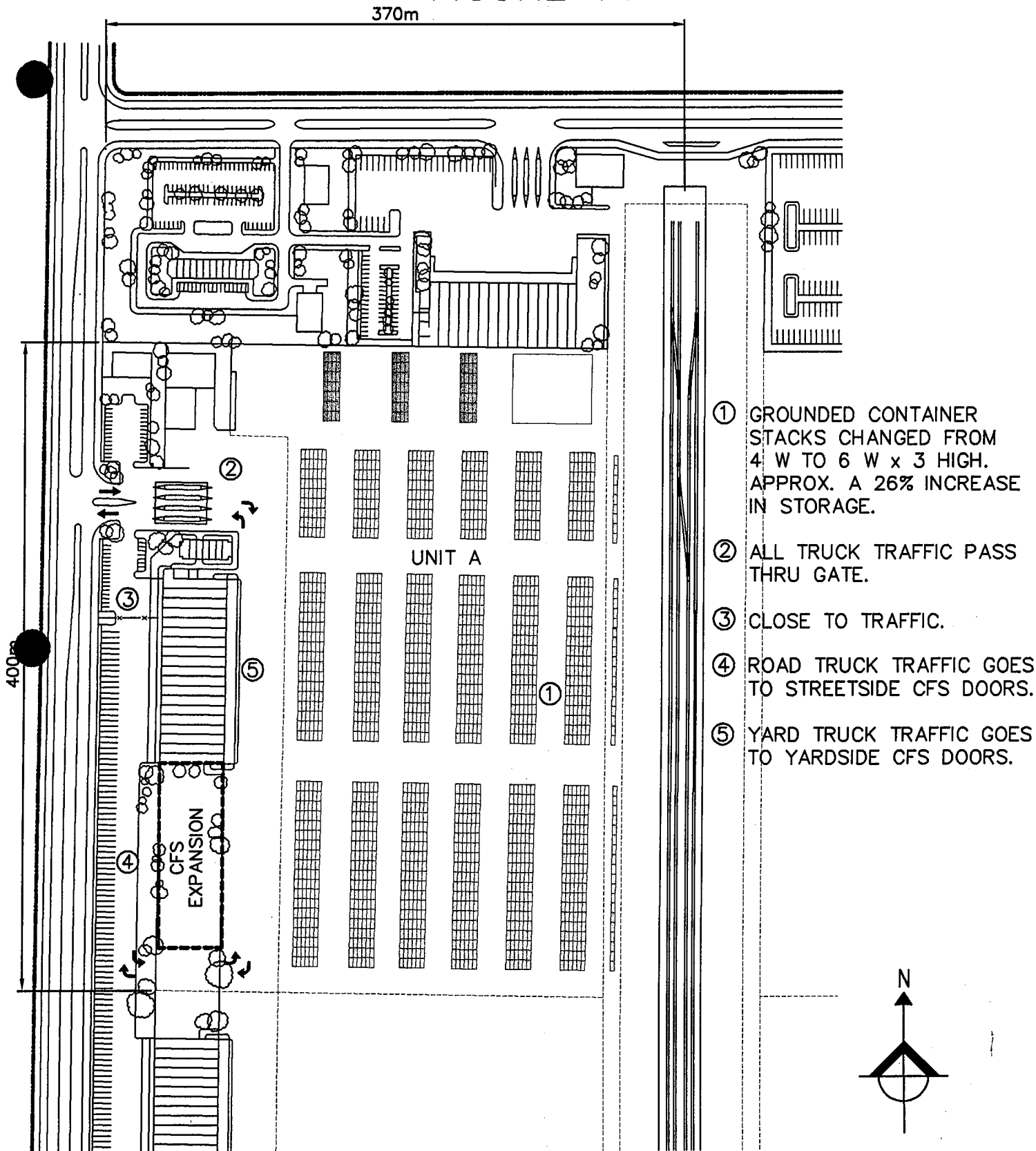
- The current container stowage layout works well as designed, but its storage efficiency can be improved by changing the density of the stacks. Currently, container stacks are four containers wide (4-wide) except for the row of stacks next to the railhead area, which is one container wide. There are seven 4-wide stacks and one 1-wide stack.

It is common in the U.S. to have top-pick and reach stacker operations similar to this with wider stacks. The majority of top-pick yards that are uniformly laid out are 6-wide, 4-high stacks with approximately 18.5 m wide aisles. The advantage is fewer aisles and more densely stacked containers. The 6-wide stacks can be accessed from both sides, so no container is more than three deep from the aisle. The disadvantages include less selectivity of containers and more digging to get to a particular container. The amount of machine operation per lift goes up on the average, increasing the operating cost, however, the throughput capability of the facility also increases. If storage capacity is the throughput constraint for the facility, the additional cost will be off-set by the increased revenue. If storage is not the constraint, the facility can continue to operate with the narrower stacks or be operated with the wider stacks, but use shorter heights. For example, if export containers are blocked stored for train delivery to a port, there will be no penalty for the wider, higher stacks. The operators may even want to consider wider stacks than 6-wide to get greater storage efficiency. It is common to see 10-wide to 12-wide stacks for export block storage. On the other hand, import containers, that will be picked up by truckers one at a time, could be laid out with narrower and shorter stacks for easier selection of containers.

The current total storage capacity at Lat Krabang ICD is 4,349 TEUs. Increasing the average stack from 4-wide to 6-wide, and using the same storage height, increases the capacity to 5,477 TEUs. This represents a 26% increase in capacity with only minor operational changes. The 6-wide stowage plan is shown on the following page in Figure 14, Improvements to Lat Krabang ICD, and results in six 6-wide stacks and one 1-wide stack.

- The CFS operation at Module A is operating as designed, but its efficiency can be improved, since only the yard-side loading dock of the CFS is currently in use. The Customs Department requires all traffic to pass through the gate, preventing use of the loading dock on the street-side of the CFS. This restriction hampers the operation at the CFS, and an arrangement should be worked out with Customs officials so that both sides of the CFS can be utilized. One side could be used for loading and unloading of street trucks, and the other for stripping and stuffing containers. Furthermore, the lawn next to the CFS is an expandable space, and the CFS could be expanded to this area when the need for more floor space occurs. All the LCL trucks would go around the CFS expansion space to its other side and utilize the street-side loading docks. This expansion could double the dock space of the CFS, and the traffic pattern change would improve cross-flow of cargo over the CFS floor.

FIGURE 14



IMPROVEMENTS TO LAT KRABANG ICD YARD

NOT TO SCALE

Figure 14 also illustrates these modifications including the fence securing the street side of the CFS. It is understood that SRT is already addressing this situation.

- Third, the current partitioning of Lat Krabang ICD hinders train operations. The modules are either 400m or 300m long, and the average train length with a locomotive (18m), 34 railcars (12.5m), and a caboose (8m), is about 450m. The lengths of the modules are shorter than a train, and the trains have to be worked in stages or across adjacent terminal space. This will cause congestion when the train traffic increases significantly, as is expected in the near future.

A more reasonable allocation of Lat Krabang ICD would be the use of only four modules, two on each side. The middle two modules, B and E, should be turned into empty container storage, and these spaces could be shared by adjacent modules. As a result, all four modules would be 550m long, and trains up to this length could be worked on simultaneously.

- In addition, the number of tracks makes train scheduling inflexible. There are four tracks inside the current Lat Krabang ICD. One track needs to be reserved as the runner to allow train turning and switching. Therefore, only three tracks are available for loading and unloading. When throughput is moderate, this can be managed through scheduling. However, as the traffic increases, the operations become more sensitive to blockage. One possibility of improvement is to add a fifth track and use the middle one as the runner. Each module will have two tracks for its operation, and so, more scheduling flexibility. This issue will be discussed in more detail in the Rail Operational Analysis section.
- One of the functions of an ICD is to serve as a buffer for the ports. To do this, it has to be able to supply and absorb a large number of containers in a short time. A ship usually calls a port once every week, and all the export containers must be transported to the port before the ship arrives. To minimize their dwell time at the port, those export containers will not be sent until the latest possible time, and this generates a surge in export demand at the ICD prior to ship arrivals. Similarly, the import containers have to be moved out of the port as soon as possible after they are unloaded from a ship. This generates a surge in import demand at the ICD after the ship arrives. Therefore, around the time of a ship call, a great number of containers need to be moved in and out of the ICD. To achieve its highest efficiency, a storage facility for trains is needed. It would allow the arrival and departure of trains without impacting the Lat Krabang ICD internal rail operation. And switching in and out of the ICD could be performed as required. The storage of trainsets in this manner will become more necessary as the volume of Lat Krabang ICD increases significantly. This point will also be discussed further in the Rail Operating Plan section.

The first improvement is operational, can be implemented in the short term, and will have the greatest single impact on the ground-based capacity of the facility. It will increase that capacity to 1 million TEU/year (aside from the rail operations capacity which is discussed later). The others require either contractual or infrastructure changes, and therefore they may be difficult to implement on existing facilities. Nonetheless, those improvements should be included in the development plans for future ICDs, if possible, since they will be easier to incorporate and can greatly enhance the efficiency of any new facilities.

c. Conceptual Design Options

Although only in operation for two years, Lat Krabang ICD has started to show sign of distress. According to the market analysis and container projections in Chapter 1, even with the increase in Lat Krabang's capacity to 1 million TEU/year, the facility will reach its capacity by the year 2006. The preliminary analysis by the PB Team determined that there were two options available to SRT after that time -- either the expansion of the existing Lat Krabang ICD to the north, or construction of a new ICD at Ongkharak.

For the sake of discussion, the market projections in Figure 8 show the expansion of Lat Krabang ICD occurring first, followed by the construction of an ICD at Ongkharak (about 70 km northeast of Bangkok) by the year 2010. There are compelling reasons for building the Ongkharak ICD

first, however, and these are discussed during the Lat Krabang ICD rail operations analysis (later in this chapter), and the economic analysis.

For the sake of reference, Figure 15, General Location of the Lat Krabang ICD shows the general location of the Lat Krabang ICD site, and Figure 16, General Location of the Ongkharak Site shows the location of the Ongkharak site.

i. ICD Design Approach

Due to its success, Lat Krabang ICD was chosen as the conceptual model for future ICD design. It was assumed that the capacity of a new ICD would be proportional to its scale, which includes its size, structure, equipment, and staff. A new ICD with half the scale of Lat Krabang ICD will thus be able to sustain half the capacity. There are improvements which can be made to the design of the track layout, but the conceptual designs can be refined in the future as more detailed information becomes available for individual sites.

The start-up scale of a new ICD depends on the demand projection for the area where it will be located, and the new facility should be able to accommodate demand growth for at least three years. In other words, the capacity of a new ICD should be no less than the demand level projected three years from its starting date. The start-up facility can later be expanded up to the size of the current Lat Krabang ICD.

The aforementioned improvements to current operation at Lat Krabang ICD should be included in the design of new ICDs, since operational and infrastructure changes cost less and are easier to implement on new facilities.

ii. Lat Krabang ICD Expansion

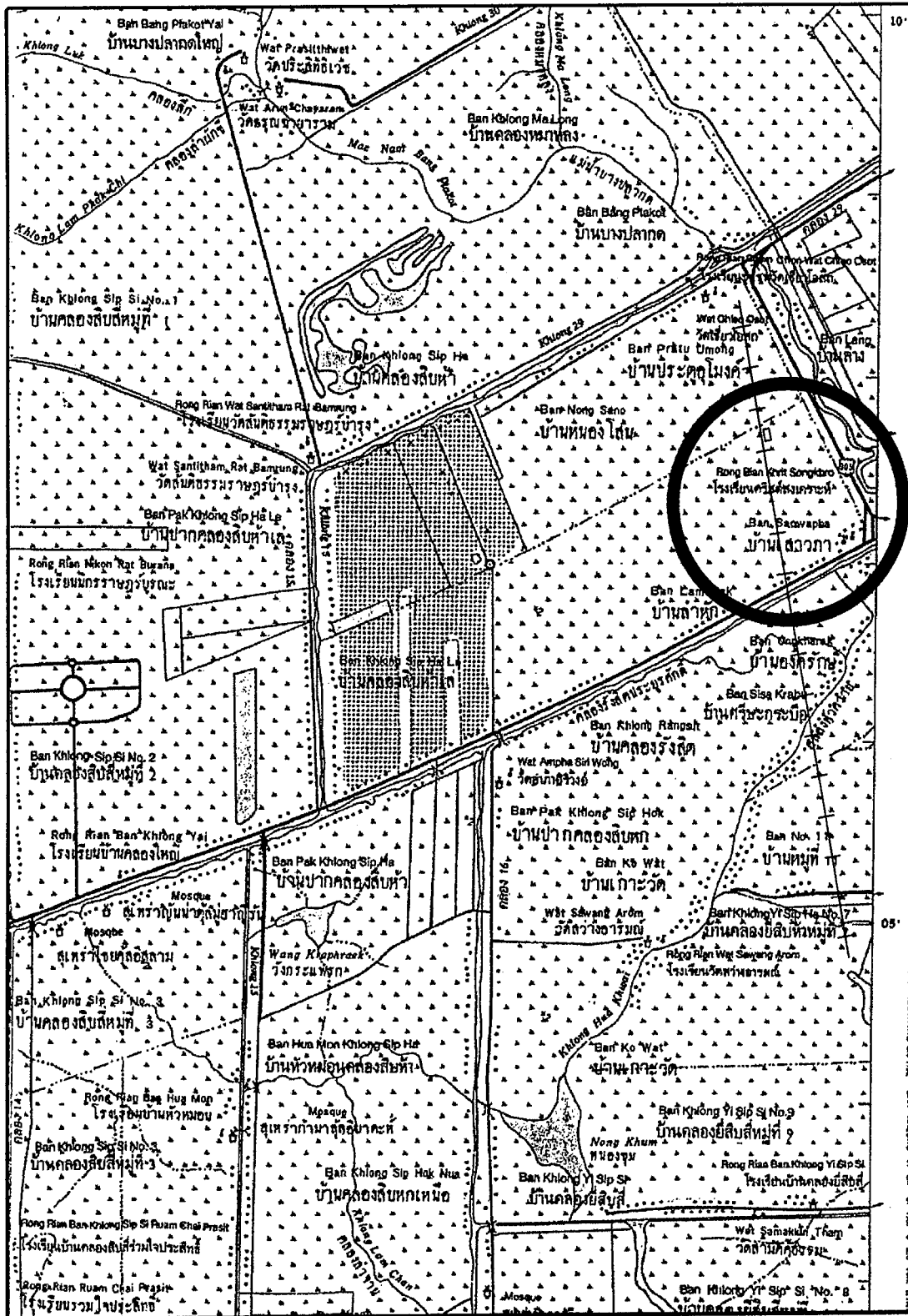
Adjacent to the north of the current Lat Krabang ICD is an undeveloped property suitable for new ICD development. The size of the land is about 800m x 1100m, and it is adequate to duplicate the existing Lat Krabang ICD.

The projections by the PB team show that the existing Lat Krabang ICD will be overloaded by the year 2006, with demand in the year 2007 of 1,164,000 TEUs. With this growth, the first phase of expansion for this facility should account for an increase of total capacity of 500,000 TEU/year, or half the scale of the current Lat Krabang ICD. The expansion should take into account the following recommendations:

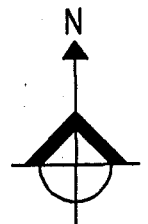
- A fifth track should be put in the current Lat Krabang ICD so that the additional traffic on the runner generated by the expansion does not impede the operation at the current Lat Krabang ICD.
- The first phase of the expansion should be built on the west side of the rail track, since this arrangement would allow the modules to share infrastructure on the same side.
- Only three tracks with eight turnouts and one access road would be needed for this phase, and the third track would function as the runner to provide a more flexible rail operation.
- To incorporate the improvements mentioned in the last section, there could be only two modules on each side instead of three. Both modules would be 550m long so a whole train can be worked on at one time.
- The CFSs could be expanded as appropriate, but both sides of the CFSs should be operational.
- The containers could be stored at 6- wide to maximize the storage capacity.
- The first phase is approximately three times the size of the existing Module A at Lat Krabang ICD. Therefore, the equipment and staff will be approximately three times the current Module A staff and equipment size.



FIGURE 16



ONGKHARAK ICD SITE
NOT TO SCALE



- The trailer parking area would not be duplicated, since the existing facility could serve both units. The real estate cost is very high in Lat Krabang, and the land acquisition cost for a 150 m x 800 m trailer parking area alone would be about 270 million Bahts, a costly component.

The second phase would complete the replication of the current Lat Krabang ICD. Two additional tracks would be needed along with an access road. The capacity of the full-scale expanded facility should be the same as the current Lat Krabang ICD, or 1,000,000 TEU/year. The total capacity of the expanded Lat Krabang ICD would be 2,000,000 TEU/year, and Figure 17, Lat Krabang Expansion (contained in a packet at the end of this report), shows the layout of the expansion along with current Lat Krabang ICD.

There are environmental and community issues associated with the expansion of Lat Krabang ICD, and the accompanying increase in rail operations. While no formal study was made of these issues, the following summary was developed from brief field visits:

- The land to be used for the expansion of the ICD is undeveloped, and contains a number of rice fields, which makes it by definition a wetland. It is likely that this was the condition of the land upon which the existing ICD was built, and it is not clear whether this will pose a serious environmental issue or not.
- A new truck terminal is being built on the west side of the Lat Krabang ICD, one of three major terminals being constructed by the Department of Land Transport (DLT) to serve the Bangkok metropolitan region. It has been estimated that the expanded ICD itself will generate over 3,800 truck trips on an average day (combining port truck traffic and local drayage or deliveries), and the combination of this traffic with that of the DLT terminal will severely tax the highway and local road system.
- At the northern end of the existing Lat Krabang ICD there is a road, currently owned by the SRT, that is scheduled to become a public road in the near future. With the construction of the expanded ICD, and increasing use of the road by the public, there may be conflicts. For instance, given the almost constant crossing of the road by SRT trains (in and out of the new facility), a sophisticated grade crossing system may be required.
- A temple and school are located west of the area where the expanded ICD would be constructed, and scattered housing east of the existing and future ICD. Given the level of development that has already taken place in the area, however, this local community may have adjusted itself to the situation and would not be significantly affected by the bigger ICD. Interviews with local officials would be required to understand this situation better.
- South of the existing ICD (and the highway overpass) there is a large section of undeveloped land, particularly on the west side of the tracks. This is the area discussed in the Rail Operational Analysis for the construction of a storage yard to serve the ICD. Without this storage yard, it is unlikely that SRT will have the desired rail capacity for either the existing or expanded ICD, and so the success of the facility may hinge on acquiring the rights to this property. East of the SRT track there are residences within approximately 500 m, but west of the track the land is more open.
- Proceeding south from the facility toward Hua Takhe station, there is considerable development along the main line. This includes residences and the local university, and the station at Hua Takhe is well patronized by the students. The station tracks could accommodate some additional activity for storing trains from Lat Krabang ICD, but the tracks are not long enough for 34-car trains, and the additional traffic would not be appreciated by the surrounding community. For this reason, a new storage yard was recommended for immediately south of the ICD.

iii. Ongkharak ICD

The market analysis further predicted that a new ICD would be needed in the Bangkok area by the year 2010, and as discussed in the previous section, the site of the new Ongkharak station was chosen as suitable for developing a new ICD. The new ICD could be located between Highway 305 and the existing station, which should afford ample space for development by SRT.

The projected demand level for the year 2018 was 945,000 TEU/year for the new ICD. As a result, an ICD on the scale of the current Lat Krabang ICD will be needed. The phased expansion plan of Lat Krabang ICD could be applied here, with the initial facility being built for 500,000 TEU/year, and the full buildout capacity would be 1,000,000 TEU/year. Figure 18, Ongkharak CT and ICD Plan shows the layout of the proposed CT and the full-scale Ongkharak ICD.

d. Capital and Operating Costs

The construction unit costs of Lat Krabang ICD were used to estimate those of the new ICDs (costs for the proposed CT are discussed later). The unit costs of Lat Krabang ICD, updated to 1997, are summarized in Table 27.

Table 27
Updated Construction Unit Costs of Lat Krabang ICD

Category	Item	Unit Cost	
Land	Lat Krabang	2,250	Baht/m ²
	Ongkharak	312.5	Baht/m ²
Civil Work	Land Fill up to 1.35 MSL	315	Baht/m ²
	Paved Road Area	675	Baht/m ²
	Car Park & Misc. Areas	675	Baht/m ²
	Railhead Operating Area	1,238	Baht/m ²
Structure	Office	8,663	Baht/m ²
	Work Shop	11,250	Baht/m ²
	CFS	2,138	Baht/m ²
	Gate	5,063	Baht/m ²
Rail	Turnout	2,430,000	Baht
	Track	15,600	Baht/m
	Grading	50	Baht/m ²

Source: Data from SRT except*

* Data from Construction Dept., Bang Sue District, originally in mid-1995 Baht, converted to 1997 Baht at 12.5% inflation (5.5% in 1996, 6.6% in 1997). Inflation data from National Economics and Social Development Board.

The non-railroad equipment capital and operating costs for the ICDs were based on the costs in the U.S., and converted at 40 Baht/US\$ exchange rate. Table 28 summarizes this estimation.

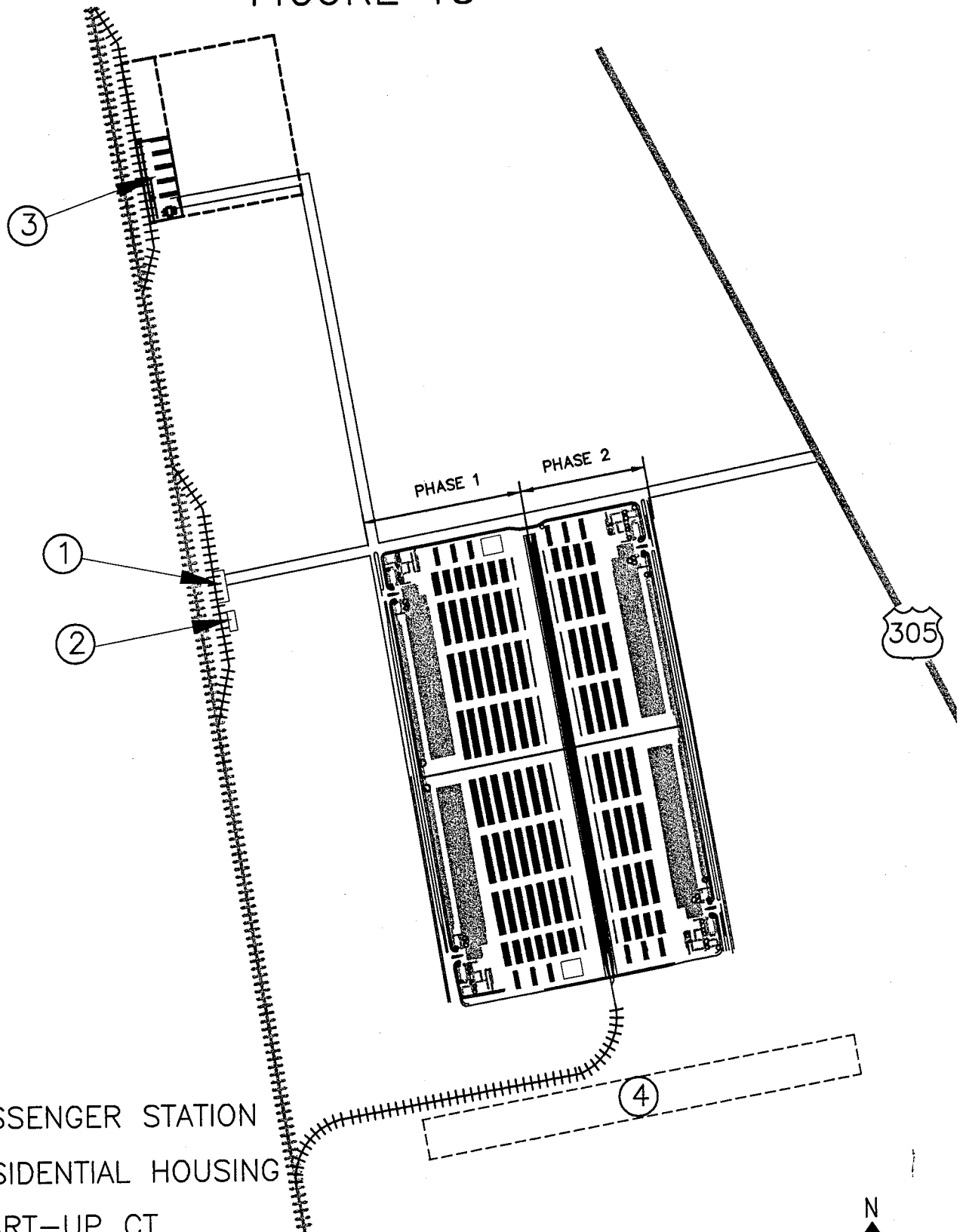
Table 28
Equipment Unit Cost of Lat Krabang ICD

Equipment	Capital Cost		Operating Cost	
	000 \$	000 Baht	\$/hr	Baht/hr
Reach Stacker	500	20,000	25.2	1,009
Sidepick	250	10,000	22.2	889
Yard Tractor	80	3,200	10.2	409
Yard Chassis	15	600	0	0

Source: JWD

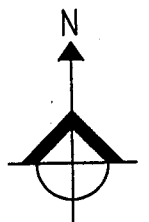
The labor cost was estimated at 20,000 Baht per month for the management staff, and 10,000 Baht per month for non-management staff, based on example salaries provided by the SRT. The

FIGURE 18



NOTE:

- ① PASSENGER STATION
- ② RESIDENTIAL HOUSING
- ③ START-UP CT
- ④ POTENTIAL STORAGE YARD



ONGKHARAK CT & ICD PLAN

NOT TO SCALE

JWD

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

operating cost of the facility was assumed to be eight percent of the sum of the amortized annual cost of all facilities.

Cost estimates for development phases of both Lat Krabang ICD expansion and Ongkharak ICD are shown in the series of tables described below. The capital costs are in full amounts, while the operating costs are on an annual basis. The labor costs do not depend on throughput since the employees are paid annual salaries, but the equipment operating costs do depend on the amount of time in operation, and as shown here are for operation at capacity throughputs.

The track layouts shown on the ICD conceptual drawings, which were used as a basis for the cost estimates, resulted from the rail operational analysis described in the next section of this report. The cost estimates for the ICD facilities, however, include only the track layout within the facility, and not the potential storage yard layouts mentioned in the operational analysis.

Costs in each phase are incremental. For example, the full cost of building the whole Lat Krabang ICD expansion in one step is the sum of the cost of Phases 1 and 2.

i. Current Lat Krabang ICD

Based on the unit costs shown above, the cost estimate to duplicate the current Lat Krabang ICD is summarized in Table C-1 in Appendix C.

ii. Lat Krabang ICD Expansion, Phase 1

The cost estimate of Phase 1 of the Lat Krabang ICD expansion is summarized in Table C-2 in Appendix C. Notice that the capital cost includes the cost of adding the fifth track to the current Lat Krabang ICD.

iii. Lat Krabang ICD Expansion, Phase 2

The cost estimate of Phase 2 of the Lat Krabang ICD expansion is summarized in Table C-3 in Appendix C.

iv. Ongkharak ICD, Phase 1

The cost estimate of Phase 1 at Ongkharak ICD is summarized in Table C-4 in Appendix C.

v. Ongkharak ICD, Phase 2

The cost estimate of Phase 2 at Ongkharak ICD is summarized in Table C-5 in Appendix C.

2. Container Terminals

a. Introduction

The rationale for the joint development of CTs and ICDs has been discussed previously in the Market Analysis section of this report. The CTs are critical for the SRT to establish a presence and a credible intermodal rail system for the provinces, but they need to be built in stages so that capital and operating costs are proportional to the projected traffic. At some locations, for instance, the starting throughput may be as low as ten containers a day.

Eight sites were identified for possible development as CTs during the Selection of Terminal Sites analysis, and those sites were the following:

- Lamphun
- Phitsanulok
- Khon Kaen
- Ubon Ratchathani
- Ban Phachi
- Korat
- Hat Yai
- Ongkharak

The development of these sites is explored in the following sections.

b. Conceptual Design Options

Due to the limited information at this stage of conceptual design, the development of CTs was modeled after Module A of current Lat Krabang ICD. It was assumed that the CTs would have the same staff, facility, and equipment as Module A after full development. This assumption might not be appropriate for every potential site, however, the conceptual designs can be modified when new information becomes available in the future.

The container flows at the start-up CTs were projected to be very low, less than 8,000 TEU/year, and it would not be economical to build a facility that will be used at only a small fraction of its capacity. Therefore, the CTs should be constructed in phases and expanded as demand increases.

As discussed earlier, the prevailing freight transportation mode in Thailand is truck, and the most common trucks have three axles, ten wheels, and a regular flatbed cargo area with added wooden fences. They are capable of carrying 20-foot containers, but usually carry break-bulk cargo. During the start-up operations at the CTs, there will be few or no road tractors and chassis available for container transportation in those provincial areas. Therefore, the ten-wheel trucks will still render most of the local pickup and delivery. Under such conditions, a CFS is essential for the survival of both the start-up CT and its local customers. It allows those trucking companies and shippers not yet fully containerized to utilize the SRT intermodal service, while making the transition to hauling container traffic. The CFS also helps attract LCL cargoes to the SRT system. For all these reasons, the CFS is considered a necessary component for the start-up CTs.

Three development phases are being recommended by the PB team: start-up, intermediate, and full-scale. Figure 19, Container Terminal (CT) Phase Diagram, presents the phased plan and shows its components.

- The start-up CT should be easily expandable, inexpensive, flexible, and capable of handling minimal throughput.
- The intermediate CT should provide a gain in capacity over the start-up CT at a reasonable expense.
- The full-scale CT should be equivalent to Module A of the current Lat Krabang ICD.

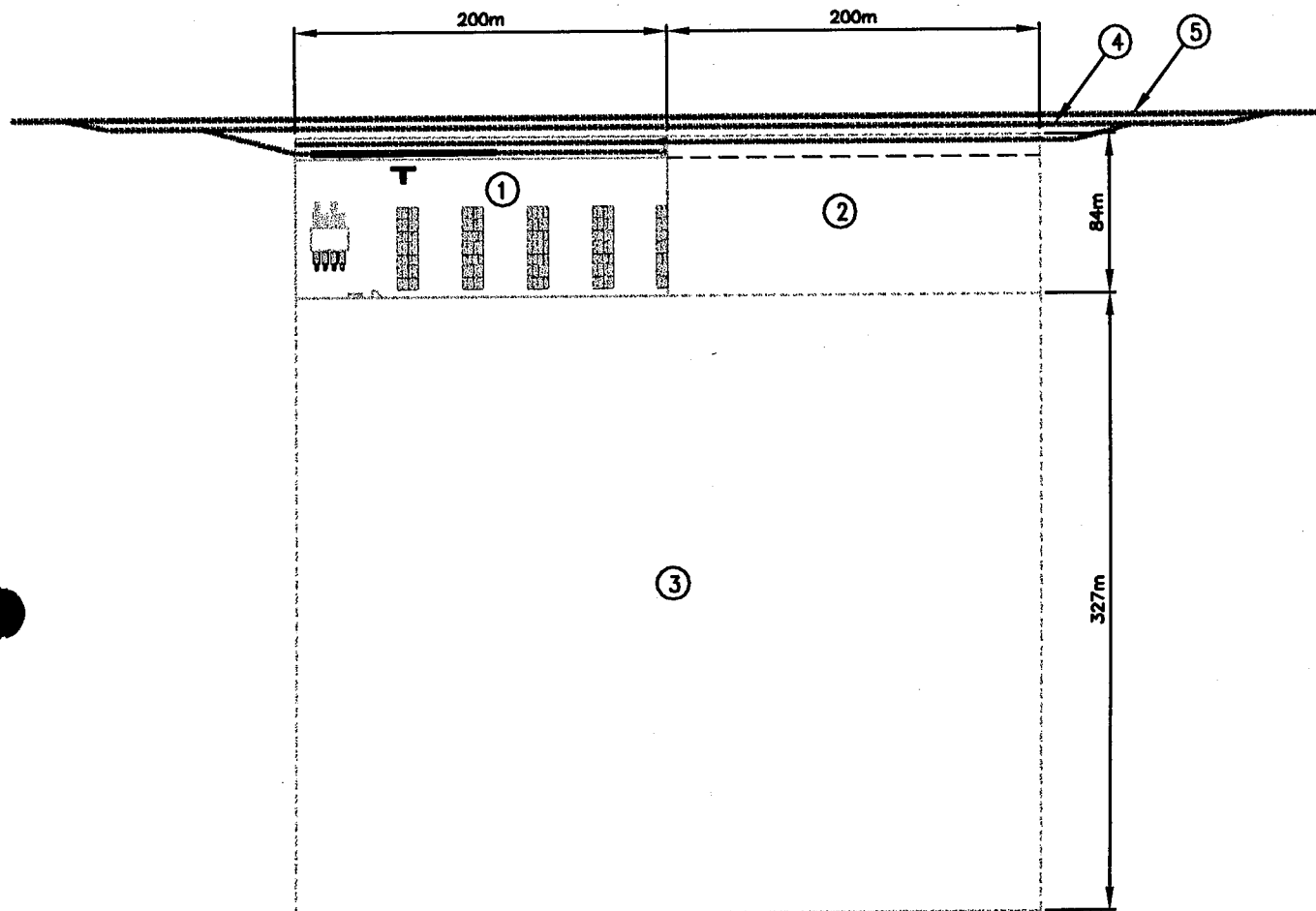
This phased plan should not be considered a rigid concept, and it is assumed that prudent judgment would be applied to each individual case. There could be, for instance, as many intermediate phases as needed between the start-up and the full-scale phase. The intermediate phase discussed in the following section should be taken as an example instead of a rule.

i. Start-up Phase

The layout of a start-up CT is shown in Figure 20, Start-Up Container Terminal, and the following comments summarize the concept. The CT would be 200m wide and 84m deep, and the depth includes an 11m rail track area. The surface of the entire terminal is covered by 50 cm of rock gravel. The gatehouse and office are combined in a modular trailer, and the CFS is a simple structure with two 4-bay loading areas, located on opposite sides with a canopy. The truck-side of the CFS is gradually sloped so that the platforms of the trucks are level with the loading dock. The yard-side of the CFS is at-grade with the CY. There would be no workshop in the start-up container terminal, and the repair and maintenance would be performed by outside contractors in their facilities.

Five rows of container stacks are planned for the CY with 25m spacing. Four of those stacks are 4-wide, 7-deep, and the other is 2-wide, 7-deep. This arrangement will yield 126 twenty-foot ground slots (TGS). The designed daily flow is 20 containers a day, and with an average dwell time of five days, the average storage requirement would be $5 \times 20 = 100$ containers. The storage height should not be more than two-high (Figure 20 shows stacks at four-high, which is

FIGURE 19



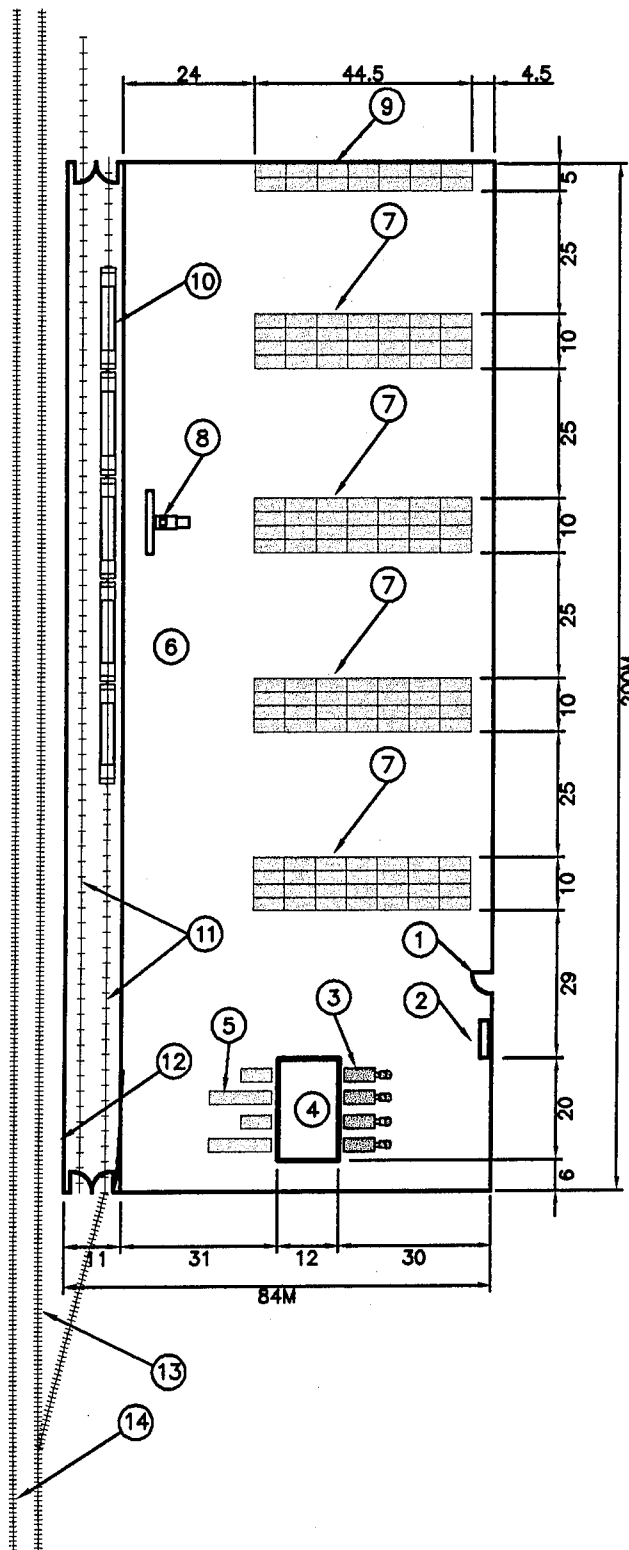
- ① START-UP CT
- ② INTERMEDIATE CT
- ③ FULL SCALE BUILDOUT (SAME AS MODULE A OF ICD)
- ④ RUNNER
- ⑤ MAIN LINE

CONTAINER TERMINAL (CT) PHASE DIAGRAM

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

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FIGURE 20



KEY NOTES

- ① 4M SWING GATE
- ② TRAILER OFFICE
- ③ ROAD TRUCKS
- ④ 12x20 CFS W/ CANOPY
- ⑤ CONTAINERS ON GROUND
- ⑥ GRAVEL PAVING
- ⑦ CONTAINER STACK-
4 W x 7 L x 4 H
- ⑧ REACH STACKER
- ⑨ CONTAINER STACK-
2 W x 7 L x 4 H
- ⑩ SRT RAIL CARS
- ⑪ RAIL SIDINGS
- ⑫ PERIMETER SECURITY FENCE
- ⑬ RUNNER
- ⑭ MAIN LINE

STORAGE CAPACITY

504 TEU @ 4 HIGH

441 TEU @ 3.5 HIGH

TEU: TWENTY-FOOT
EQUIVALENT UNIT

START-UP CONTAINER TERMINAL

NOT TO SCALE

JWD

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

for maximum capacity), and the storage space will be adequate for start-up operations. Consequently, no empty container stack is designated, and all storage is for general use.

The first rail track from the terminal is used to store inbound railcars. The second track is used for storing outbound railcars, which are organized into blocks, with each block containing railcars having the same destination. When a train arrives, it will drop off the railcars bound for the terminal and pick up the outbound blocks for this train.

The staff for a start-up CT is reduced to one manager, four operators and one SRT person. The operation will be eight hours a day, five days a week.

In the start-up phase, consistent with the market projections, the throughput level was estimated to be less than 8,000 TEU/year. It is equivalent to 20 containers per day, assuming 1.5 TEU/container and 260 workdays per year. At this level of throughput, one reach stacker with 15 lifts/hour productivity could handle the workload. The reach stacker can handle all loading, discharging, and in-terminal transportation of containers. Reach stackers usually handle containers from the side, but the spreader of the reach stackers can rotate so that they can also handle containers from the end. This capability makes the handling of containers possible at the CFS. The handling process of cargoes will be the same as at a regular container terminal.

While reducing initial costs, there is some risk to the continuous operation of the facility with only one piece of container handling equipment at a terminal. This risk can be reduced to a small amount of down time by having a thorough preventive maintenance program for reach stackers, and establishing a contingency plan for alternate equipment. The contingency plan should identify all of the available mobile cranes in the area that are capable of lifting a fully loaded container (30 metric tons), and should contain a pre-agreed method of rapidly deploying a substitute crane in the event of an inoperative reach stacker.

ii. Intermediate Phase

The layout of an intermediate CT is shown in Figure 21, Intermediate Container Terminal. In this phase, the start-up CT will be expanded to 400m wide while the depth stays unchanged. In other words, the intermediate CT will be twice the size of the start-up CT. No new structures are added in this phase, with all additional area being used as a CY, and one stack being designated for empty containers. The same 50 cm-rock gravel surface is used, and the rail track is extended to a full 400m. The staff will be doubled, and another reach stacker will be added. The operation schedule is similar to that of the start-up CT.

The throughput range for the intermediate CT is from 8,000 to 16,000 TEUs annually. As mentioned previously, this intermediate CT is an example, and more intermediate phases could be added as necessary.

iii. Full-scale Phase

The full-scale CT will be equivalent to Module A of Lat Krabang ICD. The throughput range for a full-scale CT is from 16,000 to 80,000 TEU/year, based on the current operation at Module A of Lat Krabang ICD. Higher throughput can be achieved with enhancements of the overall operation.

The CT phased plan is summarized in Table 29.



- ① 4M SWING GATE
- ② TRAILER OFFICE
- ③ ROAD TRUCKS
- ④ 12x20 CFS W/ CANOPY
- ⑤ CONTAINERS ON GROUND
- ⑥ GRAVEL PAVING
- ⑦ CONTAINER STACK—
4 W x 7 L x 4 H
- ⑧ REACH STACKER
- ⑨ CONTAINER STACK—
EMPTIES
- ⑩ SRT RAIL CARS
- ⑪ RAIL TRACKS
- ⑫ PERIMETER SECURITY
FENCE
- ⑬ RUNNER
- ⑭ MAIN LINE

1,344 TEU @ 4 HIGH

1,176 TEU @ 3.5 HIGH

TEU: TWENTY-FOOT
EQUIVALENT UNIT

Table 29
Phased Container Terminal (CT) Development Plan

Terminal	Start-up	Intermediate	Full-Scale
Size	84mx200m	84mx400m	411mx400m
Throughput Range	0~8,000 TEU/yr	8,000~16,000 TEU/yr	16,000~80,000 TEU/yr
Surface	Gravel	Gravel	Paved
CFS	Loading dock w/canopy	Loading dock w/ canopy	Building
Rail	4-100lb turnouts 1200m track	6-100lb turnouts 1460m track	6-100lb turnouts 1460m track
Equipment	1 reach stacker	2 reach stackers	3 reach stackers
			3 sidepicks
			6 yard tractors
			12 yard chassis
Staff	1 manager	2 managers	3 managers
	4 operators	8 operators	93 operators *
	1 SRT personnel	2 SRT personnel	3 SRT personnel
Operating Hours	8 hr/day, 5 day/wk	8 hr/day, 5 day/wk	24 hr/day, 7 day/wk

Source: JWD Analysis

* Includes 12 security subcontractors

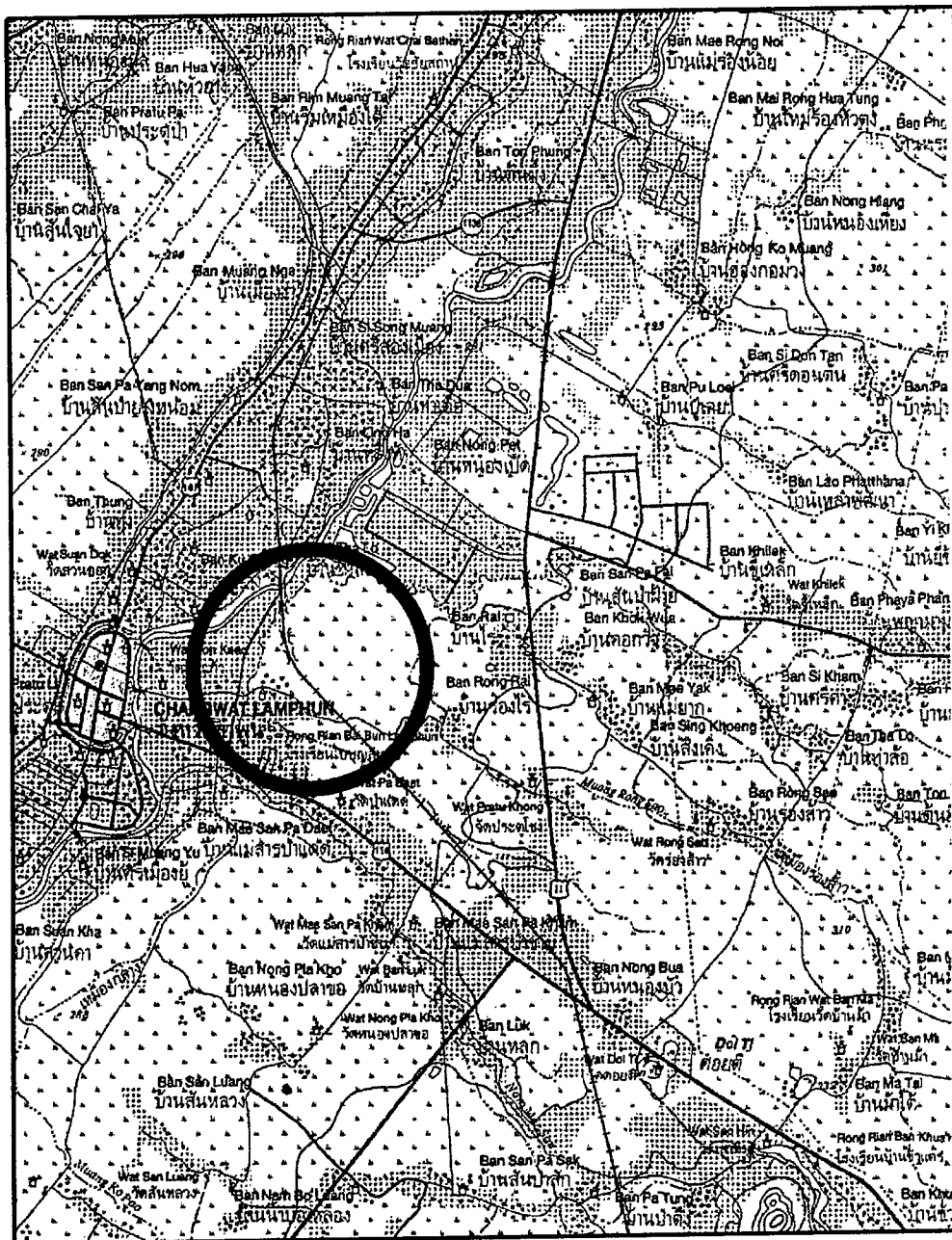
For the purposes of this report, it was assumed that all eight sites mentioned above would be developed as start-up CTs. Two figures were developed for each of these sites, with one figure being a section from a 1:50,000 scale map that shows the general location, and a second figure indicating the basic layout of the standard CT on the potential site. The following are the associated figure numbers:

- Ongkharak **Figures 16 and 18**
- Lamphun **Figures 22 and 23**
- Phitsanulok **Figures 24 and 25**
- Khon Kaen **Figures 26 and 27**
- Ubon Ratchathani **Figures 28 and 29**
- Ban Phachi **Figures 30 and 31**
- Korat **Figures 32 and 33**
- Hat Yai **Figures 34 and 35**

c. Capital & Operating Costs

Cost estimates were developed for each of the three phases involved in the development of CTs. All unit costs for ICD development are applicable to CTs, except the costs for civil and structural work. Table 30 summarizes the units costs for civil and structural work used in developing the CT estimates:

FIGURE 22



LAMPHUN
NOT TO SCALE

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

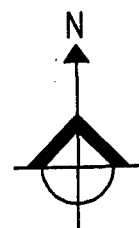
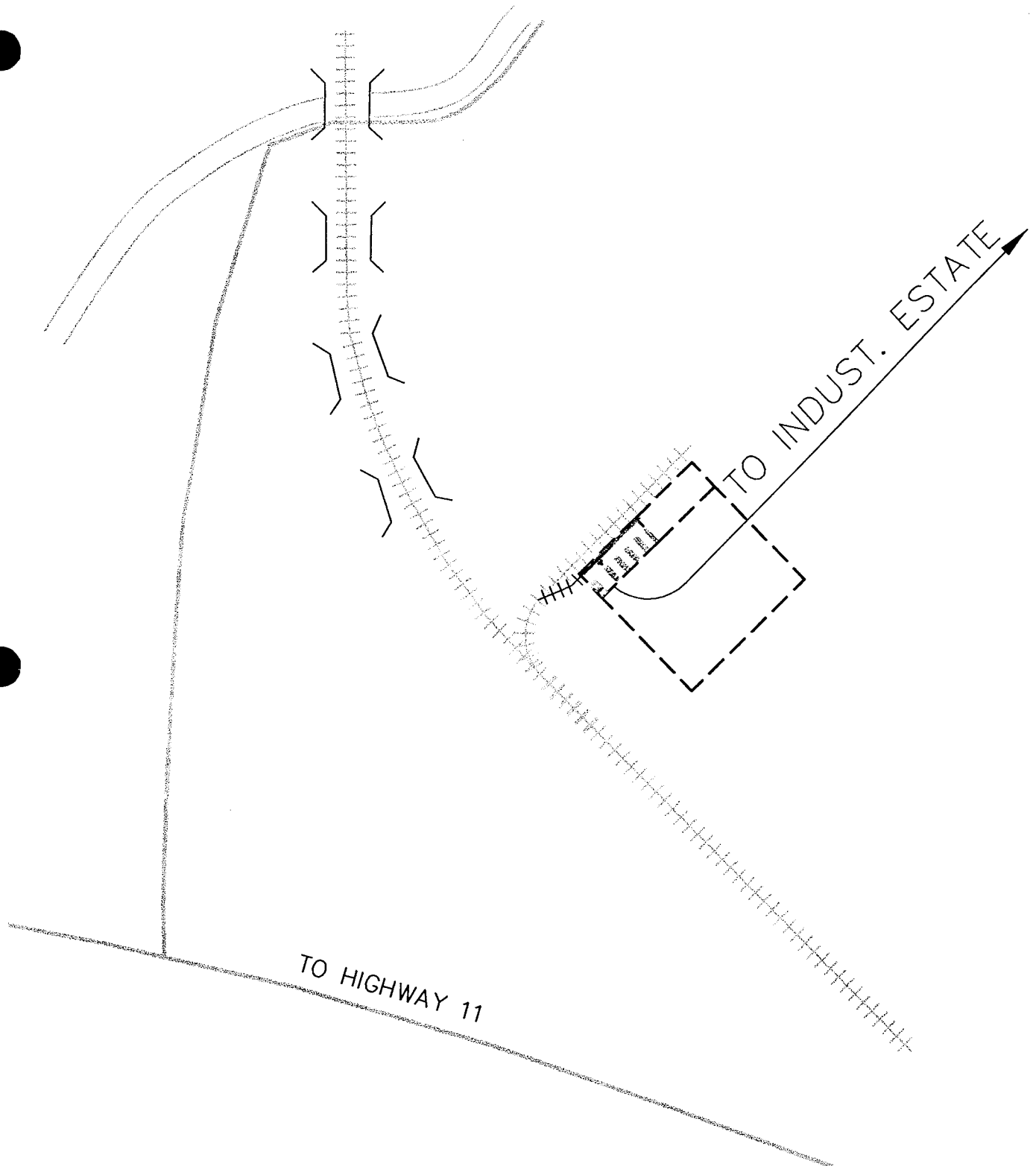


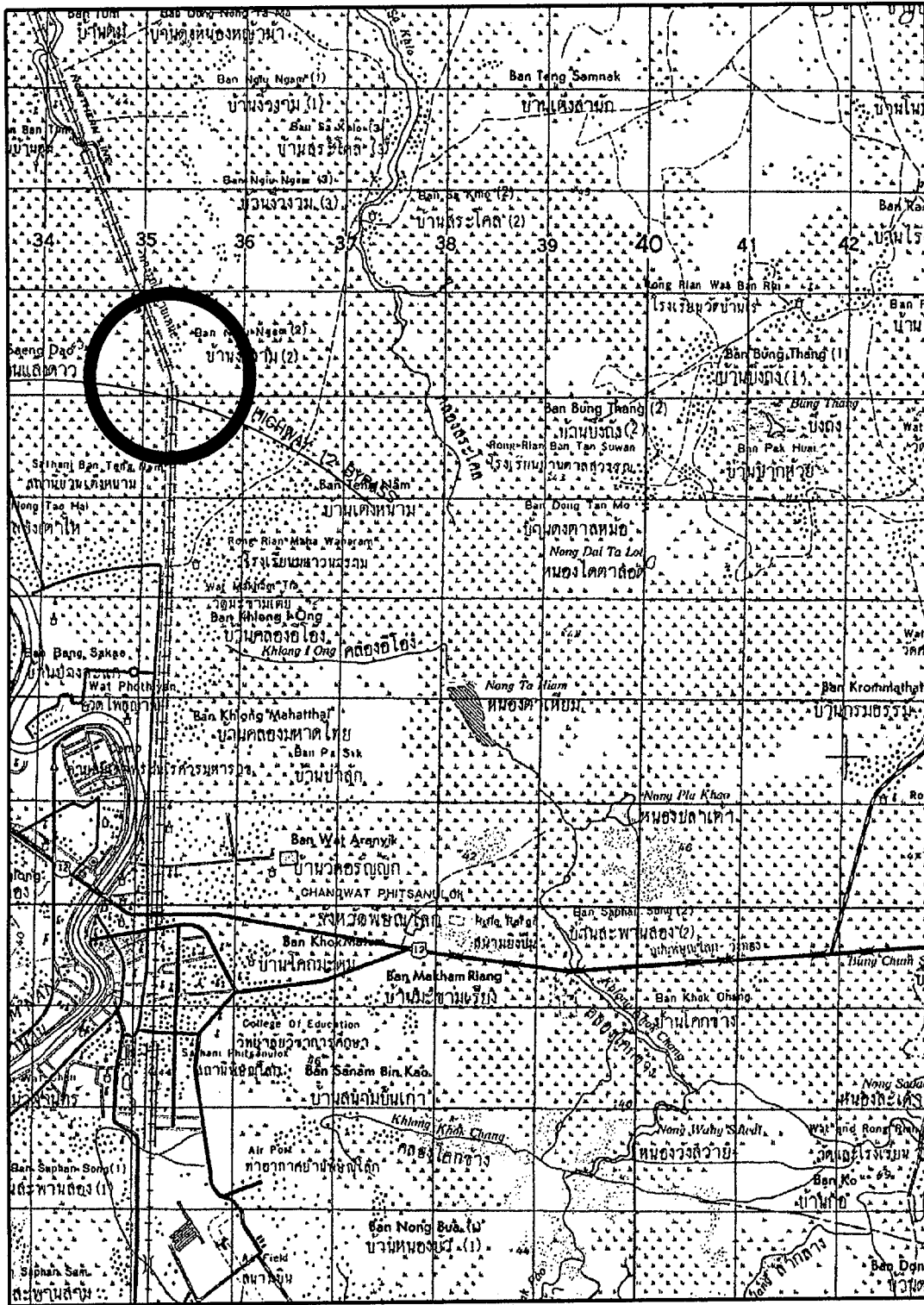
FIGURE 23



LAMPHUN
(LAMPHUN INDUSTRIAL ESTATE SITE)

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

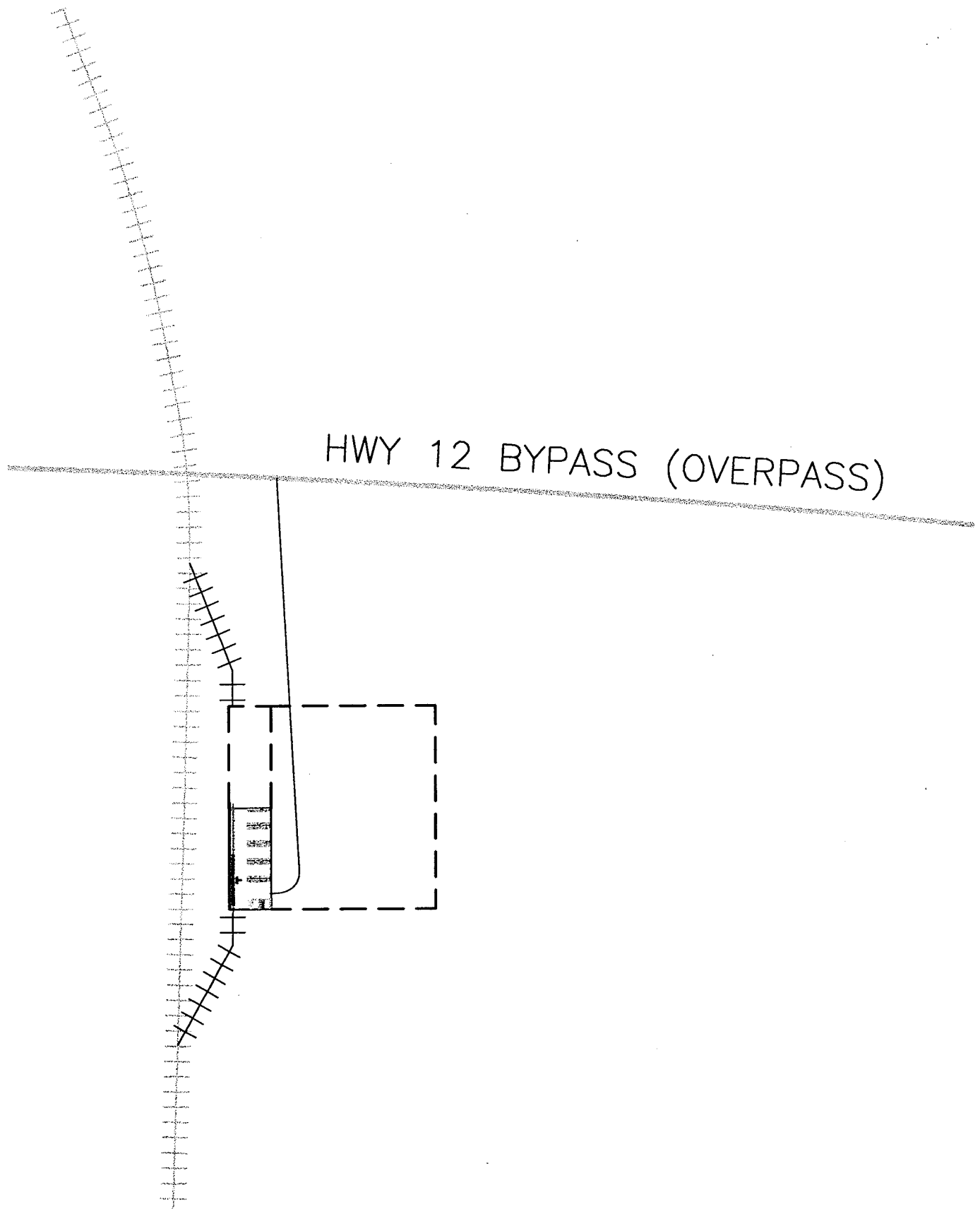
FIGURE 24



PHITSANULOK
NOT TO SCALE

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

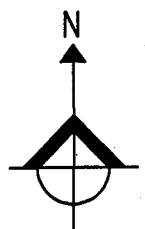
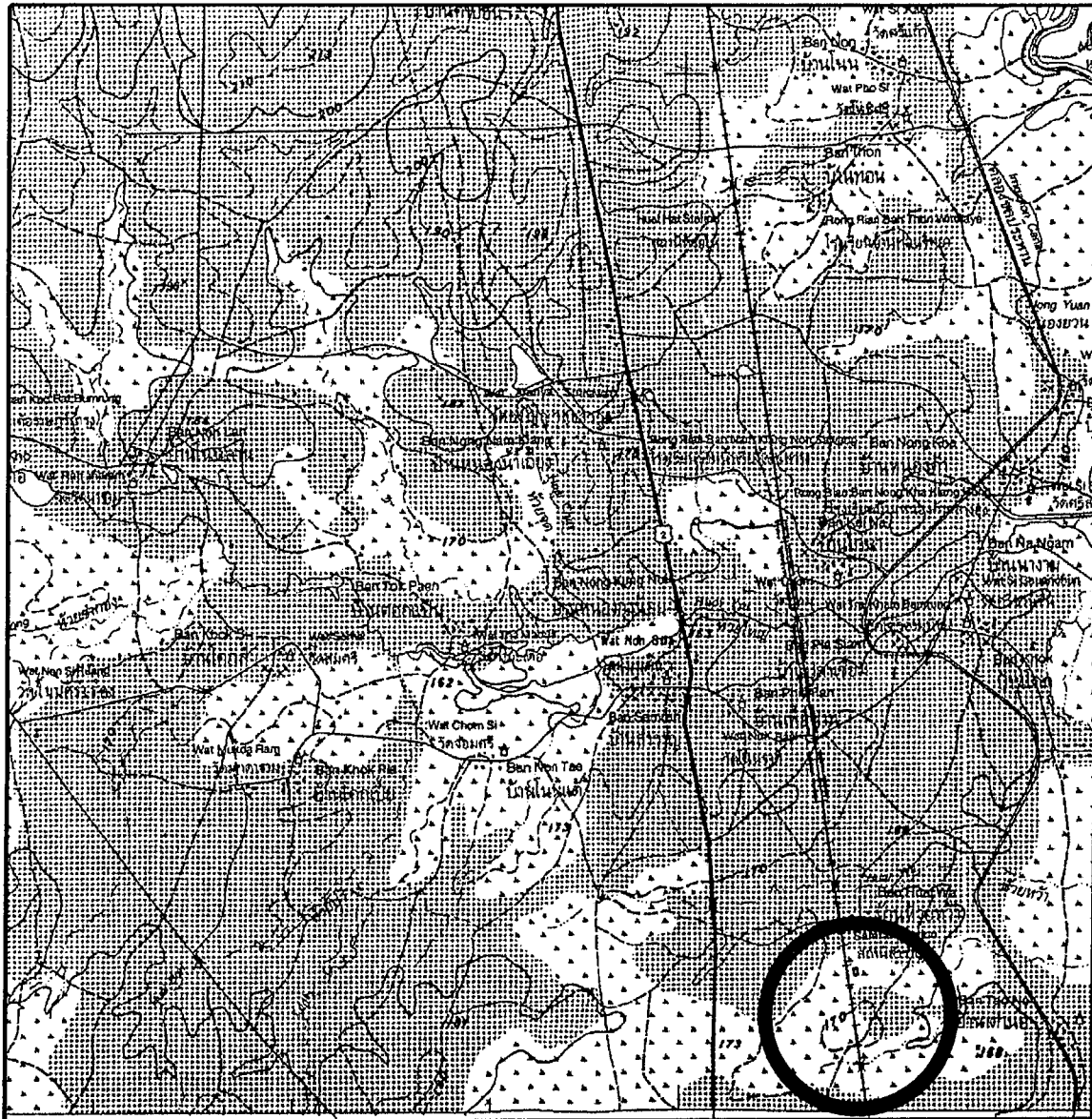
FIGURE 25



PHITSANULOK
(HIGHWAY 12 SITE)

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

FIGURE 26

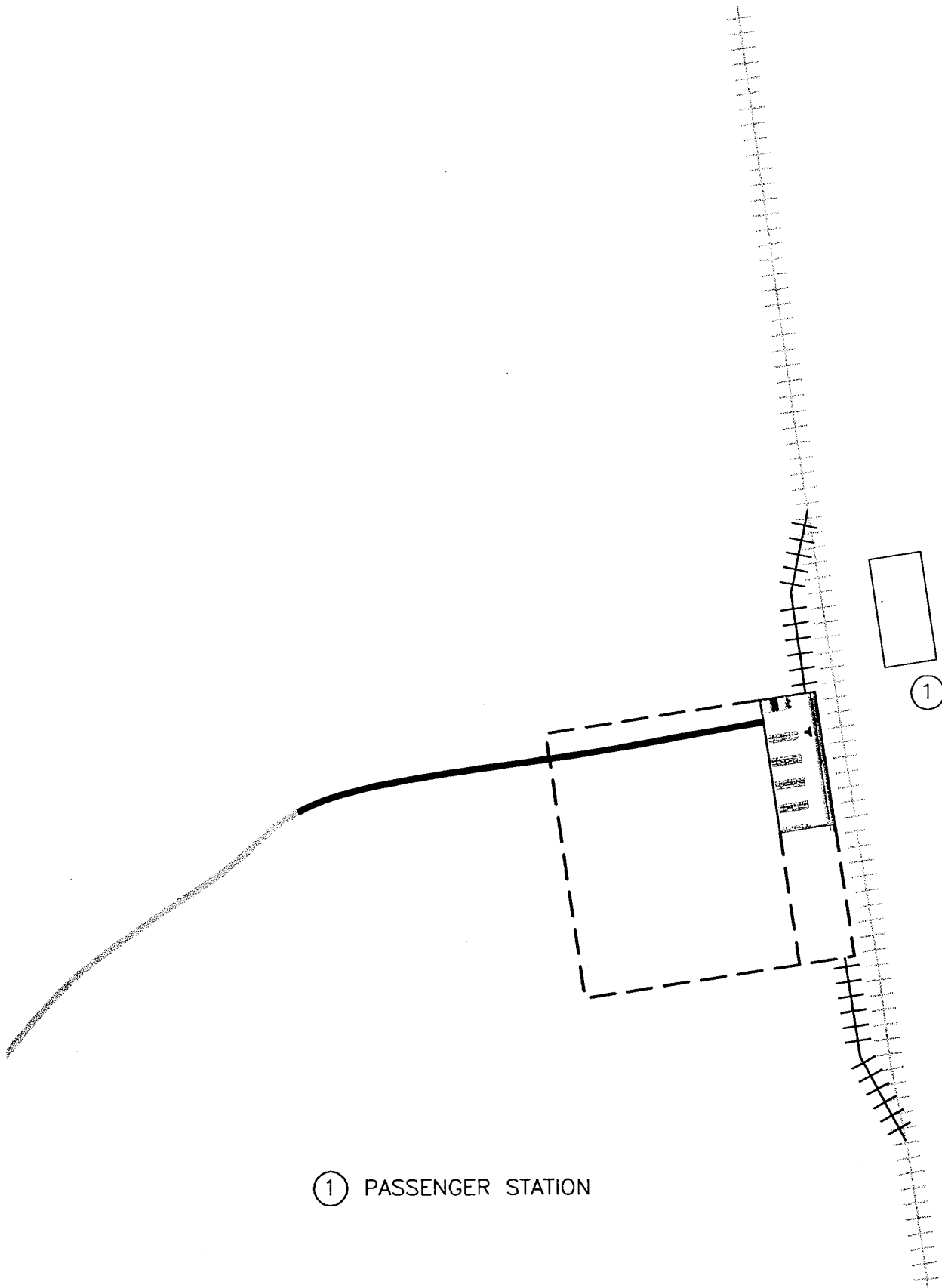


KHON KAEN
NOT TO SCALE

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

JWD

FIGURE 27

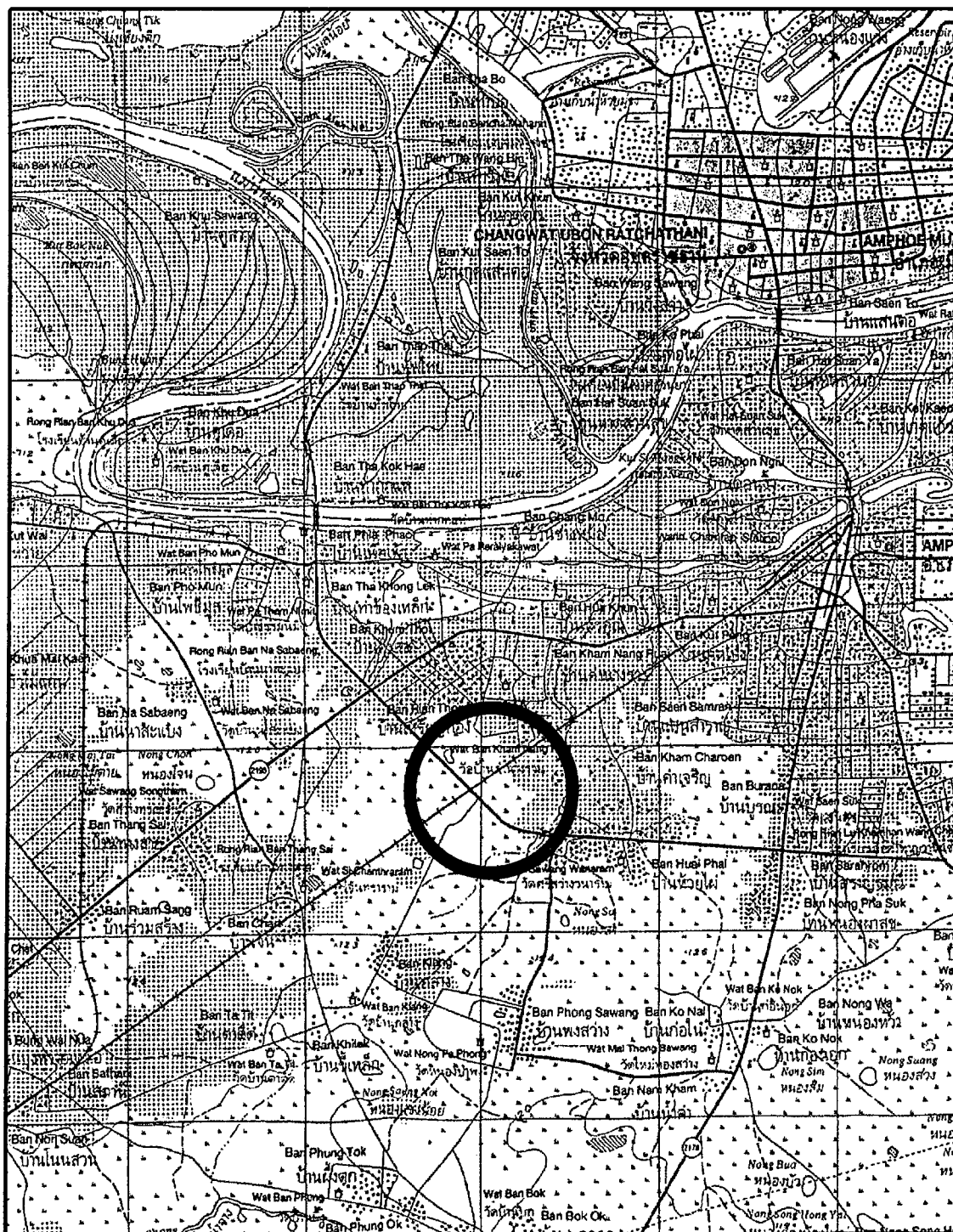


① PASSENGER STATION

KHON KAEN
(SAM RAN STATION SITE)

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

FIGURE 28



UBON RATCHATHANI

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

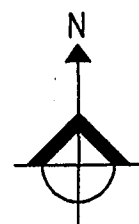


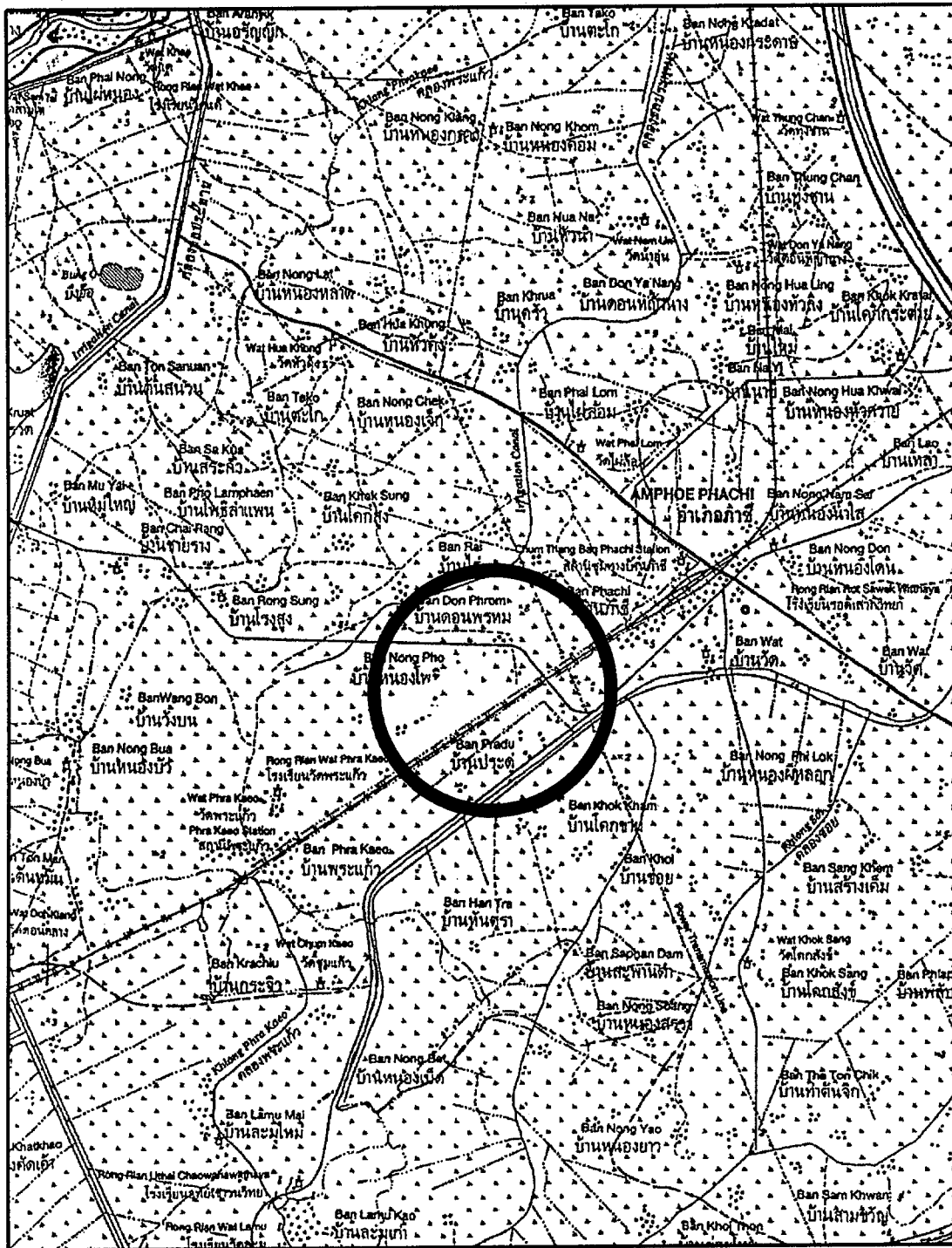
FIGURE 29



UBON RATCHATHANI
(HIGHWAY 24 SITE)

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

FIGURE 30



BAN PHACHI
NOT TO SCALE

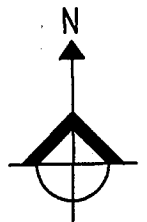


FIGURE 31

HIGHWAY 329

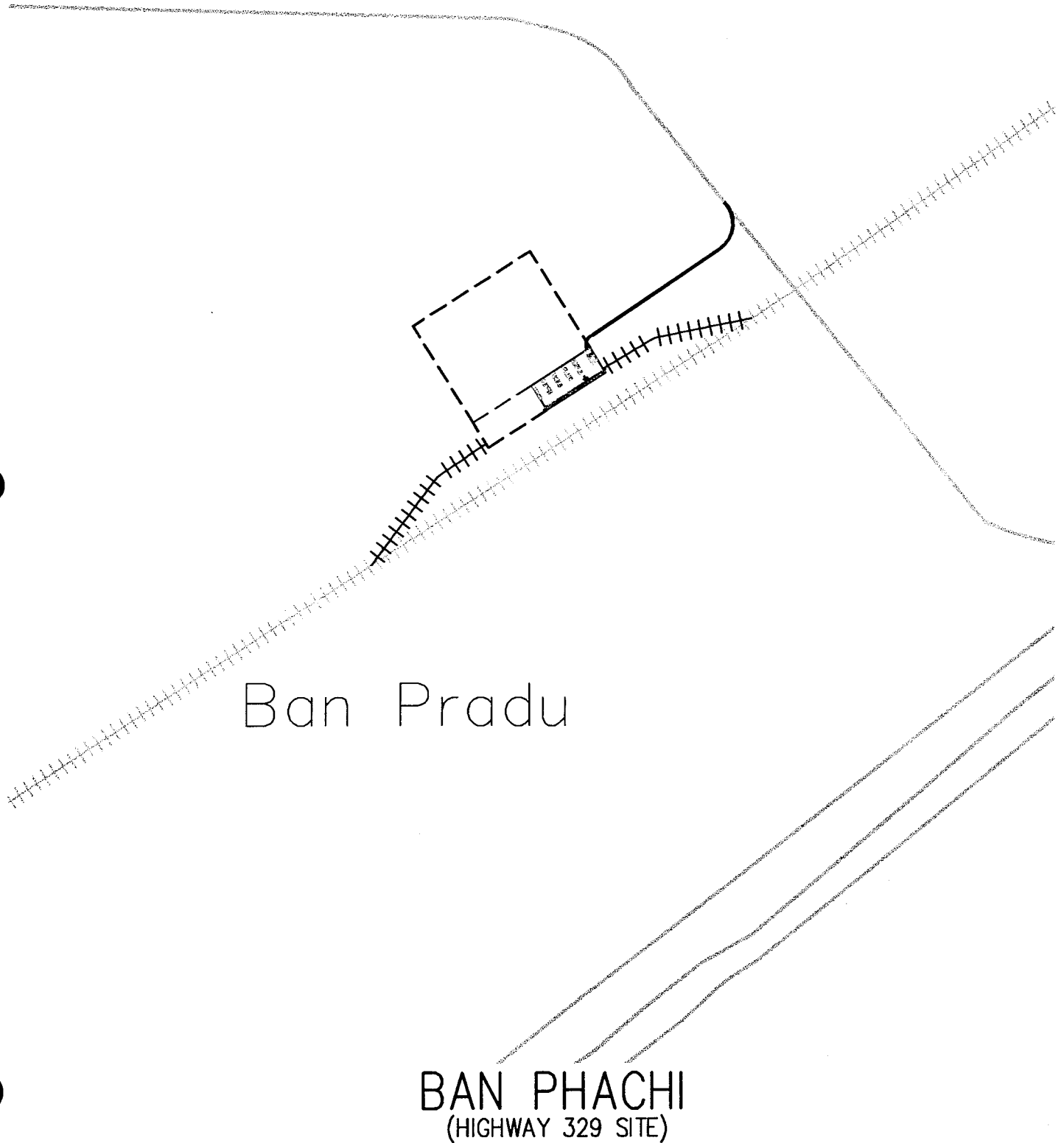
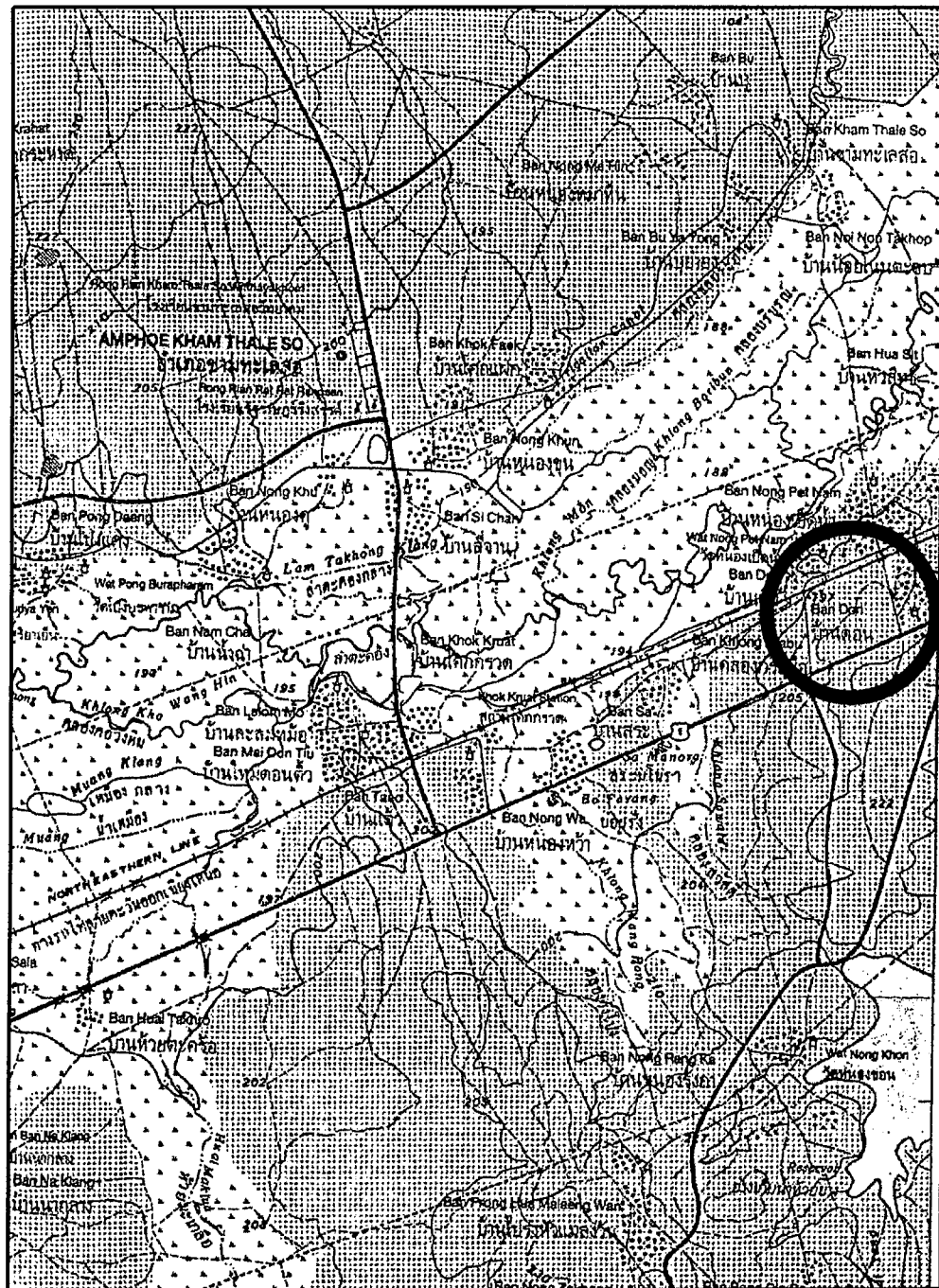


FIGURE 32



KORAT
NOT TO SCALE

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

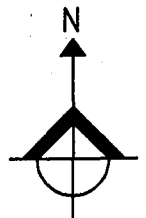
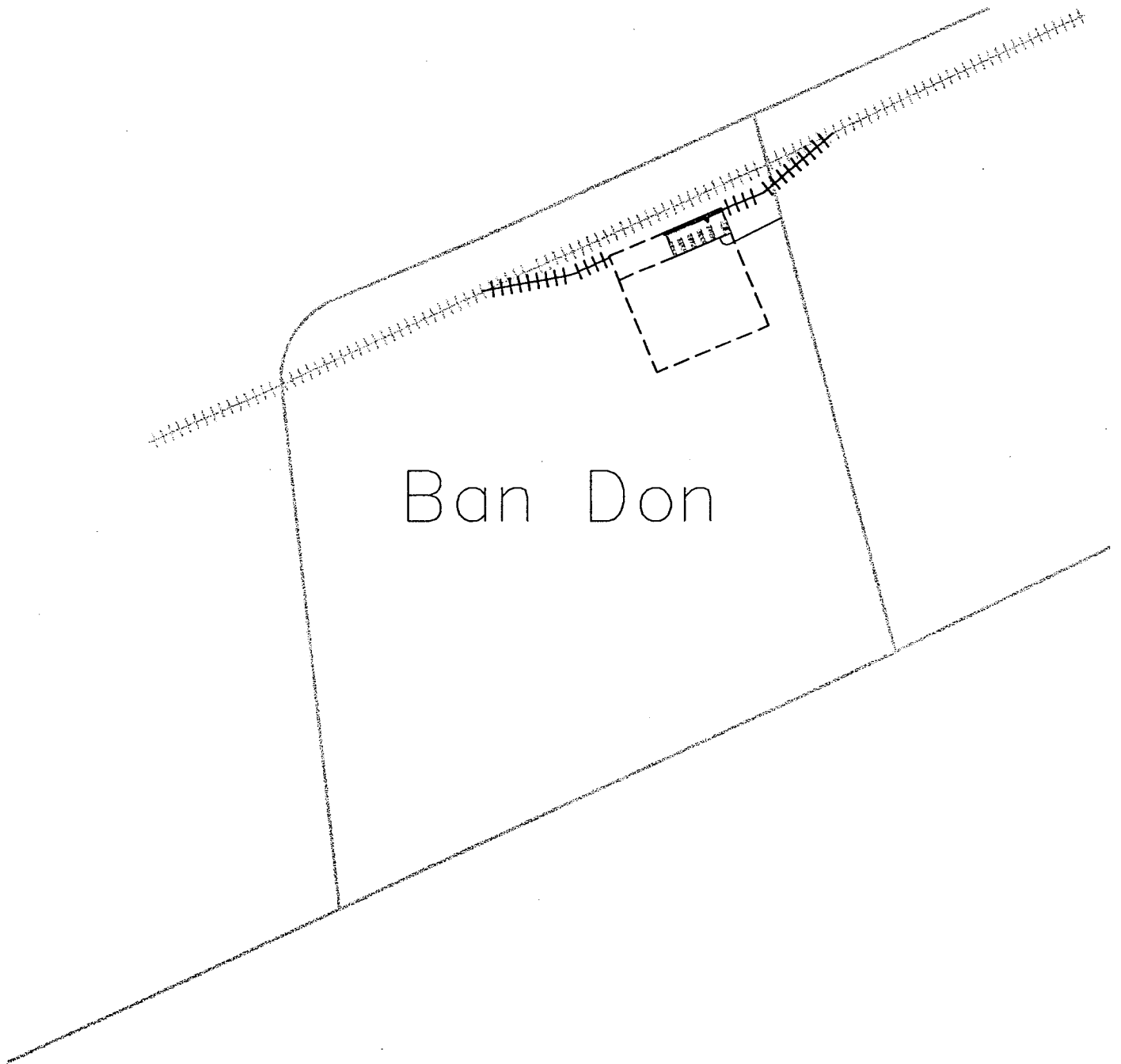


FIGURE 33

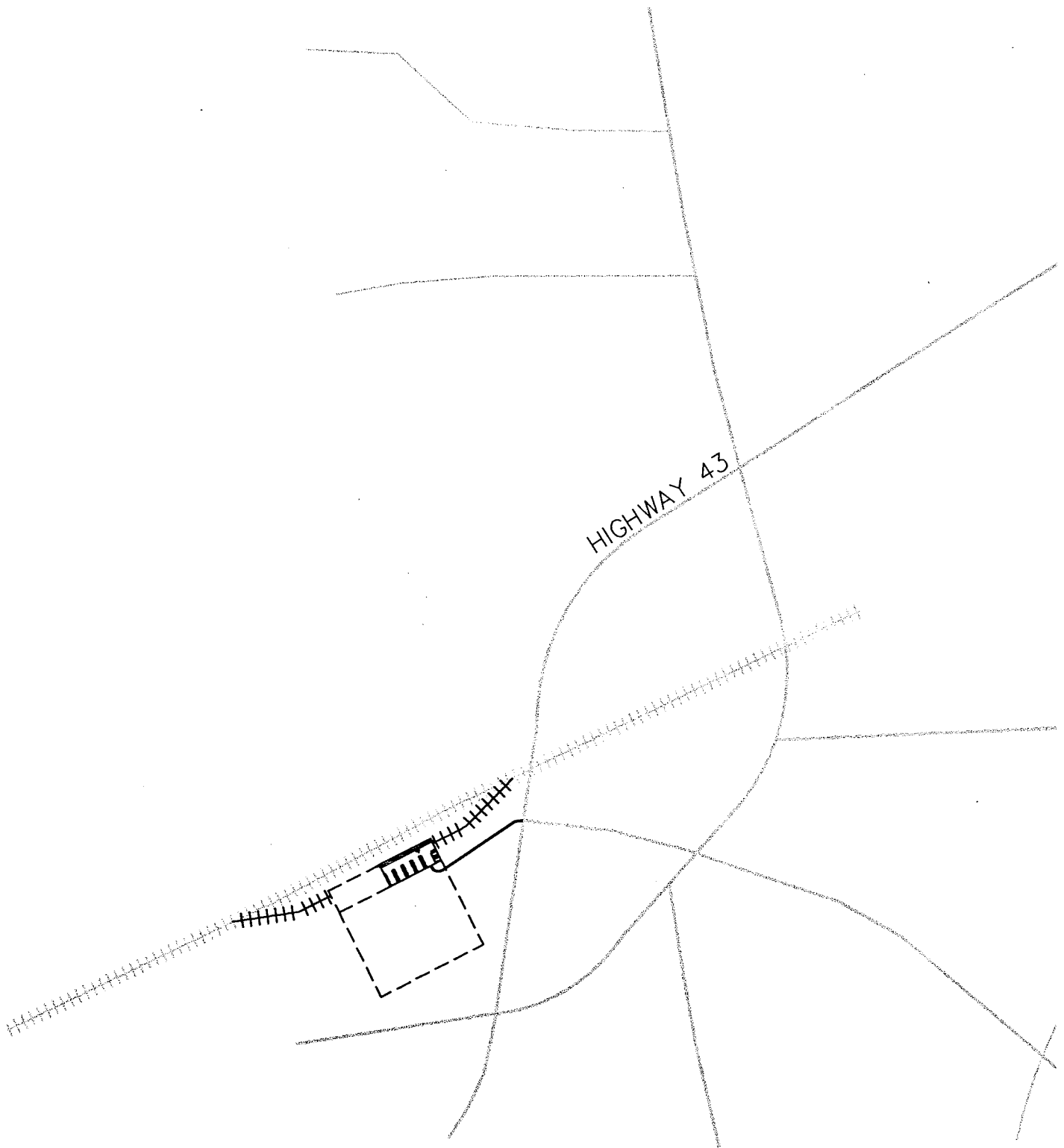


KORAT

(SITE ON SMALL HIGHWAY 7KM WEST OF KORAT)

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

FIGURE 35



HAT YAI
(HIGHWAY 43 SITE)

FEASIBILITY STUDY FOR INLAND CONTAINER TRANSPORT

Table 30
Unit Costs of CTs

Category	Item	Unit Cost	
Civil Work			
	Land Fill	350	B/m ³
	50cm Rock Gravel	510	B/m ²
	Container Yard	1,100	B/m ²
	Washing Area	900	B/m ²
	Paved Road & Car Park	600	B/m ²
Structure			
	CFS (Start-up)	4,000	B/m ²
	Office + Gate (Start-up)	800,000	B

Note: Data from SRT

Cost estimates for the development phases of a representative new CT are shown in Tables C-6 to C-8 in Appendix C. The capital costs are in full amounts, while the operating costs are on an annual basis. The labor costs do not depend on throughput since the employees are paid annual salaries, but the equipment operating costs do depend on the amount of time in operation. The equipment operating costs shown here reflect the cost when the facility is operating at capacity throughputs.

Costs in each phase are incremental. For example, the full cost of building an intermediate CT, in one step, is the sum of the cost of start-up and intermediate phases.

The real estate prices vary in each of the CT locations, and average prices for those area were supplied by the SRT. The real estate prices were not included in the cost estimates of Tables C-6 to C-8, but they were included in the Financial Analysis in Chapter IV. Table 31 lists the real estate prices.

Table 31
Real Estate Prices for CT Sites

Site	Real Estate Price (Baht/m ²)
Lamphun	150
Phitsanulok	75
Khon Kaen	900
Ubon Ratchathani	125
Ban Phachi	75
Korat	500
Hat Yai	312.5
Ongkharak	312.5

Source: Data from SRT

As can be seen in the figures of the CTs, each of the facilities has been located on a site removed from an existing SRT station, with the exceptions of Khon Kaen (Sam Ran station) and Ongkharak station. It is understood that this will require additional changes to the existing signal system, which typically does not have intermediate signals between the stations. It was felt, however, that the need to locate a CT near good highway connections took precedence.

While the typical cost estimates developed for the CTs do not include the costs for the signal improvements at each locations, the following comments are offered:

- According to the Signalling & Telecommunications Department at the SRT, if the new CT is less than 1 km removed from an existing station, there should not be any significant operational problems or capital investment.

- With existing operating rules, if the CT is located greater than 1 km from an existing station, it would require a new signal facility which would be staffed 24 hours per day.
- The alternative to modifying the operating rules, or investing in signal system changes, would involve extending the CT siding into the nearest station.

There are issues regarding safety of the operations, modifications to existing operating rules, and others, which would need to be addressed on a site-by-site basis. These issues go beyond a comparison of alternative costs, and involve institutional changes at the SRT in both the infrastructure and operating departments.

As an example of the approximate costs involved with the signaling changes, the SRT estimated that, at the CT site north of Phitsanulok, modifying the older (manual) signal system would cost 12 million Baht, and installing a new signal system would cost 42 million Baht. Extending the CT siding track 1.5 km to Ban Teng Nam, the nearest station, would cost approximately 25 million Baht (based solely on track and civil costs). The above estimates are very rough estimates based on preliminary information, and to provide better estimates each site should be evaluated separately.

D. RAILROAD OPERATIONAL ANALYSIS

1. Introduction

The MDP contained four key elements which were considered critical to its implementation: infrastructure, reliable service, competitive pricing, and customer base. With the previous sections having evaluated and discussed the terminal infrastructure, this section of the report discusses the SRT rail operation and the changes which are considered necessary for the development of a reliable customer-driven intermodal service.

The PB team performed a broad evaluation of the SRT rail operation as part of its analysis. The criteria which guided that evaluation included the following:

- Need for development of a practical strategy. The PB team worked with the existing parameters of the SRT operation (stringlines, capacity charts, slow orders due to gradients, etc.), in order to find practical operating alternatives for the short term strategy.
- Use of existing infrastructure. Considering funding and construction problems, future improvements to the infrastructure (such as the double tracking program) were not considered to be completed and operational in time for the short term program. In other words, the SRT would need to rely on its existing assets to start the intermodal service.
- Use of existing rolling stock. Again with a view toward short term solutions, the use of the existing rolling stock was considered necessary, with additional equipment to be purchased in phases as required.

The guiding principle for the PB team was to develop and discuss operational concepts which would benefit the SRT in implementing a new intermodal service. The effort was not intended to produce definitive train schedules, for instance, but rather evaluate whether there was sufficient capacity and operating windows to support the recommended train services. Likewise, it is believed that the other operating concepts discussed in this section can be implemented by the SRT and contribute to the development of a reliable intermodal service.

This section of the report begins by discussing the existing network infrastructure, followed by a brief description of the existing freight operations, including rolling stock availability and unit costs. This is followed by a discussion of the existing rail operation at Lat Krabang, a discussion of recommendations for a new intermodal container service operation, and finally a discussion of the estimated capital and operating costs associated with the proposed railroad operation.

2. Existing Railway Network and Capacity

The existing network of SRT lines consists of five major routes radiating from the Bangkok metropolitan area. These are defined as the Northern Line to Chang Mai, the Upper Northeastern Line to Nong Khai, the Lower Northeastern Line to Ubon Ratchathani, the Eastern Line to Map Ta Phut, and the Southern Line to Sungai Kolok. With the exception of the Southern Line, all of these lines terminate within the borders of Thailand. In addition, with the exception of relatively small portions of the Northern and Northeastern Lines near Bangkok, all routes are single track. A multi tracking program is currently in place, the extent of which was shown on Figure 4 in Chapter 1, with construction of a third track underway between Bangkok and Ban Phachi Junction. Engineering and design of a second track for various segments has been completed. PB was told that commencement of construction activities has been placed on hold at this time due to economic reasons.

A network of scheduled passenger and freight trains operates on a seven days per week basis on all major lines. The first step in the operational analysis was developing an understanding of the existing train schedules and capacities for each of the lines. Table D-1 in Appendix D present a summary of the capacities for the various lines in the SRT system, and the individual segments of those lines. The capacity figures were taken from SRT documents and accepted by PB for its analysis, although there may be additional capacity depending on the assumptions behind the SRT calculations. It is worthwhile noting that some segments are already operating over the SRT's theoretical capacity.

3. Existing Freight Operations

a. Train Operations

As of the close of 1996, the SRT operated a total of 445 stations and maintained an additional 141 "stopping places". The existence of privately-owned industrial sidetracks or rail-served industrial parks is almost nonexistent in Thailand, with the exception of those facilities designed for shipment or receipt of bulk commodities such as cement, petroleum or liquefied gas. As a result, delivery or receipt of carload freight to, or from, an individual customer requires transloading from or to trucks at the nearest freight station or public delivery track.

This type of operation is clearly a deterrent to increased use of rail for shipment of individual carload freight. When requested by a shipper, and if physically feasible, freight can be handled at any station or stopping place. This requires tedious double handling of cargo as well as substantially increasing the required time for a shipment to reach its destination. A March 1995 study performed by Japan Railway Technical Service (JARTS) tracked movement of cargo trains on four major SRT lines. The results of this portion of the study are shown in the following Table 32.

Table 32
Operating Data for Specific SRT Lines

Line	Length (km)	Train No.	Total Time (hh:mm)	Time Moving (hh:mm)	Time Stopped (hh:mm)	Average Speed km/h
Northern Line Bang Sue-Chiang Mai	743	607	32:03	19:53	12:09	23.18
Northeast Line Bang Sue-Nong Khai	616	561	20:36	16:01	4:35	29.90
Bang Sue-Ubon Ratchathani	567	501	23:20	15:27	7:53	24.30
Southern Line Bang Sue-Hat Yai	927	741	27:10	22:10	5:09	34.12

As can be seen from the preceding table, an inordinate amount of time from origin to destination is consumed by shunting or waiting at intermediate points. The maximum permissible operating

speed of freight trains is 70 kph, however, with the unusually high dwell times the actual operating speed is approximately 28 kph. This fact, coupled with the time required to transload, results in much longer freight shipping times when compared to trucks.

For the sake of comparison, in the U.S. most rail users own and maintain private industrial sidings adjacent to their manufacturing or distribution facilities. The serving railroad will place and pickup freight cars directly from the users' loading facility, avoiding the need to transload into trucks. In addition, many larger rail shippers such as chemical manufacturers, petroleum refiners or grain processors, or groups of users such as industrial parks, maintain complex railroad networks within their facilities, as well as operating their own shunting locomotives or railcar movers for flexibility and economy. This latter operation clearly has potential applications in Thailand for the industrial estate areas, which provide a cluster of shipping businesses and great potential for future intermodal traffic.

The SRT freight train operation is further constrained in the Bangkok metropolitan region by voluntary SRT and mandatory governmental restrictions, in an attempt to ease traffic congestion and avoid conflict with passenger train operations during peak travel periods. The SRT voluntary curfews are in place from 04:00-09:00 and from 16:00-20:00, with government curfews in place from 06:00-09:00 and from 16:00-19:00. As examples, trains arriving later than 02:00 from the Northern and Northeast lines are held at Ban Phachi Junction, and trains arriving from the Eastern Seaboard Line, specifically departing from LC Port, are held at that facility after 04:00. Also, trains arriving from the Southern Line are held at Bang Bamru after 04:00.

Further limitations result from the infrastructure requirements:

- A maximum axle load limit of 15 tons per axle is in place on the SRT as a result of light rail weights and undergrade structure capacity limits. As a result, a typical four axle freight car can impose no greater than 60 tons gross weight on rails.
- Passing track lengths at most major stations do not exceed 500 meters, which restricts train length to approximately 35 cars.
- A maximum limit on trailing tonnage further restricts train size on some lines due to severe gradients and curvatures.

b. Train types

There are three distinct types of cargo train service operated by the SRT: general cargo trains, consisting of individual carload commodities; bulk cargo trains, consisting of a single commodity and operated between a distinct origin and destination; and container trains, consisting of Containers On Flat Cars (COFC) and operated in the same manner as bulk cargo trains.

- General cargo trains operate on rigid schedules which include a large portion of idle or dwell time. This time is included in schedules in order to permit overtakes and passes by passenger trains, which have priority, as well as to permit shunting or switching operations at intermediate stations for setoff or pickup of cars. As noted in the discussion above, cargo is handled at one of 445 stations and 141 "stopping places". In most locations no special facilities are provided, and a public delivery track is utilized to manually transfer cargo between the shipper or consignor's truck and the railcar. This type of operation involves inefficient double handling of the cargo at both origin and destination, and in concert with the long travel times of the existing cargo train schedules, results in the slow movement of carload freight and a poor comparison to direct truck transport.
- Bulk cargoes such as petroleum, cement or liquefied gas are shipped from origin station to destination station in either dedicated trains, if volumes are large enough, or as a "block" of cars in a conventional cargo train. The inherent advantages of such bulk shipments is the elimination of the time-consuming need to switch individual cars of goods at origin and destination, and the classification of individual cars for delivery to ultimate destination. In addition, the utilization of specialized material handling apparatus, at both origins and destinations, eliminates the labor and time-intensive material handling operations typically

associated with conventional carload cargoes. This increases railcar utilization, permitting a greater number of loads to be carried over the service life of the railcar.

- Dedicated COFC trains carrying oceangoing shipping containers are operated by the SRT between LC Port and either Lat Krabang ICD or Bang Sue ICD. Service to the Bang Sue ICD is provided exclusively for American President Lines (APL), the lessor and operator of the container facility at that ICD. Separate from the trains to Lat Krabang ICD, there are currently six daily trains (three each direction) operated by SRT to the Bang Sue ICD, but four additional train slots (two trips each direction) are in the existing timetable but not operated.

COFC service to the Lat Krabang ICD commenced in 1996 and currently consists of between four and six round trips per day in accordance with customer demands. However, physical plant capabilities and current schedules permit operation of up to ten trains in each direction. Each trainset consists of one locomotive and 34 flat cars, each capable of carrying two 20 ft. (6.09m) ISO containers for a total of 68 TEUs.

A very limited volume of containerized freight is handled from Bangkok Port, since rail operations into and out of the Port are hampered by the previously noted curfews on rail operations in the Bangkok area, as well as general congestion at that port.

c. Motive Power and Rolling Stock

SRT currently operates a fleet of 223 diesel electric locomotives, in addition to a fleet of 73 diesel-hydraulic shunting or switching locomotives. Table 33 lists the currently operated high horsepower diesel-electric locomotives which are suitable for container train service.

Table 33
Summary of Locomotives for Container Train Service

Class	Number Series	Origin	Year Built	Usable Through	Qty.	Out. HP	Wt.	Max. Speed	Brake Type
ALS	4101-4154	France	1975 (2518)	2005 (2548)	52	2250	82,500	95	Air on Loco. Air & Vac. on Train
AHK	4201-4230	Ger.	1980 (2523)	2010 (2553)	30	2250	82,500	100	Air on Loco. Air on Train
ALD	4301-4309	France	1983 (2526)	2013 (2556)	9	2250	82,500	100	Air on Loco. Air & Vac. on Train
ADD	4401-4420	France	1985 (2528)	2015 (2558)	19	2250	82,500	100	Air on Loco. Air & Vac. on Train
HID	4501-4522	Japan	1993 (2536)	2023 (2566)	22	2860	90,000	100	Air on Loco. Air & Vac. on Train
GEA	4523-4560	US	1995 (2538)	2025 (2568)	38	2500	86,500	100	Pure Air Brake
TOTALS					170				

Source: SRT Leading Particulars of Rolling Stock, updated as of June, 1998.

* Units in service 1 year. at date of compilation.

According to statistics published by the SRT in 1996, a fleet of 9072 freight cars are carried on their inventory. Of this number 8,400 are currently in service and operated, with an average availability for fiscal years 1991-1997 of approximately 94%. Also from this overall number of 8,400, there are approximately 324 flat cars available for use in intermodal container service. These particular flatcars are of relatively recent vintage in comparison to the average age of 32.2 years for the SRT's entire fleet of freight cars. They are designated on the equipment roster as Bogie Container Flatcars (BCF), generally have a load capacity of 45 tons, and are each capable of carrying two 20 foot (6.09m) ISO containers. Table 34 lists this BCF equipment:

Table 34
SRT Bogie Container Flatcars Available for Container Train Service

A. Total Flatcars								
Number Series (Existing Cars)	Total	Tare Wt. (Tons)	Capacity (Tons)	Max. Spd. Km./Hr.	Brake Type	Year Built	Usable Through	Maker
Group 1								
1-50, 51-90	60	12	30	70	Dual	1977-78, '80		Makkasan
118-140	23	12	30	70	Dual	1981		Makkasan
28001-28020	20	12.15	29.85	70	Dual	1987(Reblt.)		Makkasan
46101-46154	54	13.25	46.75	70	Dual	1996	2026	Makkasan
48001-48099	99	15.6	44.4	100	Air	1996	2026	Korea
50061-50100	40	14.4	45.6	80	Dual	1985	2015	Korea
50101-50120	20	15	45.0	70	Dual	1989	2019	Makkasan
50201-50332	132	16.5	43.5	100	Dual	1993	2023	China
Subtotal	448							
Group 2								
46001-46020	20	13.25	46.75	70	Dual	1987(Reblt.)		Makkasan
Group 3								
91-117	25	12	26	55	Vac	1981		Makkasan
28021-28118	98	13	28	55	Dual	1957(Reblt.)		Makkasan
Total Fleet	591							
B. Flatcars Available for Container Service								
Group 1	324							
Group 2	0							
Group 3	0							
Subtotal	324							
Availability*	94.15%							
Total Available	305							
TEU avail. capy.	610							
Avg. Tare Weight		14.95**						

** Avg. of Group 1 60 gross-ton capacity cars.

Notes:

1. Railcar roster and Group 1 cars available for container service per SRT-supplied data, May 1998.
2. Only cars with a capacity of 60 gross tons are considered available for container service. Of these 345 cars, 21 are assigned to service at points other than Lat Krabang and Bang Sue, resulting in the 324 cars shown above.

The SRT currently does not own any intermodal shipping containers. Current COFC service is provided for the transport of containers owned by steamship lines, other private shippers, or freight consolidators. A small volume of bagged cement is moved in intermodal containers owned by the cement producers.

d. Unit Operating Costs

The existing operating costs of the SRT for freight service were evaluated, based on cost figures supplied by the SRT staff. In general two main categories of costs should be considered when evaluating the operating economics of rail service. These are:

- Fixed costs, such as depreciation, debt service, routine equipment maintenance functions (such as safety inspections or calendar interval-mandated services), and minimum manpower costs due to operating rule or labor agreement requirements.
- Variable costs, such as fuel, consumable parts, wrecks, overtime wages, distance-based premium pay, delays, or acts of nature.

Applicable historical labor cost figures for operating personnel were supplied by the SRT for fiscal year 1997, as shown in Tables 35 and 36:

Table 35
Average Variable Labor Costs for the SRT

Position	Type of Cost	Units	Amount
Locomotive Driver	Variable	Baht/km	0.31
Asst. Locomotive Driver	Variable	Baht/km	0.25
Guard	Variable	Baht/km	0.25
Brakeman	Variable	Baht/km	0.185

Note: Above costs are the salary bonuses given to train crews. Standard salaries are not included.

Table 36
Average Equipment Operating Costs for the SRT

Equipment	Type of Cost	Units	Amount
Locomotive	Variable	Baht/train-km	76.85
Wagon (car)	Variable	Baht/km	0.914

Source: SRT Freight Marketing Department.

Note: Above costs include fuel, supplies, and maintenance for locomotives, in addition to wagon maintenance.

The above operating cost tables were developed for the purpose of defining the variable manpower and equipment expenses which could be expected in connection with the SRT's operation of inland container transport services. They are used later in this section to estimate the variable operating costs of the proposed intermodal train service.

e. Work Rules and Operating Practices

Current SRT operating practices require the use of four man train crews, consisting of one each of the following individuals:

Table 37
Crew members for SRT Trains

Crew Member	SRT Department
Locomotive Driver	Mechanical
Asst. Locomotive Driver	Mechanical
Guard	Traffic
Brakeman	Traffic

Current SRT labor agreements dictate that locomotive (Mechanical Department) crews operate on an 8 hour maximum workday, while train (Traffic Department) crews operate on a 12 hour maximum workday. In addition, each department maintains different operating territories along a given line, resulting in the need to stop and "recrew" a train separately for each department.

4. Existing ICD Operation at Lat Krabang

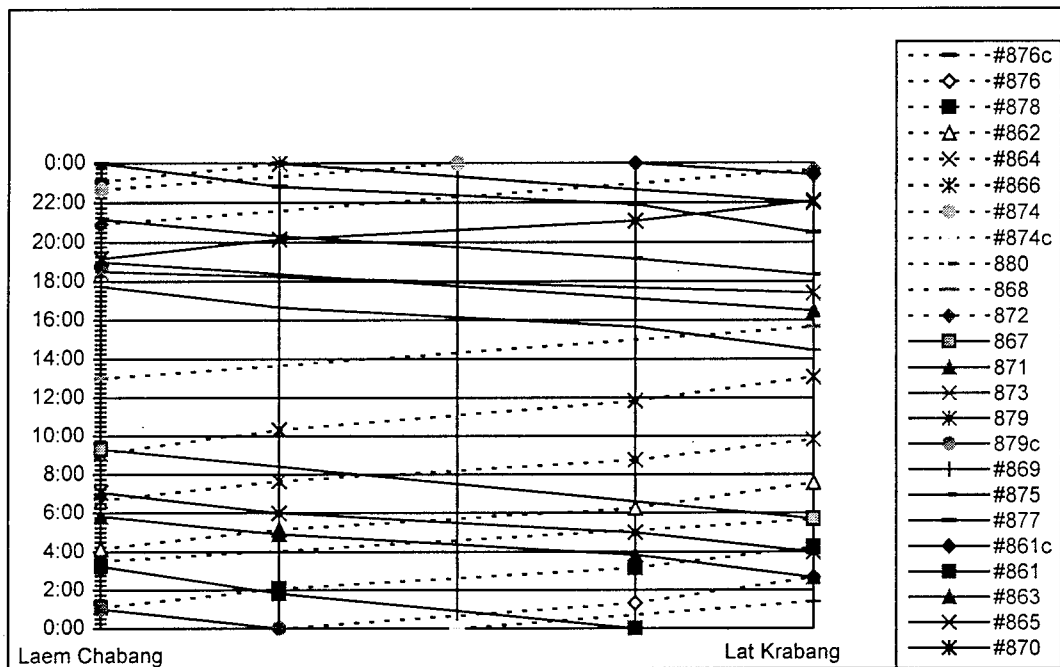
As the first ICD operation for SRT, it is informative to review the existing facility at Lat Krabang ICD and its railroad operating features. Figure 12 presented the existing layout of the facility, and conceptual designs for an expanded facility (including a new track system) were also presented earlier. This section describes the issues associated with the existing rail design at the facility.

a. Main Line Train Movements

Figure 36, Existing Container-On-Flat Car (COFC) Service between LC Port and Lat Krabang ICD, is shown below. Each diagonal line represents one train operating between LC Port, shown on the left side of the chart, and Lat Krabang ICD, shown on the right side. The hour of day (24

hour clock) is indicated vertically. A potential network of 20 trains (10 in each direction) is available (on the stringline schedules) on a seven day per week basis, with traffic demands dictating the actual number of trains operated, and selected trains are annulled or canceled if volumes do not support their operation.

Figure 36
Existing C.O.F.C. Service between LC Port and Lat Krabang ICD



Source: SRT Stringline charts

Note: Train numbers with "c" suffix are a continuation of those moves which operate past midnight.

The assumption has been made, and discussed with SRT, that when the Bang Sue ICD is closed, the five train slots for the current service to this location will be used for trains to Lat Krabang ICD (since they utilize the same rail line). This being the case, the current maximum number of daily train slots which can be used for the shuttle service between LC Port and Lat Krabang ICD is 15 in each direction.

Presently, utilizing the existing 10 train slots, Lat Krabang ICD can handle rail volumes of approximately 500,000 TEU/year on a seven (7) day per week basis, predicated on the operation of 34 car consists. With 5 additional train slots after the closing of Bang Sue ICD, Lat Krabang ICD will be able to handle 250,000 additional TEU/year, for a total of 750,000 TEUs. This is the number that was used as the maximum for Lat Krabang ICD's rail capacity for the market projections, financial analysis and other sections. Rail capacity will be increased when this particular rail line is double tracked as part of the current program, but specific information on the construction schedule for this line was not available.

In addition, it should be noted that the rail service to the new ICD at Ongkharak shares the same rail line, at least for the segment between LC Port and Chachoengsao. For the purposes of this report, it has been assumed that the projected rail traffic into Ongkharak can be supplied by the five train slots (formerly to Bang Sue ICD) not shown on the current schedules, and incremental increases in operating efficiencies on the line.

Since additional trains will be needed to supply both Lat Krabang ICD and the new Ongkharak ICD, this analysis shows that the construction of additional tracks between LC Port and Lat

Krabang ICD (which will improve the rail capacity) should have top priority above other areas of the double tracking program from a freight rail perspective.

b. Facility Rail Operations

This subject was previously discussed to some extent under the section titled Terminal Site Development, however further operational comments are provided here. Lat Krabang ICD, as constructed, is a stub end facility consisting of four tracks with middle crossovers. A total of six loading/unloading areas are provided on three of the tracks, with the fourth track utilized as a "running" or escape track for the inbound locomotives and for switching operations. The modules are either 400m or 300m long, and the average train length with a locomotive (18m), 34 railcars (12.5m), and a caboose (8m), is about 450m. The lengths of the modules are therefore shorter than a train, and the trains have to be worked in stages or across adjacent terminal space.

For the overall SRT system, operating statistics for 1995 indicate freight car turnaround time at an average of 6.5 days per car, with an average daily distance per car in service of 100 km. The existing scheduled COFC service between Lat Krabang ICD and LC Port achieves a much higher number of carloads per month, with an average of approximately 1 day turnaround per trainset. However, in view of the very short distance between origin and destination (approximately 109 km), and the relatively short times required to load and unload intermodal containers, this turnaround time and resultant car utilization is extremely poor. The low car utilization numbers are in no small part a result of the makeup of existing schedules of container trains operated in this service. Modifications to these schedules, including relaxation of the curfew on operations in the Bangkok metropolitan region, may permit more efficient utilization of the existing equipment fleet.

After performing a limited operational analysis of the Lat Krabang facility, the following comments are offered concerning the rail operation. The movement of containers on and off railcars at the existing Lat Krabang facility is limited by the following factors:

- Lack of an external storage yard. The standard configuration for a large container depot would include a storage yard, for a number of reasons. The yard would provide the flexibility necessary to operate the depot efficiently, allow trains to turn outside the facility and thus free one or more tracks for container loading, and allow cars to be shunted when needed rather than by fixed times as dictated by the railroad's main line schedule. For most modern intermodal facilities, the capacity of a rail intermodal storage yard is typically 100 to 150 percent that of the facility it serves.
- Lack of a "wye" or reversing track. Trains must currently turn (locomotive and brake van change ends) inside the Lat Krabang facility. This move requires one track to remain open for the engine move, eliminating that track from container loading operations.

Turning trains takes approximately 20-30 minutes, and although this takes place while the railcars are being unloaded, the locomotives could be used more productively hauling trains on the main line.

- Without a storage yard, loaded trains must wait until their scheduled departure times before exiting the track, making that track unavailable for additional unloading/loading operations. Empties must also wait, occupying a track that could otherwise be used for additional unloadings.

In summary, the existing four track configuration of Lat Krabang ICD is limited in its ability to handle additional railcars, due in large part to the lack of any storage or staging tracks for empty railcars. A large portion of track occupancy time is consumed by the storage of empty railcars, and this is clearly an inefficient use of existing facilities.

A storage yard is needed to act as a buffer between the main line and the Lat Krabang ICD facility, providing space to store cars which are ready for shunting into the facility (for unloading), to store empty cars after unloading, and to store loaded cars ready for transport to LC Port. The

shunting of cars between the storage yard and the ICD could occur when needed, rather than by a fixed schedule of inbound or outbound trains, making the ICD as efficient as possible. If the storage yard was connected to the lead track of the ICD with a wye, then trains could be turned on one move rather than the multiple moves now required without the wye. The need for a storage yard will increase proportionally with the need for increasing the throughput and capacity of the Lat Krabang facility.

This subject of a storage yard is explored in more detail in the following section of this report.

5. Recommended Intermodal Container Service Operation

a. Service Lanes and Schedules

Based on the traffic projections made as part of the Market Analysis, service lanes were evaluated to potentially serve the new CTs. The traffic projections formed the basis for the development of potential schedules, taking into account both the service objectives (next day service, reliability, etc.) and the physical constraints of the infrastructure. Originating and terminating stations for these schedules were considered to be the CTs previously discussed.

It is also important to mention that the CTs in the provinces were intended to serve both the domestic and import/export markets. For instance, the schedules from the Northeastern Lines were intended to provide next day service to Bangkok by dropping off blocks of container cars at Ongkharak, but also to drop off blocks of container cars for delivery to LC Port as required (before the construction of an ICD at Ongkharak, the international containers would need to be transferred to Lat Krabang ICD). Both markets were considered absolutely necessary for the future of SRT intermodal service, and these trial schedules prove that such services are possible. The terminal sites were discussed previously, and the trial schedules developed by the PB team are included as Tables E-1 to E-8 in Appendix E.

These schedules prove that, in theory, service is possible to each of the recommended terminal sites. The viability of the next day service would be dependent on the SRT developing relationships with trucking firms to complete the remainder of the trips. For instance, the overnight train from Lamphun to Ban Phachi arrives in time for early morning delivery in Bangkok, but the efficiency of the handling operation at Ban Phachi will be critical to the eventual delivery of goods to destinations in the metropolitan area.

The preceding schedules were developed with several parameters in mind:

- In general, the schedules were structured to permit afternoon or early evening departure from the originating CT, with next day or better delivery at the destination CT, within the limitations posed by existing SRT operations and physical plant constraints.
- At origin, it is anticipated that containers may be received until 30 minutes prior to scheduled train departure. This time period affords adequate time following the last lift for initial terminal inspection of the train consist with respect to the air brake test, inspection of all container pedestal locks, and final checking of container and car numbers for waybilling and equipment tracking purposes.
- It is assumed that mechanical inspection of the railcars and locomotives will have been performed previously. Removal of defective railcars and any minor running maintenance such as fueling or replacement of brake shoes will have been addressed prior to final loading of containers.
- Train activities at intermediate points, consisting of setoff or pickup of railcars, have been allocated 30 minutes from arrival. In cases where both activities are scheduled, 60 minutes have been allocated. As terminal and train crew personnel become more familiar with the routine of daily activities, it is expected that these times may prove generous enough to permit revision of schedules to further reduce total scheduled time. The initial design of rail facilities at the proposed container terminals will permit the train to clear the main track, and necessitate the minimum number of switching moves to complete the scheduled work. It

should be noted that in some cases the times allocated for switching activities at certain locations have been modified in order to avoid conflict with passenger train movements occurring in the same time frame.

- Container availability at intermediate destinations has been scheduled 30 minutes following departure of the serving train. This period affords Stations Department personnel adequate time to perform check of inbound containers and prepare necessary paperwork. In addition, in the interest of safety, unloading operations do not begin while rail movements are taking place in the terminal.
- During the development of the preceding schedules, priority of passenger operations over COFC service was maintained. In some cases, existing cargo and unit train schedules would need to be modified to accommodate the addition of the proposed COFC service. Where these modifications are necessary, a note is included at the bottom of the affected COFC service schedule detailing the nature of modification necessary.
- It should be noted that these schedules were developed based on an average operating speed of 70 kph. Improvements to the timeliness of the COFC service may be possible through detailed study of the performance of actual train consists, and through computer modeling utilizing actual physical characteristics of the subject line segments, and performance characteristics of specific locomotives and train consists. The performance of these detailed simulations was, however, beyond the scope of this study.

b. Capital and Operating Costs

Based on the projected train service, available rolling stock, and unit operating costs, estimates were developed for the capital (rolling stock) and operating costs involved in the SRT intermodal rail operation. These costs are separate from the terminal costs developed previously, but were combined for the financial analysis developed later in this report.

The first step in the development of cost estimates was a projection for the total number of trains required on each rail line to support the market projections. Table D-2 in Appendix D presents a summary of the projected trains required on each line from 2001 to 2020 in five year increments. This table takes into account the limitations discussed earlier, such as trailing tonnage and grade restrictions.

Based on this information, Table 38 below presents a summary of the daily train trips required on each line, and it can be seen that in most cases the demand can be met with one daily train trip in each direction to the CTs. As demand increases in future years, it becomes necessary to add locomotives in order to haul a full complement of 34 cars (to overcome grades and other physical constraints), but still the single train usually suffices to meet the service. In later years when it becomes necessary to have more than 1 daily train to meet demand, it is assumed that, given the time frame, SRT can make schedule adjustments and accommodate these trains.

Table 38
Summary of Daily Train Trips to CT Locations

Origin - Destination	2001		2005		2010		2015		2020	
	Train Trips	Locos/ Trip	Train Trips	Locos/ Trip	Train Trips	Locos/ Trip	Train Trips	Locos/ Trip	Train Trips	Locos/ Trip
Ban Phachi - Hat Yai	1	1	1	1	1	1	1	2	1	2
Hat Yai - Ban Phachi	1	1	1	1	1	1	1	2	2	3
Ubon Ratchathani - Ongkharak	1	1	1	1	1	1	1	2	1	2
Ongkharak - Ubon Ratchathani	1	1	1	1	1	1	1	2	1	3
Khon Kaen - Ongkharak	1	1	1	1	1	1	1	2	1	2

	2001		2005		2010		2015		2020	
Origin - Destination	Train Trips	Locos/ Trip	Train Trips	Locos/ Trip	Train Trips	Locos/ Trip	Train Trips	Locos/ Trip	Train Trips	Locos/ Trip
Ongkharak - Khon Kaen	1	1	1	1	1	1	1	2	1	3
Lamphun - Ban Phachi	1	1	1	2	1	3	2	5	3	7
Ban Phachi - Lamphun	1	1	1	1	1	3	2	4	2	6
Totals	8	8	8	9	8	12	10	21	12	28

Source: Table D-2, and arbitrary maximums of three locomotives per train, and train length of 34 cars.

i. Capital Costs

The capital costs associated with the railroad portion of the new service (i.e., in addition to the terminals and their equipment) will arise from the purchase of rolling stock in future years. The results of Table D-2, mentioned previously, were the first step in this process. This table depicted train sizes which could be expected, based on the traffic projections, for each service lane plus the shuttle services between LC Port and Lat Krabang ICD, and LC Port and Ongkharak ICD (beginning 2010). Projections for Lat Krabang ICD volumes commence in 2001 and no improvement was assumed in car utilization beyond the single round trip per car per day currently obtained.

It should be noted that schedule modifications, operational changes with respect to car handling and turnaround times, and improvements to the physical plant of the SRT with respect to track capacity and running times, will affect rolling stock requirements. Because of the complex nature of the impact of each potential change, these possibilities for container handling capacity increases were not considered in the development of this table. There are several assumptions which were utilized in preparing this table with regard to container weights, trailing tonnage restrictions, and locomotive assignments. These are detailed in the list of notes at the bottom of the table.

From these projections and train size counts, equipment acquisition requirements and costs were developed in Table D-3 in Appendix D at five year intervals beginning in 2001, for the LC Port to Lat Krabang ICD shuttle service, the proposed CT service to the provinces, and beginning in 2010 the shuttle service from LC Port to the Ongkharak ICD.

As with the previous table, certain assumptions were made with respect to equipment cycle times, capacities and equipment life.

- The existing locomotive fleet was assumed to be adequate and remain in service and operational to support the existing container flat car fleet.
- No locomotive purchases were anticipated until additional railcars were added to the roster, resulting in a net increase in fleet size.
- Equipment loss due to wrecks or other causes was also not considered.

For the purposes of this table, a new railcar was assumed to have a useful service life of 30 years, at which point it would be removed from the fleet. Based on U.S. experience and practice, it could be expected that beyond this age it would require either rebuilding or scrapping, due to component or general structural fatigue. A general rebuilding program may enable the SRT to extract additional service years from a particular fleet of railcars, but due to the numerous variables in such an assumption, consideration of this option, while potentially feasible, was ignored.

In fact, according to statistics provided by the SRT, as of September 30, 1995, 49% of the current fleet of freight cars is in excess of 30 years old. It should be noted that of the 9,072 cars on the inventory, only 8,447 are in service. No statistics were available to indicate the ages of in-service freight cars. However, the SRT's practice of operating railcars well beyond their normal useful

service lives appears to indicate that equipment purchase requirements and assumptions utilized by PB may be conservative.

ii. Operating Costs

The next step was the estimation of variable operating costs associated with the new train service. Based on the SRT unit costs for labor and equipment, variable overall operating costs were estimated as shown in Table D-4 in Appendix D.

An examination of the individual cost components reveals that the bulk of the variable operating costs are attributable to equipment-related expenses rather than labor expenses. For example, the proposed round trip service between Ban Phachi and Hat Yai, utilizing one locomotive and 19 cars, results in a total variable labor and equipment cost of 196,698 Baht, of which 6,096 Baht, or 3.1% are attributable to labor (with the labor cost calculation being based on salary bonuses). The balance is attributable to equipment. More specifically, 81% of that balance is locomotive-related costs, which would be incurred regardless if the locomotive is operated with or without a train.

Since the operating cost estimates show that the equipment costs are significantly greater than the labor costs, the accuracy of those equipment costs have serious implications for the pricing of SRT's intermodal services. A review to accurately define SRT's actual costs, labor and equipment, would be in order, so that a strategy can be developed for controlling costs. This control of costs will be absolutely critical with regard to pricing competitively against trucks for the intermodal market.

c. Capacity Issues

i. General

Assuming there is sufficient schedule capacity on a particular route to support additional train service, two criteria will dictate the maximum allowable length of the trains on any line. These criteria in turn, affect both the operating costs as well as the overall profitability of the proposed service. The two criteria are:

- Length of passing tracks. In general, passing track lengths represent the upper limit of train size with respect to the number of cars permitted in each train. Based on the available equipment fleet detailed earlier in this report, suitable container cars range in size from 13 m to 14.6 m, while typical locomotive lengths average in the vicinity of 20 m. Average passing track lengths range from approximately 400 m to greater than 600 m, and assuming an average of 500 m, this equates to a maximum train size of between 30 and 34 cars.
- Maximum allowable trailing tonnage over the particular line segment. The limit on trailing tonnage is a function of two separate criteria:
 - Locomotive performance characteristics, such as horsepower and available tractive effort
 - Physical characteristics of the particular line of railroad, such as gradient and curvature

To a much lesser extent, the relative state of repair of the railroad track itself can have an effect on trailing tonnage limits. However, as these influences are relatively small and variable over time, they have not been considered in this study. Table 39 lists the most restrictive tonnage limitations in the SRT by service lane and location. The estimated operating costs of each service lane were developed utilizing the most restrictive line segment as the limit of trailing tonnage.

Table 39
Maximum Trailing Tonnage on Each SRT Line

Line	From	To	Tonnage
South	Bang Saphan Yai	Pathiu	655
South	Pathiu	Bang Saphan Yai	655
South	Thung Song Jct.	Ron Phibun	730

Line	From	To	Tonnage
South	Ron Phibun	Thung Song Jct.	400
North	Ban Dan	Lampang	360
North	Lampang	Ban Dan	360
North	Hang Chat	Lam Phun	300
North	Lam Phun	Hang Chat	300
Northeast	Map Kabao	Pak Chong	360
Northeast	Pak Chong	Map Kabao	500
Northeast	Khok Khli	Bamnet Narong	600
Northeast	Bamnet Narong	Khok Khli	600

Source: SRT Operating Statistics

Note: For the purposes of this report, 1 ton of trailing tonnage equals 1 ton of hauling load.

In order to size train length, several criteria were established.

- Based on typical commodity mixes commonly handled in intermodal shipping containers, an average weight of 10 tons per 20 feet (6.09 m) container was utilized.
- It was assumed that each flat car would be loaded with two 20-foot containers for a total load of 20 tons. This is conservative, since in practice a mix of 20-foot (6.09 m) and 40-foot (12.2 m) containers is typically found, with a percentage distribution of 53% for 20-foot containers, to 45% for 40-foot containers, based on actual volumes handled at LC Port during fiscal year 1997. In addition, 40-foot (12.2 m) containers are utilized for lighter commodities where the cubic capacity of the smaller container would be exceeded before reaching the weight limit, and can also be expected to carry approximately 10 to 15 tons of cargo. Third, the average tare weight was calculated from the available flat car fleet at 15 tons, for a total weight of 35 tons per loaded railcar. From these criteria and the above-noted trailing tonnage limits, train size and costs were developed for single and dual locomotive consists.

ii. Lat Krabang ICD

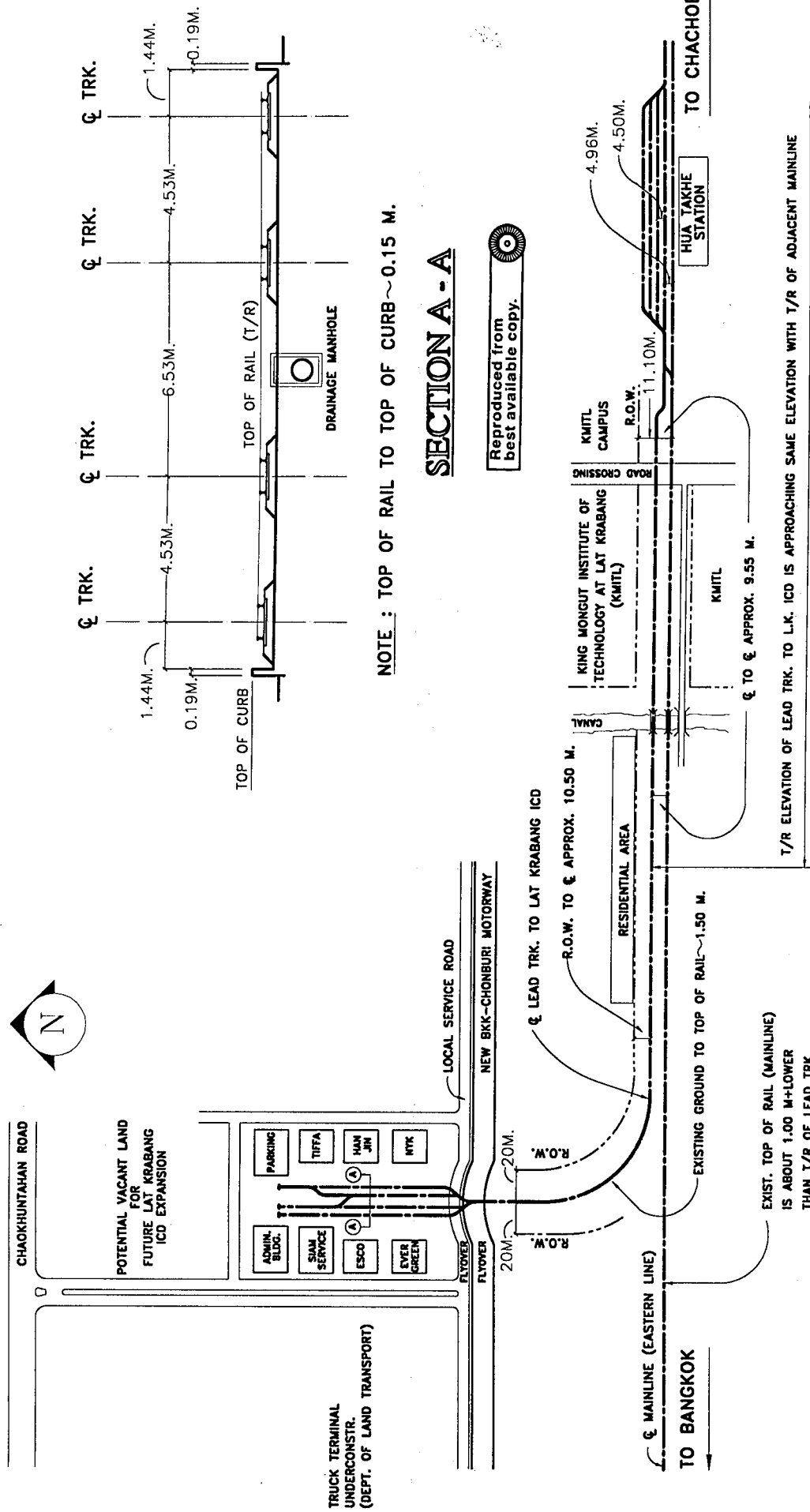
From a rail operations perspective, the existing track layout at Lat Krabang ICD provides a number of limitations which were described previously in this chapter. The focus of this section is to provide an operational analysis, and recommendations for improving the rail throughput of the facility in discrete phases. As a point of reference, Figure 37, Schematic Plan SRT Inland Container Depot and Facility at Lat Krabang, shows the relationship of the ICD to the surrounding community and Hua Takhe Station.

There were four alternatives considered in this analysis:

- Alternative 1 - Existing ICD and Track Plan: What is the maximum throughput that can be reasonably expected from the existing ICD facility?
- Alternative 2 - Existing ICD with External Storage Tracks: What is the maximum throughput that can be reasonably expected from the addition of storage tracks. This configuration would allow all four tracks in the ICD to be used for container operations (with limitations on the use of the southern bay on Track 3).
- Alternative 3 - Existing ICD with 5 Tracks and Storage Yard: What additional track infrastructure is required to provide rail capacity for 1 million TEU/year?
- Alternative 4 - Expanded ICD: What type of track layout is required to provide rail capacity for 2 million TEU/year?

The market projections from Chapter 1, which were made for the ICDs supporting the LC Port container traffic, suggest a maximum rail capacity of 750,000 TEU/year for the existing Lat Krabang ICD, based primarily on the capacity of the SRT main line between LC Port and the Lat Krabang ICD. The analysis by JWD of the ICD itself, however, clearly points toward a maximum of 1 million TEU/year based on ground storage capacity, and so there will always be the major

Figure 37
SCHEMATIC PLAN SRT INLAND CONTAINER DEPOT AND FACILITY AT LAT KRABANG



KINGDOM OF THAILAND
MINISTRY OF TRANSPORT AND COMMUNICATIONS
INLAND CONTAINER TRANSPORT SYSTEMS
FEASIBILITY STUDY FOR THE DEVELOPMENT OF
STATE RAILWAY OF THAILAND

DRAWING TITLE
SCHEMATIC PLAN
SRT INLAND CONTAINER DEPOT
AND FACILITY AT LAT KRABANG

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SCALE : NOT TO SCALE
DATE : 9 APRIL 1998

issue of overall capacity versus rail capacity. The assumption is that SRT wants to increase the rail capacity of the ICD as much as possible, and so the discussion of this section focuses on the rail operations issues facing the SRT as it increases the rail capacity. The references in this section to 1 million TEU/year rail capacity for the existing facility, and 2 million TEU/year for the rail capacity of the expanded facility, are intended as discussion points (i.e., what would it take to reach these theoretical maximums). The rail capacity will likely never equal the overall capacity, and trucking will retain a major percentage of the business.

As a starting point, Table 40 lists the number of trains and track turnover rates required to meet the goals of 1 million TEU/year for the existing ICD, and 2 million TEU/year for the expanded ICD. As shown, between 40-48 trains per day (24 to and 24 from Lat Krabang ICD) would be necessary to reach the intended goal of 1 million TEU/year for the existing facility, with each bay turned over (1 train out, 1 train in) every 8 hours on average. Actual time in the bay would average 6 to 7 hours, allowing for time to shunt cars.

Table 40
Theoretical Maximum TEU/year
Lat Krabang ICD

No. Bays	Avg. Track Occupancy (hours)	Total Trains/Day	TEU/Train	Maximum TEU/Year	Notes
2 Tracks/4 Bays					
4	24	8	68	200,000	(1)
4	12	16	68	400,000	
4	8	24	68	600,000	
3 Tracks/6 Bays					
6	24	12	68	300,000	
6	12	24	68	600,000	
6	8	36	68	900,000	
4 Tracks/8 Bays					
8	24	16	68	400,000	
8	12	32	68	800,000	
8	8	48	68	1,200,000	(2)
8 Tracks/16 Bays					
16	24	32	68	800,000	
16	12	64	68	1,600,000	
16	8	96	68	2,400,000	(3)

Assumes 34 fully loaded rail cars in each direction

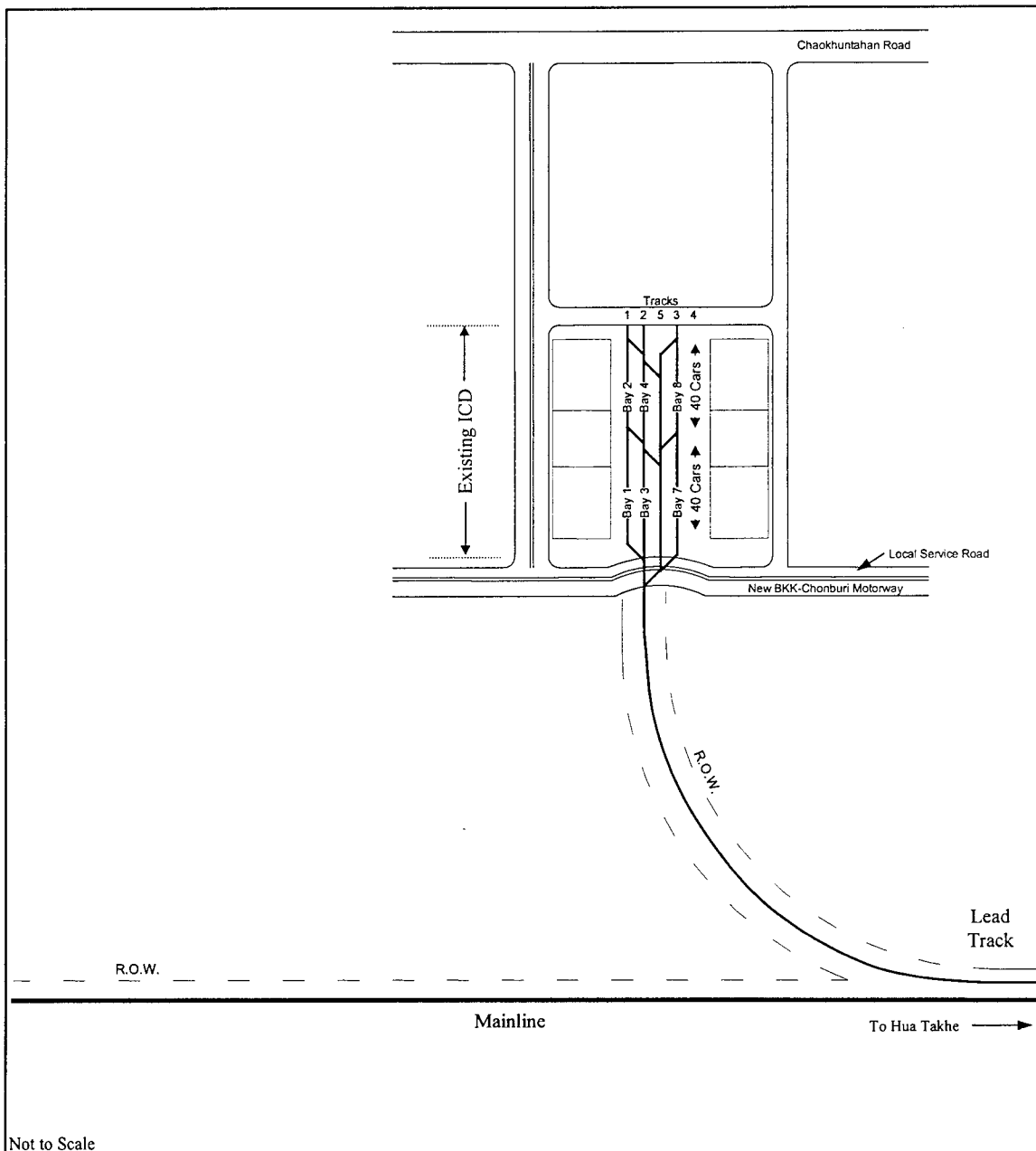
Notes:

- Total trains/day includes both directions; i.e. 16 trains/day = 8 to and 8 from Lat Krabang
- (1) Current volumes
- (2) Although 1 million TEU/year requires 4 bays turned every 8 hours, and 4 bays turned every 12 hours, fluctuations in demand will likely require the full 48 trains to reach 1 million.
- (3) Although 2 million TEU/year requires 8 bays turned every 8 hours, and 8 bays turned every 12 hours, fluctuations in demand will likely require the full 96 trains to reach 2 million.

The operational analysis was predicated on the basic volumes stated in the above table, and the description of each alternative and the analysis of operations is provided below.

Alternative 1 - Existing ICD and Track Plan. With the existing track layout of Lat Krabang ICD (as shown in Figure 38, Alternative 1 Existing Track Layout at Lat Krabang ICD on the following page), additional container volume could be handled by the rail system through increasing the frequency of trains serving the facility (from LC Port). However, due to the lack of a storage yard at Lat Krabang ICD, the need to vacate a bay (a location for loading or unloading a train) before the next port-to-ICD train arrives for that bay, and the variability of loading times, means that trains with a large percentage of empties may frequently move between LC Port and Lat Krabang ICD.

Figure 38
Alternative 1
Existing Track Layout at Lat Krabang ICD



For example, current operations show more unloading activities in the morning hours, with more loading activities in the evening hours. Therefore, during the morning hours trains would arrive full with containers, and then depart with empties to open the track for the next train loaded with

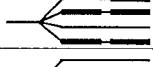
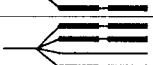
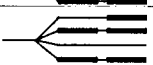
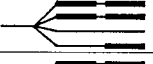
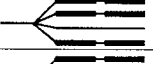
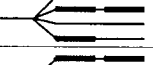
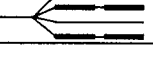
containers. Those trains of empties can be moved back to LC Port or to any available storage yard. Some cars can be stored at Hua Takhe, for example (although trains longer than one track may need to be split and stored on multiple tracks). In the evening the operation is reversed: trains of empties would be moved to Lat Krabang ICD, where they would be loaded and then moved to the port. (This alternative makes no attempt to evaluate the cost-effectiveness of moving empties to LC Port or storage yards, versus increasing the volumes of container movements at Lat Krabang ICD.)

Using a total of 6 bays on the three usable tracks, each bay holding one 34-car train, the existing ICD can serve 204 cars at one time. Assuming that fewer loading operations take place during the hours of 4:00-16:00, approximately 445,000 TEU/year on average could be handled by rail at Lat Krabang ICD, with a theoretical maximum of 600,000 TEU/year. Average turnover time would be 12 hours per bay on average (with actual times between 10-11 hours), although these times vary widely based on the available time slots on the main line.

This volume requires at least 12 trains per day both to and from Lat Krabang ICD. Table 41 shows a hypothetical schedule and track occupancy using the train 'slots' in the main line schedule provided by SRT. Altering the container train schedule, in order to provide loads and empties at times more convenient to the container shippers, could improve the volumes somewhat.

However, due to the surges in demand from each operator, based on when their ship(s) are scheduled to arrive at LC Port, the demand for railcars is not expected to be even during the day or week, possibly resulting in the movement of more empties than assumed here and lower total TEU/year. Further analysis with specific information on operator needs is required.

Table 41
Schedule for Alternative 1 - Existing ICD and Track Plan

		Time at	Consist			Track	Trains
Time	Train	ICD	Loads	Empties	Movement	Occupancy	In
0:00					All pads full		6
0:05	861	11:15	34		leave > Laem Chabang		5
0:55	841	9:15	34		leave > Laem Chabang		4
1:20	874		34		Laem Chabang > arrive		5
2:30	876		34		Laem Chabang > arrive		6
2:50	863	5:26	34		leave > Laem Chabang		5
3:12	845	6:50	34		leave > Laem Chabang		4
3:16	858		34		Laem Chabang > arrive		5
4:05	878		34		Laem Chabang > arrive		6
4:10	865	4:30	0	34	leave > Laem Chabang		5
5:37	880		34		Laem Chabang > arrive		6
5:42	867	7:47	0	34	leave > Laem Chabang		5
7:25	862		34		Laem Chabang > arrive		6
11:15	849	8:45	0	34	leave > Laem Chabang		5
12:50	866		34		Laem Chabang > arrive		6
13:07	851	11:47	34		leave > Laem Chabang		5
14:37	869	10:32	34		leave > Laem Chabang		4
15:40	868		34		Laem Chabang > arrive		5
16:30	871	13:14	34		leave > Laem Chabang		4
17:25	873	10:00	34		leave > Laem Chabang		3
20:22	850		0	34	Laem Chabang > arrive		4
21:24	852		0	34	Laem Chabang > arrive		5
21:55	870		0	34	Laem Chabang > arrive		6
22:00	879	16:23	34		leave > Laem Chabang		5
23:40	872		34		Laem Chabang > arrive		6
Daily Avg. TEU			1224	408			
Avg. Annual TEU			450,000				
Maximum Annual TEU			600,000				

In summary, the existing Lat Krabang facility can handle more rail volume than at present, but as volumes increase, so do the operating constraints. With the times for setting out and picking up cars from the ICD dictated by the available main line slots, flexibility is greatly hampered in meeting the operators' needs for moving empty railcars out of the way for more unloading operations, or for moving empty railcars in for loading. Actual volumes are limited due to the main line capacity, less-than-convenient main line slots, and lack of a storage yard.

Alternative 2 - Existing ICD with External Storage Tracks. Rather than move empties from Lat Krabang ICD either back to LC Port or storage yards, this alternative (Figure 39, Alternative 2 Existing Lat Krabang ICD with Storage Tracks, on the following page) includes the construction of a 3-track storage yard and wye west of the existing lead track. This would be used for arriving and departing trains and for temporary storage of empties. Trains inbound to Lat Krabang ICD would use the wye to reverse the engine, and then push the train into the ICD. Departing trains could pull their cars out to the storage yard, where they could be inspected before the trip on the main line to LC Port. During the midday, empties could be stored on two tracks.

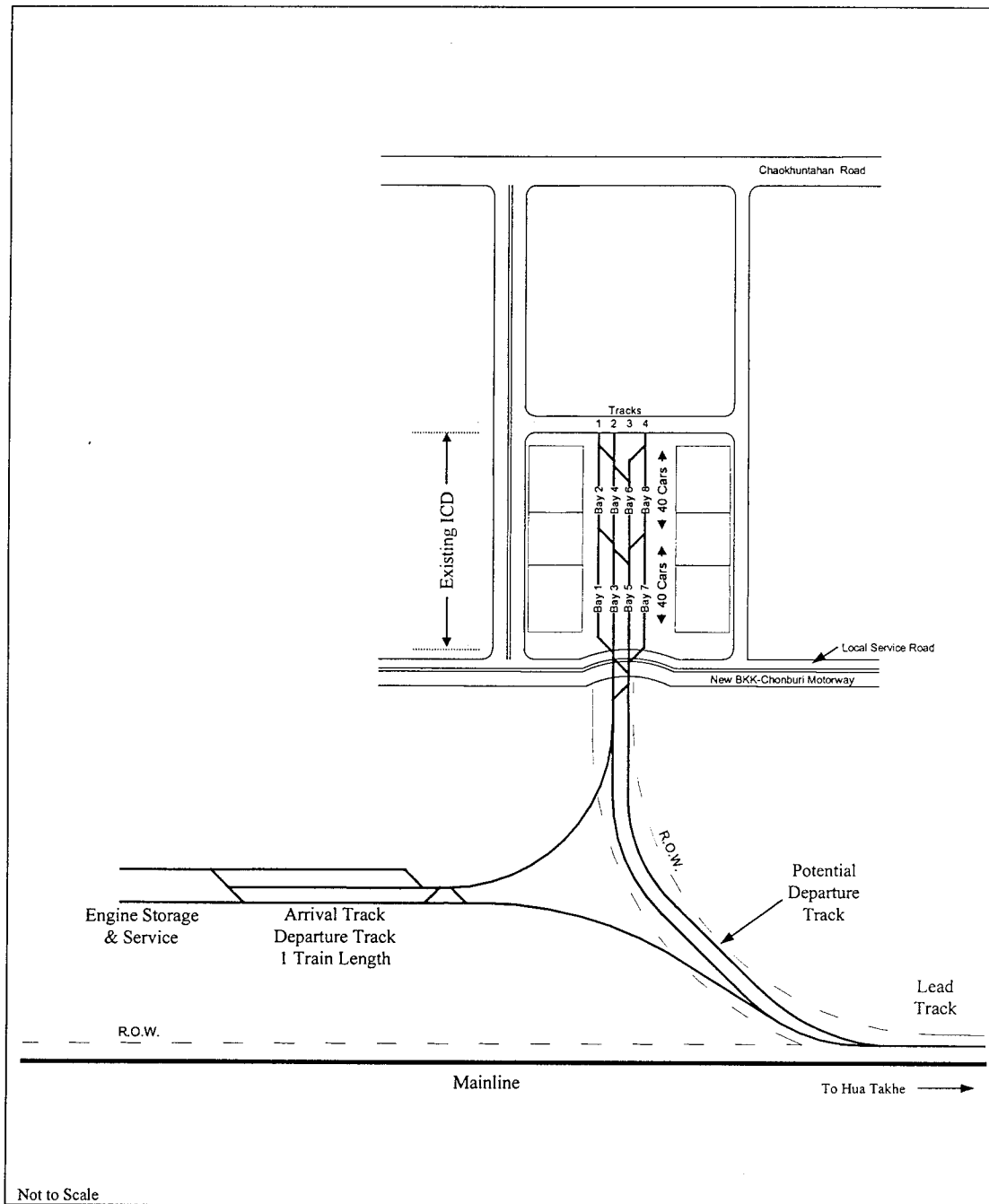
With trains turning outside of the ICD, track 3 inside the ICD, which is now used as a runner, could be used for container operations. This would theoretically increase track capacity by 25 percent. However, there would be limitations on the use of this track, without the addition of a fifth track for moving trains from the rear (northern-most) bays. If bays 1, 3, 5, and 7 are occupied, then no trains can move in or out of bays 2, 4, 6, or 8. If bay 5 is open, then all other bays can be accessed.

Assuming that all 8 bays are usable for container operations, and that a schedule can be developed that keeps bay 5 open when trains are scheduled for bays 2, 4, 6, and 8, then approximately 550,000 TEU/year on average could be handled, with a theoretical maximum of 750,000 TEU/year. However, because train arrival and departure times would still be controlled by the main line schedule, container operations would be restricted, requiring trains of empties to be moved into midday storage locations in order to make bays available for other operations.

Some empties could be stored on one or two of the storage tracks outside of the facility, yet the expected volumes of empty railcars will require some cars to be moved off-site.

In summary, adding a small number of tracks outside of the ICD for arriving and departing trains, and for the temporary storage of empty railcars, increases the expected volume of the ICD to approximately 550,000 TEU/year. The few tracks are insufficient by themselves, however, to increase the rail volume to the desired 1 million TEU/year.

Figure 39
Alternative 2
Existing Lat Krabang ICD with Storage Tracks



Alternative 3 - Existing ICD with Yard to Support 1 Million TEU/Year. The average track occupancies and total trains per day for this volume were shown earlier in Table 40. In order to make the ICD as efficient as possible, and reach the goal of 1 million TEU/year, additional tracks would be required. The improvements include a larger on-site storage yard and a fifth track inside the facility. As shown in Figure 40, Alternative 3 Existing Lat Krabang ICD with 5 Tracks on the following page, the preferred arrangement would provide the following elements:

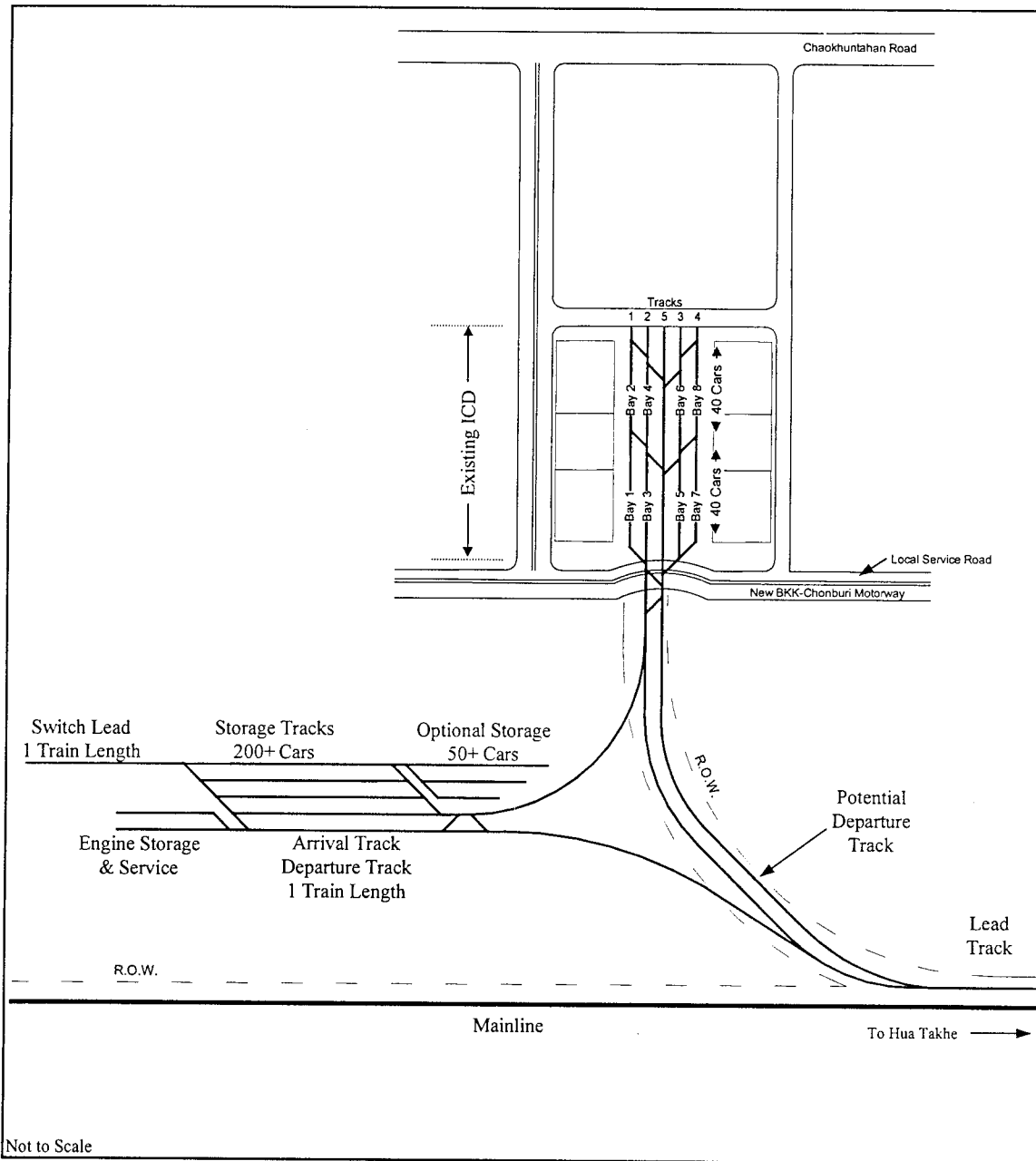
- A fifth track in the ICD in order to provide access and allow all four existing tracks (8 bays) to be used for container operations;
- A wye (as in Alternative 2) for the quick turning of trains. Arriving trains would pull through the wye onto the arrival track. If the bay is ready, the crossover would be thrown and the train pushed back into the ICD. If the bay is not ready, then the train sits either on the arrival track (depending on availability) or on one of the storage tracks. Turning the trains on a wye would eliminate 9 of the 10 moves required with a run-around track. (Replacing brake vans with End of Train Devices would also eliminate 6 moves compared to using a run-around track to spot the van at the end of the train.);
- Storage tracks to store empties until needed, store arriving trains until their bay becomes available, and store departing loaded trains until their scheduled departure times;
- A switch lead for a dedicated shunting locomotive to move blocks of cars to and from the ICD.

With facilities as described, 1 mil TEU/year could be handled with the current 6 modules and 8 bays, limited only by demand and the efficiency of the land-based container operations. Loaded and empty cars could be moved between the ICD facility and the storage yard when ready, without effect or dependence on the main line train schedule. Inspection of the trainsets could be performed in the storage yard before departing for the main line. When the main line can handle additional trains, those trains can be sent from LC Port to Lat Krabang ICD and kept in the storage yard, until the respective bays become available. Loaded cars can be moved from the ICD to the yard and then moved to LC Port at times best suited for main line traffic.

This volume requires all 8 bays to be turned over every 8 hours on average (although 1 million TEU/year requires 4 bays turned every 8 hours, and 4 bays turned every 12 hours, fluctuations in demand will likely require the slots for the full 48 trains per day to reach 1 million/year). With this high turnover rate, and the large number of trains required to serve it, a storage yard is recommended to provide the required flexibility at the ICD and for the scheduling of trains to reduce congestion on the main line. The size of the storage yard should be as large as feasible. The ability to store at least the same number of cars as serviced by the ICD, 270 cars with all 8 bays, would increase the facility's flexibility and throughput significantly.

With this arrangement, the number of locomotives required to serve the facility could also be reduced. With a dedicated shunting locomotive, other locomotives would not need to stay with a train. Instead, they could shuttle between LC Port and the Lat Krabang storage yard, dropping off a set of cars in the storage yard and then picking up the next set of cars destined for LC Port.

Figure 40
Alternative 3
Existing Lat Krabang ICD with 5 Tracks



In summary, although the existing ICD facility can handle 1 million TEU/year within the ground-based operations, the rail capacity is much more limited. More than 20 trains in each direction per day, and turnover rates of 8 hours for all 8 bays, are required to reach that volume. A fifth track in the Lat Krabang ICD, a nearby storage yard with a dedicated shunting engine, and a wye for turning trains, are recommended to handle the intended volumes.

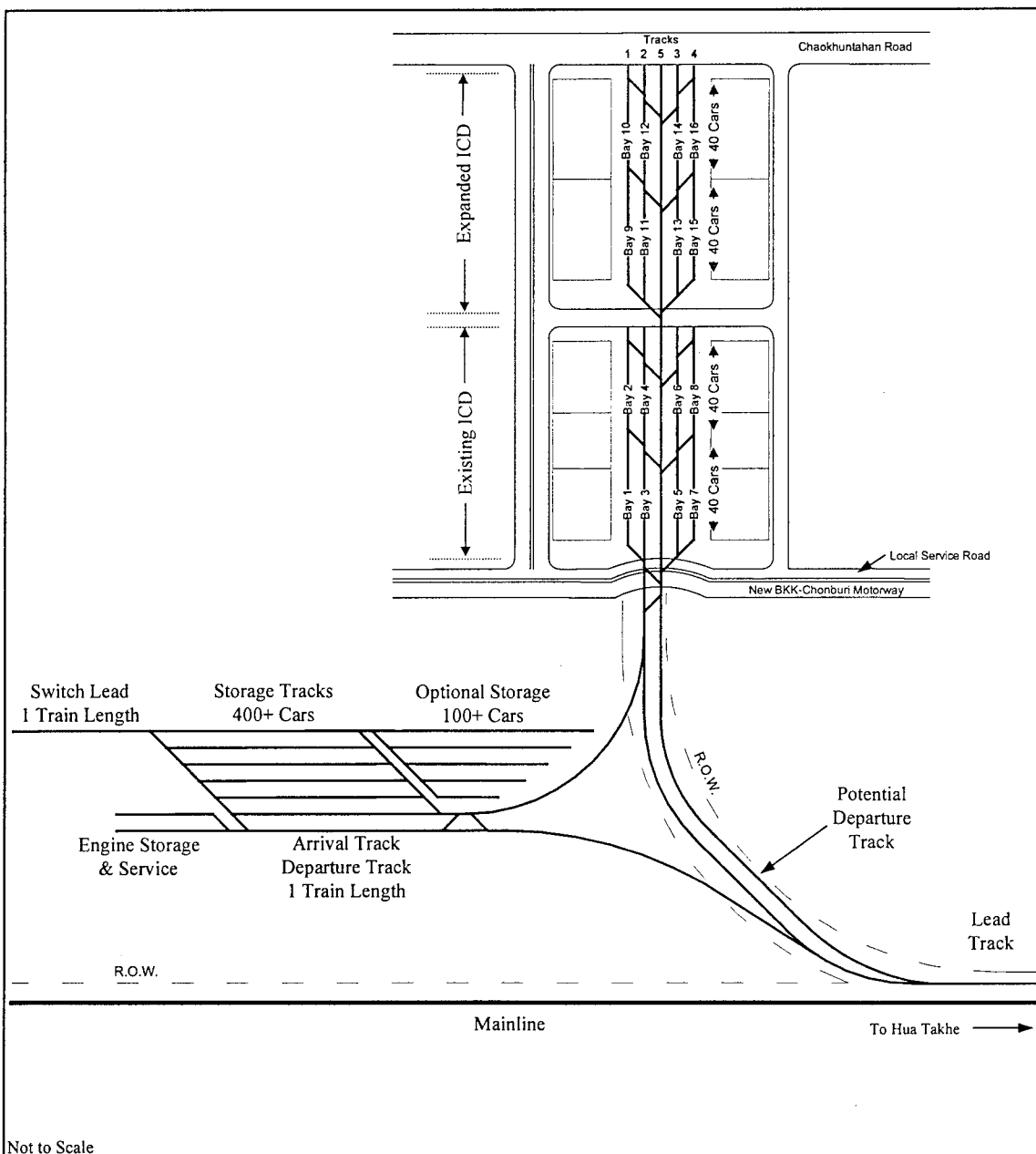
Alternative 4 - Expanded ICD with Yard to Support 2 Million TEU/Year.

Expanding the existing Lat Krabang ICD with a duplicate facility, and doubling the volume of containers handled through the facility, requires more than 40 daily trains in each direction between Lat Krabang ICD and LC Port. All of the facilities described in Alternative 3 are recommended with the following additions (shown on Figure 41, Alternative 4 Expanded Lat Krabang ICD Track Layout on the following page):

- Enlargement of the storage yard to hold 450 cars.
- Additional storage for 50+ cars, typically used for empties during the midday.
- Additional tracks for inspecting trainset. Trains will likely be dispatched one after another to take advantage of openings in the main line schedule, and space should be provided to inspect the trains outside of the ICD proper.
- Enlarged engine facilities. With 16 trains in the ICD at any one time, with more in the storage yard, fueling and inspection tracks are recommended.

The same operations as described in Alternative 3 would occur with the expanded facility, just on a more frequent basis.

Figure 41
Alternative 4
Expanded Lat Krabang ICD Track Layout



It can be seen that the operation and investment level associated with the volume of containers discussed in Alternatives 3 and 4 would be significant, and would require considerable resources. It is also clear that each level of expansion of Lat Krabang ICD will require a corresponding level of investment in the rail infrastructure, if the throughput of the rail operation is to keep pace with the ground-based operation. Considering the amount of land required for this future rail infrastructure, and the increasing development of the Lat Krabang area for other purposes, finding the space for such rail improvements in that area will be difficult.

As the Lat Krabang ICD increases its annual rail throughput to the theoretical limit of approximately 1 million TEU/year, from a rail operations perspective it would appear more logical to develop the Ongkharak ICD than to expand the existing Lat Krabang ICD. While this issue is discussed more in the economical analysis, the reasons for this conclusion include the following:

- The Ongkharak area is more open and would place few restrictions on the rail-based facilities, which require significant space.
- Until the Ongkharak ICD is constructed, the transport of international containers between the new CTs and LC Port will be an inefficient operation for the SRT, involving moves through Lat Krabang ICD (rather than straight moves from Ongkharak to LC Port). The ICD at Ongkharak will reduce the overall mileage to the port for these containers, and provide a more competitive situation versus the truckers.
- Since a CT has been recommended to be completed at Ongkharak by 2001, the construction of a start-up ICD at this location in the same time-frame would make this area a complete facility for handling domestic and international containers.
- With a more efficient track layout at Ongkharak, that facility can handle a larger percentage of the containers by rail than Lat Krabang ICD, increasing the SRT revenue.

As a final point of clarification, the track layout recommended in Alternative 4, for inside the ICD facility, became the basis for the cost estimates of the expanded Lat Krabang ICD, which were developed in the previous section of this report. Those costs for the expanded facility did not include the costs for construction of any track improvements outside the facility (e.g., the storage yard), since it was not clear if or when the SRT would proceed with those improvements.

Rough cost estimates for the improvements suggested in this section were developed, however, to provide a point of reference for the SRT. Using the unit costs from JWD's estimates, the following are the cost estimates for developing the track layouts in each alternative:

- | | |
|-----------------|--------------------|
| • Alternative 1 | 0 |
| • Alternative 2 | 69.9 million Baht |
| • Alternative 3 | 129.1 million Baht |
| • Alternative 4 | 207.9 million Baht |

d. Operating Speeds and issues.

The current maximum operating speed of cargo trains on the SRT is currently limited to 70 kph, while in comparison, COFC trains are regularly operated at 115 kph in the U.S.. Through a detailed evaluation of equipment capabilities, consideration should be given to route alignment and curve superelevation changes to increase the maximum allowable speed for the proposed COFC service, to a speed equivalent to that of passenger trains. Purchases of new rolling stock and motive power should be limited to equipment which can sustain operation at these higher speeds.

Existing locomotives suitable for COFC service, as detailed in a previous table, are currently suited for operation at speeds in excess of 70 kph. However, the individual performance characteristics of any particular class of locomotive currently operated by the SRT, such as acceleration rates, fuel consumption, and braking rates, were not known to the PB team. Therefore, it was not possible to predict the abilities of these locomotives to suitably operate in

COFC service at speeds in excess of 70 kph, without detailed computer simulations or actual on-track testing.

e. Operating Philosophy

i. Priority of Operations

The future operation of COFC service, beyond the existing service to Lat Krabang ICD, will involve a shift in operating philosophy from the existing SRT operation. This shift will be necessary in order to achieve the goals of reliability and cost competitiveness, and the following issues should be considered as part of this new philosophy:

- Intermodal COFC service should be operated as a premium service on fast schedules with little or no room for error, in order to be competitive with trucks.
- The schedule of COFC trains should be afforded the same priority as first class passenger trains with respect to movement superiority, while conventional mixed cargo or unit trains would be of a lower priority.
- The service should permit delivery of a customer's shipment within the same or shorter time frame afforded by direct truck transport.
- The schedules should provide "seamless" overnight service from the shipper to the receiver.
- The inherent advantages of truck transport, that is, personalized door to door service, flexibility to conform to the customers schedules, low theft or damage rates, high levels of reliability, and face to face customer relations, should be provided by the railroad in order to attract the high value, time sensitive shipments that are suited to movement via containerization.

ii. Rolling Stock Reliability

To achieve the goal of capturing and retaining traffic currently handled by truck, equipment utilized for COFC service must have high operating reliability and be maintained in first class condition at all times to assure reliable on-time service. To accomplish this, a rigid program of preventative equipment maintenance should be developed and strictly adhered to. In addition, a certain redundancy in the assigned equipment roster should be maintained in order to protect adherence to published schedules in the event of an equipment failure.

f. Customer Interface

High-value, high-tariff goods, which are well suited to intermodal container transport, command different handling procedures from bulk or carload commodities currently carried by the SRT. These handling procedures include not only the handling of the cargo, but other services to the customer as well. The SRT should consider the establishment of a dedicated Customer Service Department within the SRT, and the following services should be implemented in order to serve the SRT intermodal customers:

- A trained and well-informed sales force
- Real time information on shipments. Information on shipment status should be readily available to the sales representatives as well as staff members at the Customer Service Office. To achieve this, consideration should be given to the use of Electronic Data Interchange (EDI) with larger customers, and use of facsimile equipment for dissemination or receipt of order, waybilling, and delivery information.

This goal may require expanded use of electronic data processing (DP) by the SRT. The DP system should link the Customer Service Office with the individual CTs, customers, and sales staff. In this way up-to-the-minute shipment status information will be maintained on a real time basis. In the longer term, consideration should be given to equipping sales staff personnel with modem-equipped notebook computers which would be, via a cellular telephone link, able to access the information maintained in the DP system.

- A strict set of policies and procedures for the intermodal service. These should be drafted and followed as part of the operation of the proposed service, and should include: a

program of regularly scheduled sales calls to new, and ultimately, repeat customers; regular sales staff meetings which include representatives of SRT's Police, Mechanical and Traffic departments, in order to discuss strategies and review performance; development of problem resolution procedures and remedial measures for customers' issues; establishment and maintenance of theft and damage control measures; and establishment of guidelines for day-to-day procedures regarding dissemination of waybilling and status information to the customer.

- A "toll free" or special telephone number to provide the most convenient and efficient method for customer input. This number can be established for customers to place orders, obtain information on the status of shipments or, if needed, file damage claims. Creation of a "One Stop Shop" for the transportation customer will aid in the establishment of good customer relations, and help reinforce a positive opinion of rail transport in the customer's mind.

g. SRT Internal Incentives/Quality Control

Incentives need to be implemented within the SRT organization, and possibly in its contracts with terminal operators, that will focus employees on the new intermodal services and motivate them to achieve high quality standards.

For instance, establishing an internal incentive/disincentive program with each of the SRT operating departments is one option. In other organizations, this has meant the establishment of internal contracts with the operators of the COFC service, contracts which provide for penalty payments in the event of damaged or delayed shipments. Conversely, consistent on-time damage-free performance is awarded under these contracts with bonus payments. An acceptable service level would be detailed in the contract, as well as the structure for bonus or penalty payments. In addition, individual recognition for those involved in the actual performance of the service in the form of awards, monetary payments, or other gratuities, are utilized in order to build awareness among the rank and file involved in the operation of the trains.

An added incentive to the SRT customer, in order to improve the attractiveness of the proposed COFC service, could be service guarantees in the form of penalty payments or discounts by the Customer Service Department, or third party concession operator, in the event of delays or service failure. These were discussed in the MDP from Chapter 1.

h. Train Crew Changes

By virtue of the fact that the proposed SRT intermodal service is a concept unlike most current SRT freight operations, the opportunity exists to achieve modifications to existing labor agreements and work rules currently in place, with resulting economies in operating costs. As an example, train crew sizes may be reduced from the current four man norm. Negotiations with organized labor, with respect to work rule changes, should stress the benefits to both labor and the SRT of attracting new business away from trucking companies, since additional freight traffic moving via rail will ultimately result in additional jobs created at the SRT.

One of the most significant changes the SRT could undertake would be the unification of operating practices, crew districts, and labor agreements to permit a uniform 8-hour, maximum 12-hour, workday for train crew members of both the Mechanical and Traffic Departments. This will result in improved efficiency of operations, since the entire crew can remain on the train for the same length of time and distance. Economies of operation and improved manpower utilization will ultimately reduce operating costs while maintaining operational safety.

i. New Technology

There are many examples where the use of new technology could assist the SRT in providing more reliable service and reducing operating costs. Some examples are:

- End of Train (EOT) devices. A Brake Van (caboose) is currently utilized on all freight movements on the SRT and serves as the accommodations for the Traffic Department personnel. Due to the unique nature of the proposed intermodal service, blocks of cars are handled between terminals, minimizing the need for time intensive switching operations.

Since complex switching operations at intermediate points are eliminated, EOT telemetry devices could be used to eliminate the brake van or reduce the train crew size. These devices monitor train brake line pressure and transmit this data via radio signals to the locomotive crew. In this manner the locomotive crew is alerted to anomalies, such as loss of brake pressure, parting of the consist, or derailments.

These EOT devices have been employed in the United States in excess of 20 years with great success, and have permitted the safe operation of freight trains, in some applications with only one crewman, the locomotive engineer. In most other applications, two crewmen (engineman and conductor) are stationed in the locomotive and safely operate the train for long distances. It should be stressed that eliminating the Brake Van will simplify the switching moves at the CTs and save considerable time in building the trains.

- Automatic Equipment Identification (AEI) system. These systems may be considered in an effort to further automate tracking of railcar movements. Such a system employs "transponder" tags affixed to the sides of each railcar. Radio transceivers are located adjacent to the track at entrances and exits of the container terminals or inland container depots, and are integrated into the data processing (DP) system used for car accounting, waybilling, etc. As the railcars pass by the transceivers, the car number of each railcar in the consist is reported to the DP system and an accurate real time record of car movement is established. Collection of container assignment information, i.e., which containers are on which railcar, may be accomplished with hand-held data collectors, which then may have the information downloaded into the DP system
- Electronic Data Interchange (EDI) equipment and waybilling systems. Some of the global firms interviewed by the PB team in Thailand were beginning to implement these systems, which significantly increase the reliability and speed of transferring and tracking containers. It is understood that the Customs Department and the Port Authority of Thailand, among other departments, have formed a working committee aimed at starting the implementation of EDI at LC Port. It is recommended that the SRT become part of that team, and possibly implement a pilot program for EDI with some of its major customers.

Equipment requirements for implementation of EDI, including container equipment tracking and accounting systems, can vary widely depending on complexity. At a minimum, a central computer system for maintenance of car movements, waybilling records, customer order information, billing details, etc. should be located at the Customer Service Office. The system could be linked via modem and telephone line, fiber optic link, or microwave relay system to each remote CT or ICD, for transfer of equipment inventory and tracking information, as well as for timely receipt and transmission of shipping-order information. In addition, large volume customers as well as sales representatives should be afforded the ability to access the system either through dialup capabilities or dedicated data links.

EDI system hardware requirements can vary widely depending on complexity. For example, integration of Automatic Equipment Identification (AEI) system will require additional hardware and additional sophistication beyond a basic data terminal network. Further sophistication can be added through use of Global Positioning System (GPS) receivers on locomotives. The position of the locomotive can be transmitted at regular intervals to the DP system via a data "burst" over existing train radio equipment. In this manner the Customer Service Office can monitor actual movement of shipments, and take remedial action should an operational anomaly pose a risk to schedule integrity.

- Specialty containers. Various types of intermodal shipping containers are available for specialty service, in addition to the common 20 ft. (6.09m) and 40 ft.(12.2m) dry or refrigerated containers found in oceangoing service. These include open top containers suitable for dry bulk materials such as coal, coke, construction aggregates, scrap metal or agricultural products not adversely affected by weather. Several photos of such equipment are shown below.

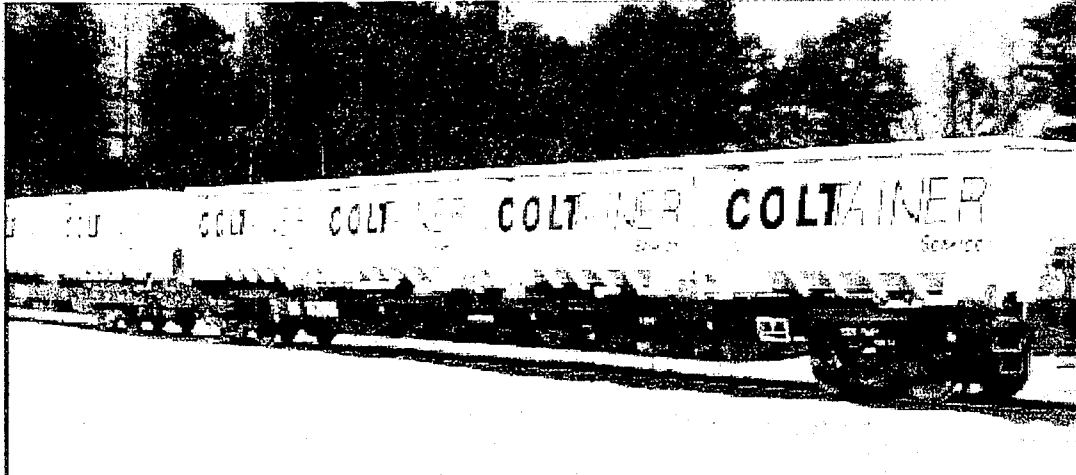


Photo 10
"COLTAINER®" Dry Bulk Container

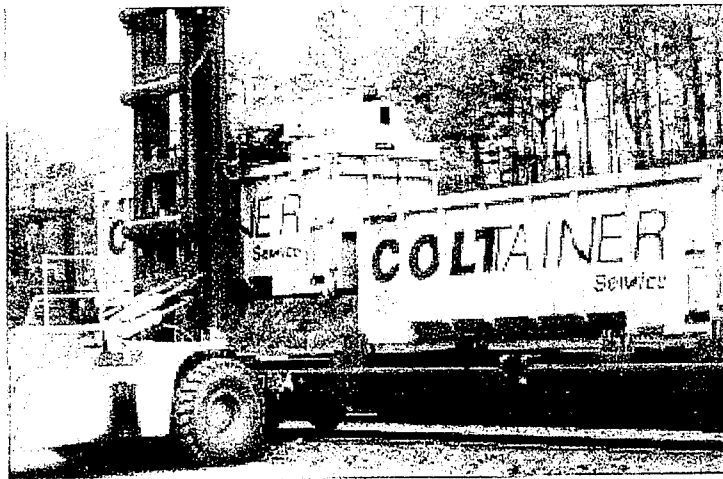


Photo 11
Dry Bulk Container Loading

In addition, fully enclosed containers for shipping packaged, bulk dry or bulk flowable commodities are available and are well suited for diverse cargoes from foodstuffs to hazardous waste. Several examples of these containers are illustrated below.

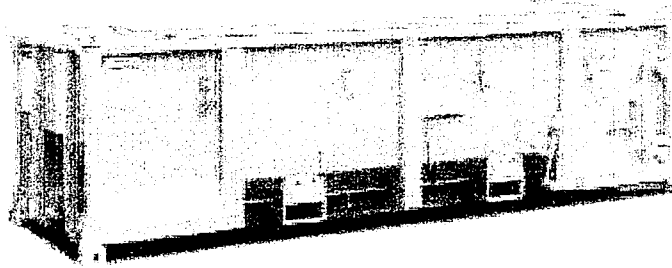


Photo 12
Sealed Covered Top Container

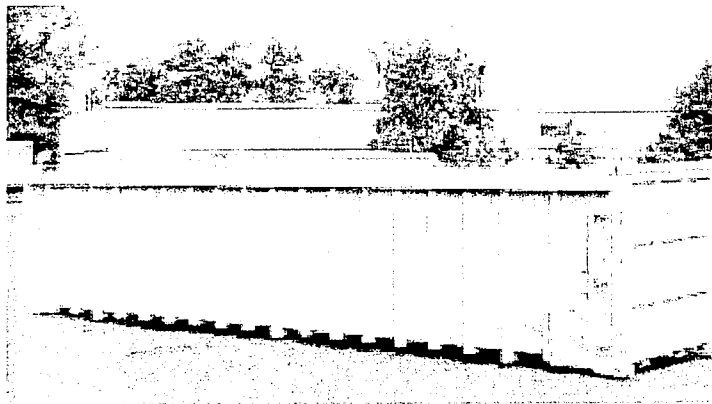


Photo 13
Sealed Covered Container for Municipal Solid Waste

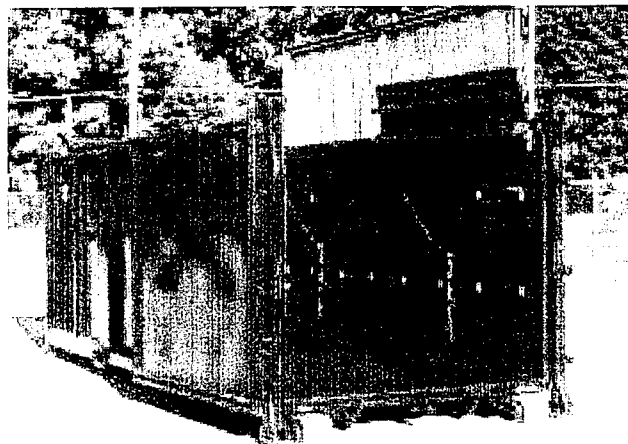


Photo 14
Sealed Covered Container for Shipping of Drums

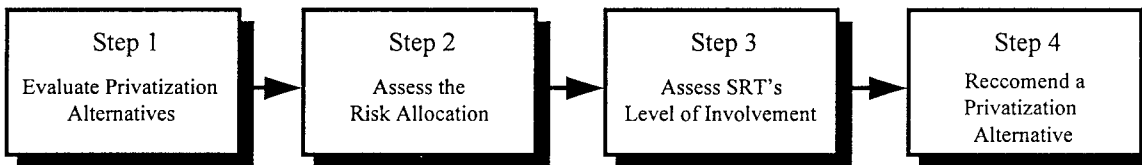
Ownership and maintenance of intermodal containers may be handled in one or more of several ways. Containers may be purchased and maintained by the SRT, leased and maintained by the SRT, owned and maintained by a third party such as a leasing company or concession operator of the COFC service, or owned and maintained by the shipper(s) and used in captive service in

much the same fashion as privately owned railcars. The most desirable and least costly option entails ownership and maintenance by a third party concession operator or the shipper.

E. PRIVATIZATION ALTERNATIVES SUMMARY

In this section, privatization alternatives open to the SRT are proposed and evaluated. Actual recommendations for the privatization of SRT terminals are discussed in the Economic and Financial Analysis. To begin with, the functions of ICD and CT operations are illustrated in order to determine which functions are more conducive to being privatized. These functions are categorized into three general areas: (1) planning and management, (2) operations and (3) ancillary services. Next, privatization alternatives are proposed, and for each alternative an assessment of the basic governance structure is undertaken, as well as a discussion of financial responsibilities and risk allocation. This discussion includes similar past privatization experiences. Finally, an alternative is recommended and compared to the fully public operation.

In order to accomplish this, a four step process was undertaken. The methodology was based on research in specific topic areas, interviews and peer analysis. The following steps are outlined in the following flowchart.



The first step is perhaps the most cumbersome part of the process since several privatization alternatives are assessed, including: five general approaches, an example of a U.S. inland container facility, and SRT's Lat Krabang ICD. A review of similar privatization efforts highlights significant aspects of the operating structures as well. Steps 2 and 3 address each alternative further by assessing the risk allocation and the SRT's continuous level of involvement. Finally, Step 4 is covered in the Economic and Financial Analysis, and it offers a privatization recommendation based on the criteria evaluated in this chapter, as well as the financial expectations which are evaluated separately.

1. Evaluation of Privatization Alternatives

a. ICD Functions

The functions an ICD will perform is one of the key drivers for deciding which privatization alternative fits best. Other drivers such as Thai government policy and institutional barriers will be discussed later in this chapter. By identifying the inherent characteristics of each function – and how each is best performed – the appropriateness of each privatization alternative can be evaluated. For example, a short-term service contract, which would be executed by a firm with near-term operating goals, would not be appropriate to cover the responsibilities of developing long term infrastructure. There are eight basic functions that a container terminal operator can perform:

Table 42
ICD Functions

Category	ICD and CT Functions
Planning & Management	• Terminal/Contract Management • Infrastructure Development
Operations	• Container Handling • Container Stuffing & Stripping • Maintenance • Warehousing
Ancillary Services	• Freight Forwarding • Logistics Management

Source: BA&H Analysis

Both ICDs and CTs perform the same functions, however, they differ in terms of their scale and scope of operation. ICDs are more closely integrated with port activities than CTs, and they are located closer to Bangkok where the larger volumes allow a greater scale of operations. The majority of ICD cargo activities are imports and exports with the facility functioning as an inland port. CTs, located away from Bangkok in regional population and manufacturing centers, support cargo activities which are both international and domestic.

The nature of an ICD operation is considered an industrial activity, where infrastructure can be both expensive and resources scarce. This type of an industrial environment, therefore, can create a natural monopoly whereby effective barriers to entry can prevent companies from competing. Such barriers are fostered by large investments and the rights to access a major distribution network. In order to develop a recommendation for a privatization alternative it is important to assess this operating environment. Moreover, it is imperative to assess how each ICD or CT function fits into the overall operation.

Each of the functions is essentially long term infrastructure development, or short term operations oriented.

- Long-term functions include the ownership of property, buildings, and rail infrastructure. Long-term functions necessarily require contractual obligations that are longer in duration, allowing time for return on investment. Short term functions include the operation of equipment and the ownership of disposable assets, and do not require long contractual obligation. Private firms may avoid ownership of items such as rail infrastructure and property if the long-term investment is not viewed as favorable. These items can also be more difficult to privatize if private firms are not convinced they have the time to realize a financial return, or if they feel exposed to expropriation or confiscation.
- Short term functions, however, can more easily be privatized due to the attractiveness of immediate profitability for the private firm. Moreover, privatizing variable functions are attractive for governments because of the opportunity to achieve operational efficiencies.

Operational efficiencies are not the only driver for privatization, however. SRT will be able to alleviate many of the institutional barriers, which are typical in government operations, by shifting responsibilities to private companies. These institutional barriers can stem from government agencies competing for oversight of government services, or the reluctance to give up the responsibility of governmental oversight. Consequently, attention is turned to bureaucratic entanglements rather than customer service. Removing such institutional barriers enables a private firm to focus on operating efficiently. Separating the regulatory authority from the operations also creates an institutional framework whereby government policy and operational performance are clearly defined. This is accomplished, once again, by focusing on the goal to provide customer service.

The attributes governments typically seek from private sector firms are as follows:

- **Dynamic Efficiency:** The motivation to maintain equipment and embrace the latest technology
- **Accountability to Customers:** The motivation to adapt operations to changing markets, in order to achieve better service quality and customer satisfaction
- **Financial Autonomy:** The reduction of a government's financial burden for operating or capital expenditures and debt servicing¹
- **Productive Efficiency:** Lower unit production costs
- **Managerial Skill:** Rapid and flexible decision-making due to performance based incentives

Each of the ICD functions identified above benefits from at least one form of the private sector efficiencies. While each of the functions is not limited to any one form, some functions enjoy efficiencies more than others, which results in tangential benefits to SRT such as a better return on investment (ROI). Procuring the latest technology and lowering unit costs increases the utilization of SRT's investments.

Since ICD functions have different operating parameters defined by their unique operating characteristics, private sector benefits vary with each ICD function. These benefits are outlined in Table 43. It should be noted that all types of ICD functions enjoy every operational efficiency in one form or another. The checks in this table only indicate the major operational efficiencies of privatization.

Table 43
Illustration of Major Benefits Resulting From Privatization of ICD Functions

ICD Function	Dynamic Efficiency	Accountability to Customers	Financial Autonomy	Productive Efficiency	Managerial Skill
Planning & Management:					
Terminal Contract Management		X			X
Infrastructure Development	X	X	X	X	X
Routine Operations:					
Cargo Handling		X		X	X
Container stuffing and stripping		X		X	X
Maintenance	X	X		X	X
Warehousing		X		X	X
Ancillary Services:					
Freight Forwarding		X		X	X
Logistics Management	X	X			X

Source: BA&H Analysis

Table 43 shows that accountability to customers, and managerial skill, impact most ICD functions if privatization were to occur. (Customers in this case are shippers and receivers.) These two operational efficiencies, compounded with the removal of institutional barriers, will have perhaps the greatest impact on the performance of the ICDs. Past experience demonstrates that governments are not as flexible to customers to the extent that private firms are. Moreover, a

¹ Kessides, Christine, "Institutional Options for Provision of Infrastructure" World Bank Discussion Papers, Washington, DC, 1993.

private contractor or concessionaire will demonstrate the ability to provide services that require specialized skills and experience which may not have been traditionally provided by SRT.

b. Review of Privatization Alternatives

Five privatization alternatives have been identified as potential models:

- Service contracting
- Management contracting
- Leasing
- Build Operate and Transfer (BOT)
- Asset sale

Throughout this section several samples of similar privatization experiences are reviewed. Privatization of government services has been a trend in Thailand during the past decade, but Thailand has had mixed results from these privatization efforts. In projects where the services traditionally performed by the state were privatized using less complex arrangements, the success rate was higher. Where arrangements with private firms became more complex, such as BOT contracts, the success rate was not as favorable.

For example, the Telephone Organization of Thailand (TOT) successfully awarded 30-year concession contracts for installation of equipment, and the Shinwarta Group was awarded a contract to operate Thailand's first satellite. Under both of these successful examples, the private firms were under the jurisdiction of a state agency. As another example, in the case of Bangkok Expressway Company, the government had a conflict over the BOT concession. Consequently, the private firm was forced to open the toll road without an agreement on collections. In a similar conflict over the BOT arrangement on the Don Muang Tollway, the private firm decided to sell its equity in the project to the government and pull out of the project all together.²

Past experiences indicate that careful planning of privatization efforts has led to a higher success rate. Each of the examples focuses on the structure of the arrangement and, in some cases, any lessons learned. Each case is related to Thailand's ICDs in that they are either transportation-oriented, Thailand-oriented or intermodal-oriented.

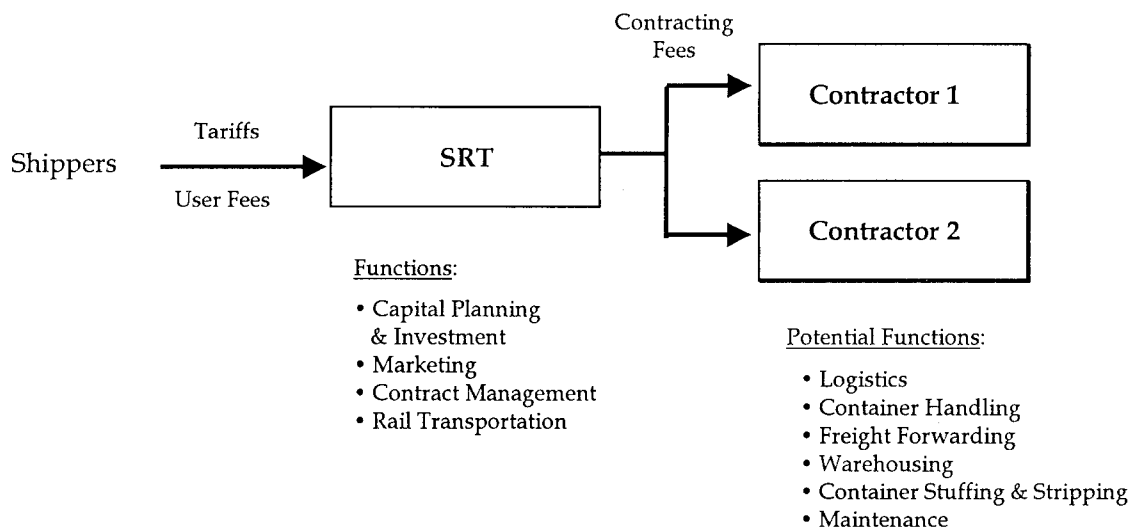
A basic description of the operating mechanics for privatization alternatives are described in the following paragraphs. Following these descriptions there is a comparison of the financial obligations and risk allocations of the alternatives.

i. Service Contracting

In a service contract, a private firm agrees to perform an operating or maintenance function for a fixed period of time and for a pre-determined fee, regardless of the operating activities. In the case of the ICDs, functions performed by individual private operators could include: cargo handling, maintaining equipment (gantry cranes, forklifts, trucks, buildings, etc.), and stuffing and stripping containers. This type of arrangement is shown in Figure 42, Illustration of Service Contracting Structure With SRT.

² Investing, Licensing & Trading in Thailand, The Economist Intelligence Unit, New York, NY, 1997, pg. 8.

Figure 42
Illustration of Service Contracting Structure With SRT



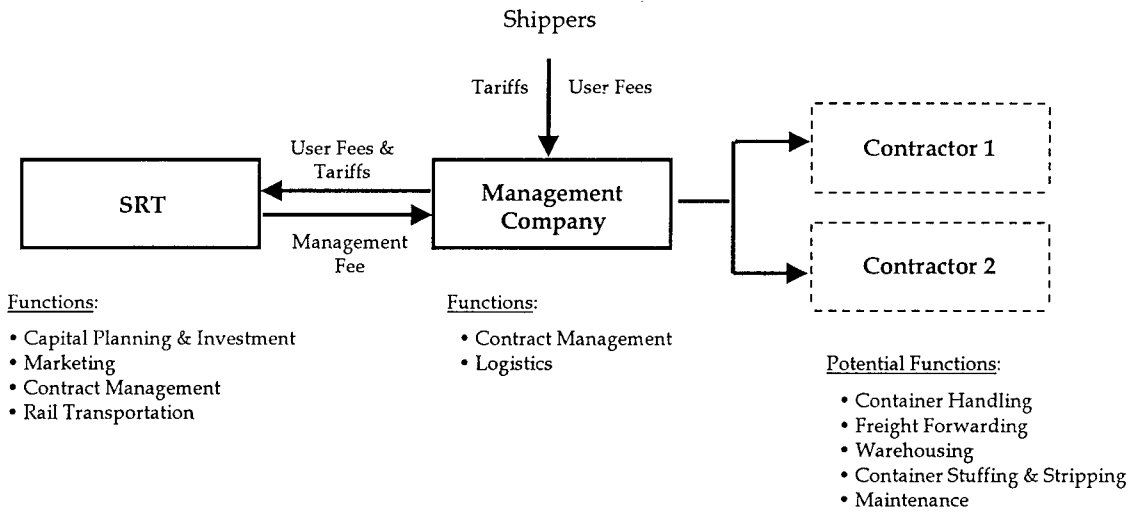
Under this arrangement, the public authority would be financially obligated to provide fixed compensation for services rendered, regardless of operating activity. SRT would retain the overall responsibility for the operation and maintenance of the ICD, while one or more private contractors would perform a limited scope of service. Typically, service contracts are not unit-based, although some terminal operators have structured charges on a per unit basis if they perform several of the terminal functions.

In comparison to other alternatives, service contracts typically require more oversight by the public authority. Where responsibilities lie in maintaining assets or providing service, the risk of non-performance can be minimized by utilizing performance-based mechanisms in the contracts. Service contracts are typically attractive to the public authority because competition is usually high, ensuring services can be obtained at reasonable prices.

ii. Management Contracting

In management contracts, a private operator typically assumes the responsibility of a wide range of operation and maintenance functions, or perhaps all ICD functions. Compensation is often in the form of a management fee which can either be fixed or based on a unit of activity. Where the management contractor's compensation is based on an activity level, this implies a moderate level of financial risk. A fixed fee would imply no financial risk to the management contractor. See Figure 43, Illustration of Management Contracting Structure with SRT.

Figure 43
Illustration of Management Contracting Structure With SRT



* Dotted boxes indicate there is no contractual arrangement with SRT

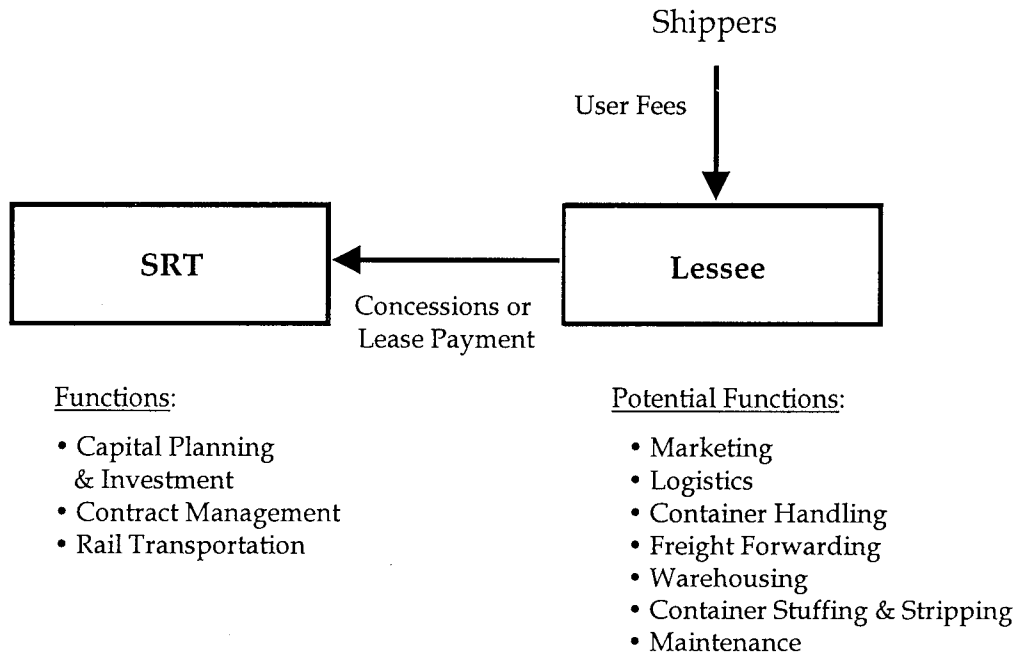
In the case of ICDs, SRT would own the capital-intensive assets of the facility (i.e., cranes and buildings), and the management contractor would be responsible for providing ICD services. The management contractor would sub-contract the various functions to other private entities. For the government agency, an advantage of management contracts is that they require far less staff time, and the third party acts as a single point of contract. However, the disadvantage to this alternative is that private firms have large responsibilities but short term contracts. Furthermore, adding an additional party between SRT and the service contractors creates additional costs to SRT and, potentially, to the customers.

iii. Leasing

In a lease arrangement, a private party contracts with a public authority for the right to operate a facility for a specified period of time. This type of contract reflects a franchise or license agreement. Unlike a BOT contractor, a lessee is not responsible for investments in fixed assets.

SRT would own the major assets, be responsible for capital expenditures, debt service, tariffs and cost recovery. The lessee would purchase the disposable assets such as vehicles and inventory. The financial risk for the operations and maintenance of the facility is borne by the lessee. At the end of the contract, the assets would revert back to the SRT. Figure 44, Illustration of Leasing Structure With SRT shows this arrangement.

Figure 44
Illustration of Leasing Structure With SRT



Leasing arrangements can take many forms. For example, the lessee of an intermodal facility, typically an intermodal carrier, would take overall responsibility for the services, operation, maintenance, and management of capital assets. The public authority, however, remains the owner of the assets. Unlike management contracts, lease contracts are long-term arrangements. In some contract structures, commercial risks can be shared between SRT and the lessee.

In an example of leasing, during the early 1990s Ferrocarriles Argentinos (FA), the Argentine state owned railway, began to privatize six major lines. A 30-year concession contract with a 10 year option was open for private operators to bid on. Under this concession-based contract, all cargo operations were to be performed by a private sector firm including freight train marketing, operations, rolling stock maintenance, and investment. The concessionaire would have the right to the FA track, unless it gave operating consent to others. The concessionaires were to hire only FA employees from the outset, but only those required for operational needs. The concessionaires negotiated directly with the unions while the government stepped aside, except for safety issues. Freight rates were essentially deregulated, however, concessionaires were required to file their highest rate with the government.

Since the concession operations went into effect, the FA has gone from \$600 million in losses per year to \$150 million in losses per year. Lessons learned from the private operators are that accurate financial and traffic projections are crucial to a profitable operation. These risks can be mitigated by undertaking prudent due diligence. The government recognizes risks such as default on concessions, service deterioration or discontinuance.

Additionally, the FA began to appreciate the complexity of concession contracts. While the FA attempted to develop perfect evaluation criteria and methodology, it realized that the price of administering and executing such a process put the project at risk due to delays. In other words, the bidders can be confused by such a complex bidding process and will, therefore, lose focus of the real intent of the evaluation criteria. Evaluation that focuses on a pre-qualification process and a single financial outcome has proven to be faster and more reliable.

A facility can have a single or multiple lessees, and the decision to have multiple lessees depends on a number of factors. In order to sustain multiple lessees at a facility, there must be sufficient business to support the operations, and in addition, the physical facility must be large

enough to allow multiple lessees to efficiently operate. In the case of SRT, some ICDs could support multiple lessees, however, smaller CT operations will likely only support a single lessee. Having multiple lessees promotes price competition between lessees, encourages customer service and adds marketing capacity. Multiple lessees at the ICDs also creates an environment where smaller, more flexible firms can operate a facility. As firms compete for the right to operate a facility, customer satisfaction becomes a priority as well as operational efficiency. Consequently, the multiple lessee environment encourages ROI at the benefit of SRT.

There can, however, be some drawbacks to multiple lease arrangements. Multiple operators may not be advantageous to SRT because of the potential increase in costs due to redundant services, equipment and staff. Furthermore, SRT may have to intervene if there are disputes between lessees.

iv. BOT (Build, Operate, and Transfer)

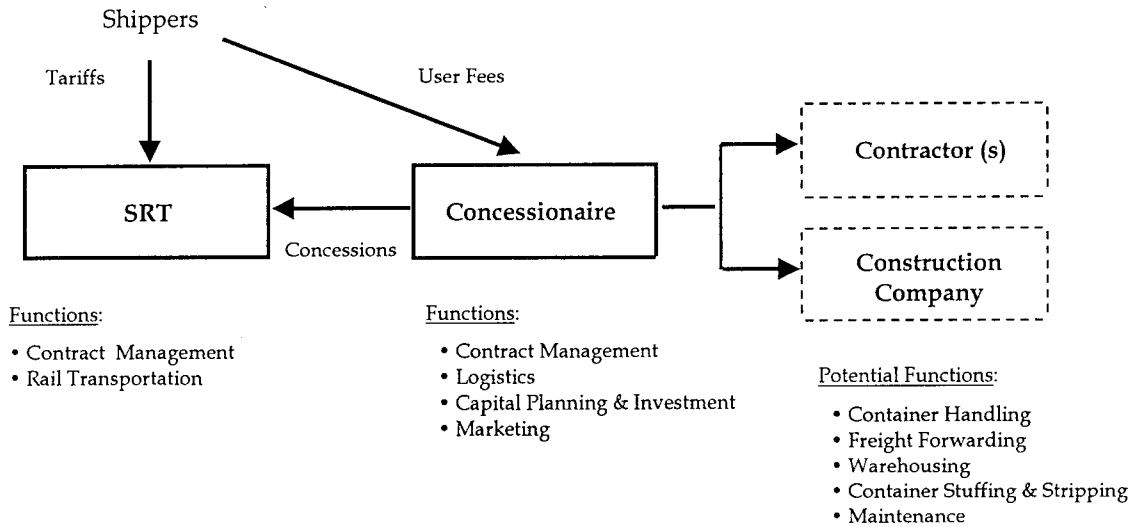
BOTs are concession-based privatization efforts commonly referred to as greenfield projects. Under a BOT approach, one or more private firms are authorized to build public works. In this case, ICD facilities would obviously be the focus of the project. Interested firms typically include large international engineering and construction firms as well as equipment suppliers. The firm or project company owns and operates the facility for a period of time, and the income stream from user fees and/or grants from the government during the duration of the contract is expected to service the private firms debt in the project. At the end of this period, the project company transfers ownership of the project to the host government.

In an example from Thailand, the construction of Bangkok's metro system is scheduled to be privatized by 1998, and the public authority administering the concession is the Bangkok Transit System. The basis of the construction contract was a BOT agreement whereby a consortium of companies led by an international engineering firm undertook the first phases of the project. Key factors that led to the successful bid were the level of technology, the operating systems, and the financial structure. A group of Thai companies also participated in the consortium.

The Thai government's participation included a 25 percent stake in the equity of the project. Private investors provided a majority of the equity and the concessionaire took a minor stake, with no agreed minimum compensation requirements. The concessionaire can only charge as much as the authorized fare, which is based on the consumer price index and various other factors such as exchange rate variations, interest rates on concessionaire's debt, the cost of inputs, exceptional risks, and major investments the company makes besides those listed in the agreement.

Variations of BOT also exist, such as the BOOT (Build, Own, Operate, and Transfer) approach or BOO (Build, Own and Operate). Each variation depends on the policy or goals of the host government. Furthermore, each approach also allocates project risk in different ways. The major disadvantage to the BOT alternative is that both the contracts and pricing mechanism are usually complex. Consequently, problems often arise if there are differences between real and estimated demand. Figure 45, Illustration of BOT Structure With SRT illustrates the BOT concept.

Figure 45
Illustration of BOT Structure With SRT



* Dotted boxes indicate there is no contractual arrangement with SRT

In another BOT example, an Indian privatization effort was undertaken recently, involving the construction and operation an intermodal port. The Jawaharal Nehu Port Trust contracted with a consortium led by Peninsular & Oriental Steam Navigation (P&O) to Build, Operate and Transfer (BOT) the port facilities. The partnership included several companies based in the host country, while P&O holds 49% of the equity. This privatization effort was instigated because capacity had been overstrained and private investors were willing to expand the facilities. This 30 year effort is expected to double the throughput of the facility from 500,000 TEU/year to 1,000,000 TEU/year. This concession-based contract has a minimum guarantee of 550,000 TEU/year in the first year and 600,000 thereafter. The contract also makes available nearby property for the development of ICDs. The P&O led consortium will provide virtually all terminal operation services while the Port Trust will provide warehousing services.

Financing BOT projects primarily comes from commercial lenders, and the private firms involved in the project often become equity partners. Depending on the arrangement, the private interest equity is often given up at the end of the project. Host governments often become a minority equity partner as well.

v. Asset Sale

This form of privatization can come in two forms: direct sale or divestiture. Direct sale of assets refers to a government selling ownership of assets or infrastructure to a private entity. Under this arrangement the private entity is often regulated. In the case of government divestiture, there is typically no regulation of the assets remaining after the sale. After divestiture, the government generally has no role concerning financial support, management regulation, or oversight. This arrangement is often used when an organization controls a natural or non-natural monopoly.

The privatization alternative may well differ on a case-by-case basis depending upon the attributes of the individual ICD. A smaller ICD, which might not have as many functions as a larger operation, would require a less complex contractual arrangement, such as a service contract. A larger, underdeveloped ICD, on the other hand, would require a more sophisticated contractual mechanism such as a BOT arrangement. Further, the size and functions of an ICD may influence the level of interest by private firms, and consequently the privatization alternatives.

Joint ventures are a common approach to privatizing public services. Each of the privatization alternatives discussed can be undertaken with a joint venture party. In joint venture arrangements, two or more firms own or operate a public asset or perform a public service. Joint ventures in the context of privatization often include a firm that is based in the host country.

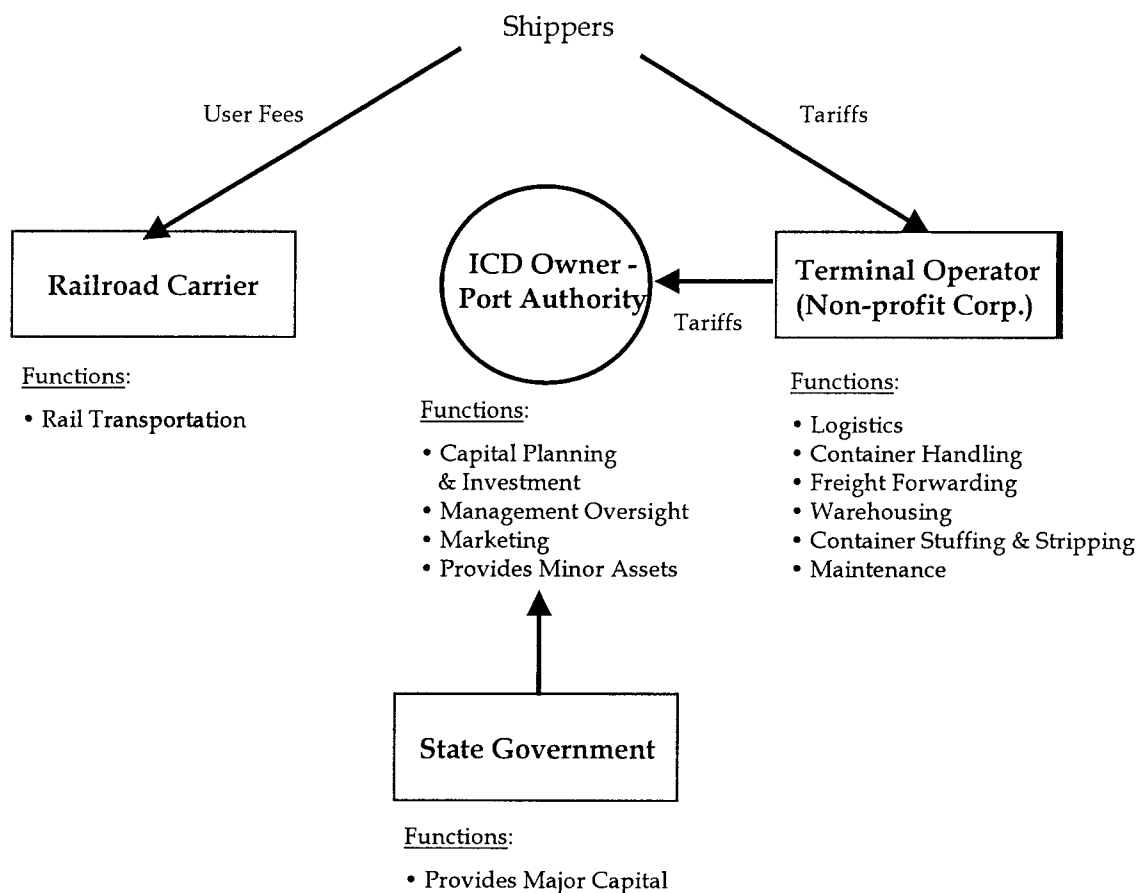
Under this scenario, synergy is created through technology transfers from the multinational firm or through local knowledge of operations or cultural traits. Joint ventures can also contribute to capital investments and participate in any of the alternatives for privatization previously cited.

In North America, the world's most developed intermodal market, there is no typical intermodal terminal operating arrangement. Interviews with several intermodal operators and intermodal rail terminal operators indicate that most facility arrangements depend on the location and regional characteristics of the operation. Furthermore, those intermodal carriers who are involved in terminal operations abroad also indicate that each arrangement varies by location. According to several intermodal operators, the factors which determine the operating arrangements include:

- Availability of property
- Existing proprietary arrangements (e.g. equipment leases, labor agreements), and
- Economies of scale (e.g. cooperation with other carriers).

One ICD operation in the United States, however, demonstrates how a successful arrangement might be structured. The arrangement, as shown in Figure 46, Illustration of Sample U.S. ICD Operating Structure, represents a public-private partnership. The goal of the operation is to service shippers and receivers of containers whose destination is a nearby port. The inland container facility in this case is a transshipment point near a metropolitan area. Trucking companies haul containers and general cargoes in and out of the facility. There are four primary parties that successfully run the operation. They are: (1) the port, (2) the operator, (3) the rail carrier, and (4) the state government.

Figure 46
Illustration of Sample U.S. ICD Operating Structure



The Port Authority (PA) owns the inland container facility, that is, the property and most minor assets. In addition, the PA is responsible for management oversight, marketing, and capital planning and investment. The State Government acts as the parent to the PA whereby it provides capital for major assets such as cranes and buildings. The operating arm of the terminal is a not-for-profit corporation responsible for the administration and operations of the facility. A not-for-profit corporation in this context is essentially a private firm that has a tax free status, and the firm sub-contracts some ancillary services. Finally, the private rail carrier provides rail services between the inland facility and the port.

Shippers pay two rates when using the services of the facility. First, the terminal operator collects tariffs from the shippers. These tariffs are on a per unit bases (*i.e.*, \$ per pound or \$ per ton) and are used for operations and maintenance of the facility. Second, the rail carrier collects a separate haulage fee from the shipper for providing rail transportation services. Under either arrangement, there are no minimum or fixed guarantees that the shippers or carriers have to pay.

In another example from India, Container Corp. of India (CONCOR) is a subsidiary of India's Ministry of Railways. This intermodal operator was formed in 1988 to meet the demands of containerization in India, by establishing and operating ICDs, CFSs, and portside container terminals. In 1994 the government divested 20% of the corporation's shares, leaving 80% of the corporation owned by the government. Since then CONCOR's throughput and revenues have been growing inexorably. Throughput has grown 200% from 155,000 TEUs in FY 1992 to a projected 450,000 TEUs in 1996. Revenues have grown 250% from 811 million Rupees in FY 1992 to a projected 2,880 million Rupees in 1996.

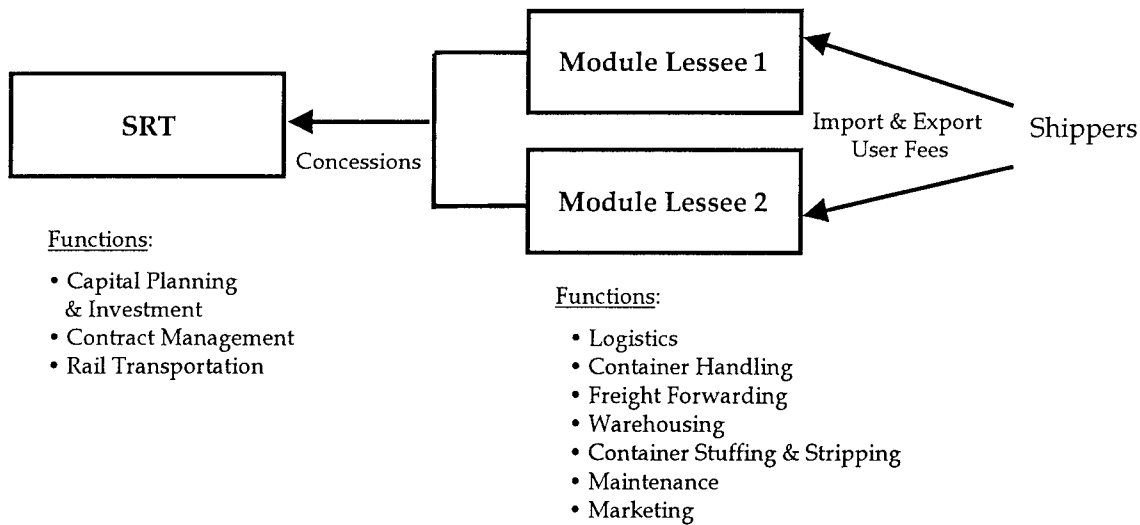
Part of the success of CONCOR is attributed to the common ownership between the various intermodal facilities (ports, ICDs, CFSs). The majority of CONCOR's customers are intermodal carriers and multi-national shippers, while a smaller portion of its customers are freight forwarders. Although this is an example of a partially privatized company, performance in terms of growth has improved since it was corporatized. CONCOR has attributed its success more to its focus on customer needs and flexibility than to its ownership.

vi. Lat Krabang ICD's Structure

Finally, it is worth reviewing the existing structure at Lat Krabang ICD which, as previously mentioned, is similar to a leasing arrangement described above. Lat Krabang ICD currently leases four modules to concessionaires: (1) Siam Shoreside Services Co., Ltd., (2) Eastern Sea Laem Chabang Terminal Co., Ltd. (ESCO), (3) Evergreen Container Terminal (Thailand) Ltd., (4) TIFFA ICD Co., Ltd., (5) Thai Hanjin Logistics Co., Ltd., and (6) NYK Distribution Service (Thailand) Co., Ltd.

Contractual arrangements require that that module lessees be responsible for the process of handling containers from the time they enter the ICD, to the time they are placed on the rail car. This requires the processing of imports and exports such as freight forwarding, customs processing and other necessary paper work. In addition, the lessees are responsible for stuffing, stripping and moving their containers onto the train. This process may require a moderate level of investment in cargo handling equipment by the lessees. The lessees are also responsible for maintenance of all equipment at the ICD facilities. Finally, the lessees are required to pay a monthly concession fee for 10 years. Figure 47, Lat Krabang's Operating Structure illustrates this concept.

Figure 47
Lat Krabang's Operating Structure



SRT is responsible for contract management and monitoring the performance of the lessees. This also includes settling any disputes arising between the ICD lessees. Furthermore, SRT is responsible for the ownership of all major fixed assets, and as part of this responsibility, SRT must provide capital planning and investment services. SRT is also responsible for the public relations activities associated with Lat Krabang ICD, and if there are any complaints from the public, SRT acts as the liaison between the ICD and the interested party.

Similarly, Klang Port in Malaysia was privatized through the use of lease arrangements. Three port operating companies presently lease space from the Klang Port Authority: (1) Kelang Container Terminals, (2) Kelang Port Management and (3) Klang Multi Terminal. The duration of leases range from 21 to 30 years, and in addition to its lease, Klang Multi Terminal also has a 33 year concession agreement to develop part of the port.

It has been generally agreed that the lease agreements were structured improperly from the outset in this Malaysian example. In the Kelang Container Terminal privatization agreement, the lease contract gave the company exclusive rights to provide container handling services at the Klang Port. This structure was flawed because the new tenants of Klang Port were allowed to develop their own facilities, thereby violating the exclusive rights of Kelang Container Terminal. The dispute was resolved by allowing Kelang Container Terminals to develop an additional container berth within the port.

Despite the difficulties of the contractual arrangements, the privatization efforts are considered a success. Since Port Klang was privatized, much of Malaysia's import and export cargo has shifted from foreign to domestic ports.³ Furthermore, throughput has increased from 603,000 TEUs in 1991 to 1,100,000 TEUs in 1995.⁴

In the Lat Krabang ICD concession contract, SRT is subject to commercial risks, although these are primarily borne by the operating firms. SRT is also subject to investment risks since SRT is the owner of all major fixed assets. If distribution channels change or if the market for containerized cargo diminishes, SRT may be responsible for any bond payments on any fixed assets. However, if a module lessee defaults on its concession payment, SRT has the right to confiscate or expropriate its assets. The following section compares the different risk allocations for each privatization alternative in further detail.

³ Edward, Ion, "Developing Nations Fight to Win Trade", November 18, 1998, Lloyd's List, London, England, pg. 6.

⁴ 1993 and 1997 Containerization International Yearbook

2. Risk Allocation

There are five general categories of risk. Where these risks are not born by SRT, they are mitigated between the private contractors. Contractual arrangements should be based on the allocation of risk, and the general principle is that each risk should be born by the party best able to mitigate it. These general categories of risk do not necessarily encompass the universe of risks involved in a project, but rather they are generic risks characterized by a typical transportation project. Risk categories are discussed in further detail below.

- **Commercial Risk.** Driven by market forces through either direct inputs such as traffic levels and distribution channels, or indirect inputs such as shifts in population or production centers. Commercial risks are shifted between parties by guaranteeing a certain level of activity for a period of time.
- **Operational Risk.** The capability of executing a process or task. This includes the technical and managerial capacity to meet the certain standards. Such standards are often performance-based, whereby unit measurements determine a particular "level of performance."
- **Investment Risk.** Contribution margin toward fixed costs. Capital investments are supported by a streamline of income that is intended to cover both variable and fixed costs. Investment risks are often mitigated by government financial guarantees. These risks can also derive from foreign exchange or interest rate changes.
- **Regulatory Risk.** Unforeseen change in the regulatory environment. The success of a project can often be threatened by public policy changes that affect either the viability of the project, or the capacity of a firm to generate revenues. Often such risks are instigated by, but not limited to, environmental or displacement issues. Changes in tariff formulas are often a result of other regulatory authorities actions as in the case of the Bangkok Second Expressway.
- **Third Party Risk.** Non-performance beyond normal operational competence. The stability of a project often depends on the products or services of other parties involved. Their absence can threaten the success of a project depending on the criticality of their inputs. Smaller firms tend to be more at risk of non-performance than larger firms because they have fewer resources. Furthermore, third parties have risks in other lines of business that can threaten their existence.

The allocation of these risks across the various types of privatization alternatives is presented in Table 44 below.

Table 44
Illustration of Risk Allocation To SRT

Privatization Alternatives	Commercial	Operational	Investment	Regulatory	Third Party
SRT Operated	●	●	●	●	None
Service Contracting	●	○	●	●	◐
Management Contracting	●	○	●	◐	●
Leasing	◐	○	◐	○	◐
BOT	○	○	○	○	○
Asset Sale	None	None	None	None	None

Source: BA&H Analysis

● = High ◐ = Moderate ○ = Low

As indicated in the table above, where SRT operates the facility, all risks fall under its auspices. On the other extreme, where SRT divests the assets all risks are born by the purchasing party. In service contracting, all but operational risks are born by SRT. This is due to the fact that service contractors are usually compensated based on a fixed fee and are not required to participate in the equity of the project. In addition, SRT is faced with third party risks, but not as much as management contracts. Management contracting is similar in scope, however there is more third party risks because of the additional level of contracting.

In a leasing arrangement, the operator assumes the larger commercial risks since its financial performance is often dependent upon the volumes of traffic. Lessees also have a moderate level of investment in the facilities and, therefore, lessen some of the investment risk for the SRT. Under a BOT arrangement, most of the risks of the project are born by the concessionaire.

Ideally, there should be a balance between the level of involvement and the allocation of risk. In the next section SRT's level of involvement versus the privatization alternative is assessed.

3. SRT's Level of Involvement

The allocation of risk is complemented by the level of involvement. As SRT assumes more risk, its level of involvement increases as well. For the most part, SRT's level of involvement will primarily be in contract management of the various functions. In order to effectively administer, contract management requires technically capable staff and managerial resources. The complexity and scope of the privatization effort will dictate SRT's level of involvement in contract management. In this capacity, there are two factors which determine SRT's level of involvement:

- Privatization alternative
- Public policy

The relationship between the privatization alternative and SRT's level of involvement is straightforward. As the responsibility for the number of functions increases per alternative, so does the necessary level of SRT's involvement. Table 45 shows how SRT's level of involvement depends on the privatization alternative.

Table 45
Illustration of SRT's Level of Involvement With ICDs Post Privatization

Privatization Alternatives	Infrastructure Development	Operations	Management	Marketing	Asset Ownership
SRT Operated	●	●	●	●	●
Service Contracting	●	○	●	●	◐
Management Contracting	◐	○	◐	○	◐
Leasing	◐	○	◐	◐	◐
BOT	○	○	○	◐	◐
Asset Sale	○	○	○	○	○

Source: BA&H Analysis

● = High Level of Involvement ◐ = Moderate Level of Involvement ○ = No Involvement

Public policy and SRT's long term goals will help direct which, if any, privatization alternative fits best. SRT operational involvement with the ICD and CTs depends on its policy and the privatization alternative. As seen in the table, SRT's involvement is highest for alternatives where SRT uses service contracts and, of course, where SRT operates the ICDs. SRT's involvement is

lowest in a BOT arrangement or if it simply sells the assets. Although the level of involvement is minimal for the latter privatization alternatives, they still require the administration of contract management.

i. Financial Obligations

The purpose of this section is to describe the type of fiscal transaction each privatization alternative commands. These financial obligations are not necessarily indicative of the privatization alternative, but are most appropriate given the nature of the contract. Financial obligations essentially fall into one of two categories: inflows and outflows. Each privatization alternative has a different medium for executing the financial transaction, as illustrated in Table 46.

Table 46
SRT's Revenue and Cost Alternatives

Privatization Alternative	Inflows	Outflows
SRT Operated	Tariffs	Direct Costs
Service Contracting	Tariffs	Investments & Fixed Payment
Management Contracting	Tariffs	Investments & Fixed or Variable Payments
Leasing	Concessions	Investments
BOT	Concessions	Special Arrangement
Asset Sale	Sale Proceeds	None

Source: BA&H Analysis

Generally there are four types of financial transactions that can be used in the privatization effort: (1) tariffs, (2) concessions, (3) investments, and (4) fixed fees. Tariffs are variable revenues by design, and can take many forms. For example, they can be cost-based, regulated, or set through a competitive bidding process. Concessions, however, offer the public authority a fixed source of income. Depending on the contractual arrangement, SRT can generate revenues or incur costs by one or more of the various financial structures.

- **Concessions.** Fixed payments over a period of time. Payments can be either be from concessionaires to the public authority or vice versa. This will depend on whether or not the project is deemed a profitable service.
- **Cost-based Tariffs.** Unit pricing based on the cost of inputs. Cost-based tariff formulas typically cover capital expenditures, operating and maintenance costs, and a reasonable rate of return. Cost-based tariffs become problematic when the rate of return is capped at certain level. Investors may be deterred from participating if the regulatory body has a history of changing tariff rates. Capital expenditures also become difficult to measure.
- **Competitive Bidding.** Unit pricing based on the lowest bid from competitors. High returns for firms are usually gained from increased operating efficiencies. This form of tariff is advantageous only if there are several bidders competing. Otherwise, a higher tariff may result from the process.
- **Regulated Tariffs.** Unit pricing fixed by a public authority. The selected concessionaire offers the highest bid for the rights or license to operate a facility and have the rights to the income generated. Most often used when the concessionaire interfaces directly with the customer.
- **Investments.** Bonds and financial guarantees used for capital expenditures.
- **Fixed Payments.** Fees for services rendered for a given period of time.

ii. Foreign Investing Rules and Regulations in Thailand

The Thai Government is responsible for monitoring foreign direct investments, and the Board of Investment (BOI) is the governing agency that develops and enforces investment policy and regulations. The BOI was established by the Investment Promotion Act in 1977 in order to

promote Foreign Investment in Thailand. During the first eight months of 1997, the BOI approved 642 projects valued at 342 billion Baht.⁵ The BOI has the authority to offer incentives such as tax and tariff exemptions, and guaranteed work permits for foreign nationals.

Key regulations in Thailand are that foreign companies are limited by are the 49% foreign ownership limitation, and in order to obtain a business permit, debt financing can exceed no more than seven times the combined shareholders' equity. Furthermore, foreign ownership of property in Thailand must be approved by the BOI or the Industrial Estates Authority of Thailand. Ownership of land is limited to the appropriate amount needed to perform an industrial activity. Moreover, there is a 30 year limit on leasing property.

⁵ Investing, Licensing & Trading in Thailand, The Economist Intelligence Unit, New York, NY, 1997, pg. 4.

IV. ECONOMIC AND FINANCIAL ANALYSIS

A. FINANCIAL ANALYSIS

1. Overview

In addition to operational and market-based feasibility evaluations, the PB team performed a rigorous financial feasibility analysis to determine the financial merits of the recommended ICD and CT sites. The financial feasibility analysis was designed to determine the attractiveness of each facility to a private, stand alone terminal developer, who may also assume a role as terminal operator. The outcome of the analysis was driven by several components:

- Revenue streams
- Operating costs
- Capital costs and associated financing
- Taxes

Each of these components is described in greater detail below, and then the results of the analysis are presented.

The financial analysis also helped determine the best privatization alternative for each proposed ICD/CT site. The importance of using financial analysis as a primary determinant in deciding the privatization structure cannot be overstated, since the financial analysis gives the best glimpse as to when, or even whether, the ICD and CTs will be attractive to investors. Privatization options and recommendations are addressed at the end of this chapter.

2. Analysis Methodology and Assumptions

a. Revenue Streams

To determine the revenue streams for each facility, the PB team developed facility-by-facility usage projections in TEU/year, and multiplied these volumes against an average terminal revenue per TEU.

In the Market Analysis, the container freight flows by region were developed. In addition, the port volumes were used to develop specific forecasts for the Bangkok area ICDs of Lat Krabang and Ongkharak.

To translate the regional forecasts into moves per proposed CT, the freight movements per line were apportioned based upon:

- Population - the greater the population, the greater the consumption potential;
- Manufacturing Base - the greater the manufacturing base, the greater the production potential; and
- Length of Haul - the longer the distance between the ports and the terminals, the greater the volumes, due to the economies and efficiencies of rail use at increased distances.

The results of this analysis are presented in summary form below in Table 47.

Table 47
Annual TEU Volumes at Proposed CTs

Line/CT Site	2001	2005	2010	2015	2020
South Line - Hat Yai	2,583	5,550	13,550	23,350	34,985
North Line					
Lamphun	2,583	5,850	13,900	23,300	35,281
Phitsanulok	1,417	3,000	7,150	12,200	18,382
Ban Phachi	927	2,234	7,178	14,840	27,938
Northeast Line					
Korat	500	1,200	3,050	5,050	7,412
Khon Kaen	1,417	3,100	7,200	11,650	17,196
Ubon Ratchathani	1,917	4,400	10,400	16,700	24,608
Ongkharak (CT)	398	1,150	3,758	7,410	14,059

These projected volumes represent both the extension of the rail traffic from port and international trade container volumes to the regions and, to a lesser extent, the development of a domestic intermodal system. That is, the volumes include both domestic containers moving by rail between the hinterland regions and the Bangkok metropolitan area, as well as international containers for import or export, which would travel by rail between the hinterland CTs and LC Port.

The volumes shown for Ongkharak CT in the table above are domestic containers only. As discussed in an earlier chapter, the Ongkharak facility would ultimately consist of a domestic CT and an international ICD. The CT would function as a distribution point for next-day delivery of domestic containers from the northeast (i.e., Khon Kaen, Ubon Ratchathani, and Korat). Consequently, the Ongkharak CT is grouped with the Northeast Line system of CTs. Volumes at the Ongkharak CT increase over time, as the domestic share of total projected containers from the northeast rises from about 10 percent to closer to 30 percent over the twenty year forecast period. Similarly, the Ban Phachi CT functions primarily as a distribution point for next day container deliveries from the North (Lamphun and Phitsanulok) and the South (Hat Yai).

The share of domestic containers within the total is greater at Ban Phachi and Korat than at the more distance CTs, but would still be a fairly small minority.

For both the CT and ICD facilities proposed, the annual volumes were multiplied by an average revenue per TEU estimated at Baht 2,200. This figure, constructed as an "all-inclusive" average charge per TEU, was derived from two primary sources:

- First, the PB team examined the existing tariff structure at Lat Krabang ICD and developed an average revenue figure per TEU, based upon representative charges for lifts, gate moves, limited storage, and container handling fees such as stuffing and stripping.
- Second, this estimated rate was tested for a degree of reasonableness, based upon average U.S. per TEU revenues after allowing for the lower costs of labor in Thailand.

For purposes of this financial analysis, it has been assumed that every five years the terminal operators will be able to pass along a 5% increase in prices to their customers. Such a staggered increase is very much in line with transport pricing throughout much of the world.

b. Operating Costs

Operating costs are a highly variable cost, that is, they are primarily determined by the level of volumes experienced by the terminal. Operating costs can be divided into three main categories:

- Labor costs, including management, terminal workers, and rail workers
- Facility costs, such as maintenance
- Equipment costs, which are necessary to operate and maintain the machinery

For each type of ICD and CT, the specific levels of people and equipment were developed by the PB team as detailed in Chapter III. In the cases of the Lat Krabang ICD expansion and Ongkharak ICD, these were largely additions of people and equipment to large scale operations. In the instances of the regional CT's, however, there was a very specific phasing of facility types upward as volumes grew, from a relatively unsophisticated gravel yard building, to a more developed terminal patterned after a single ICD module. For each of these types and phases of terminals, detailed costs were developed.

In addition, the financial feasibility analysis takes into account changes in cargo volumes at each terminal, and the corresponding changes in the labor and equipment resources which would be needed to cope with these variations. For example, the second phase of development at Ongkharak ICD allows for the terminal to grow between 500,000 and 1,000,000 annual TEUs. As growth progresses from 500,000 to 600,000 to 700,000 and so on, however, the terminal will incrementally add resources to handle the additional volumes. The financial feasibility models allow these changes in required assets and consequential related costs to be phased in over time for both the ICDs and the CTs, by pro-rating the costs of a fully developed terminal.

It is important to note that all costs have been increased at 1.5% per annum to reflect the effects of a relatively low global inflation outlook over time.

c. Capital Costs

In addition to operating costs, the financial feasibility analysis includes a comprehensive look at required capital expenditures. Capital expenditures include purchases and the building costs of land, facility infrastructure, and operating equipment. Full schedules of the assets and capital expenditures required in each phase of the different terminals can be found in Tables F-1 to F-9 in Appendix F.

Several assumptions were made in performing this analysis.

- First, it is assumed that the terminal operator will be able to access capital at an average cost of 8% over time.
- All assets were fully amortized within twenty years or their useful life, whichever was less.
- Capital equipment costs were calculated on an operating lease basis, to allow for the need of easily adding or replacing equipment. In general, a lease period of 75% of the asset's useful life was assumed, with a 30% residual value used to calculate annual payments.
- The overall structure is highly leveraged, using loans to cover all purchase needs.

Capital costs are essentially divided into two parts: leases and term debt. Leveraged leases were used to calculate the highly variable equipment cost needs, such as reach stackers, sidepicks, yard tractors and chassis. In the U.S. and elsewhere, leasing is viewed as a particularly helpful means of obtaining highly leveraged capital goods, and was therefore viewed as appropriate for this analysis. Lease costs include both principal and interest.

Structured term debt (using straight line amortization) was used to calculate capital obligations on more major fixed investments, such as land and buildings, track, and other long term improvements. The costs of the terminals were specific to each of the phases of terminal development, and costs of the land was particular to each location. The term of the majority of this debt was assumed to be 20 years and the debt was structured as full pay-out over that period. In all cases, both for leases and term debt, the costs of future purchases were inflated in accordance with the stated inflation rate, and phased in the appropriate years as driven by demand. Both principal and interest are shown, where interest is calculated, at the stated 8%.

The financial analysis assumes that land would be acquired by a developer in phases, as the CTs and ICDs are expanded. As a practical matter, it may be desirable for the SRT to purchase the land at the beginning in order to lock in land prices and sell it to the developer in phases, for those facilities with the greatest privatization potential.

d. Taxes

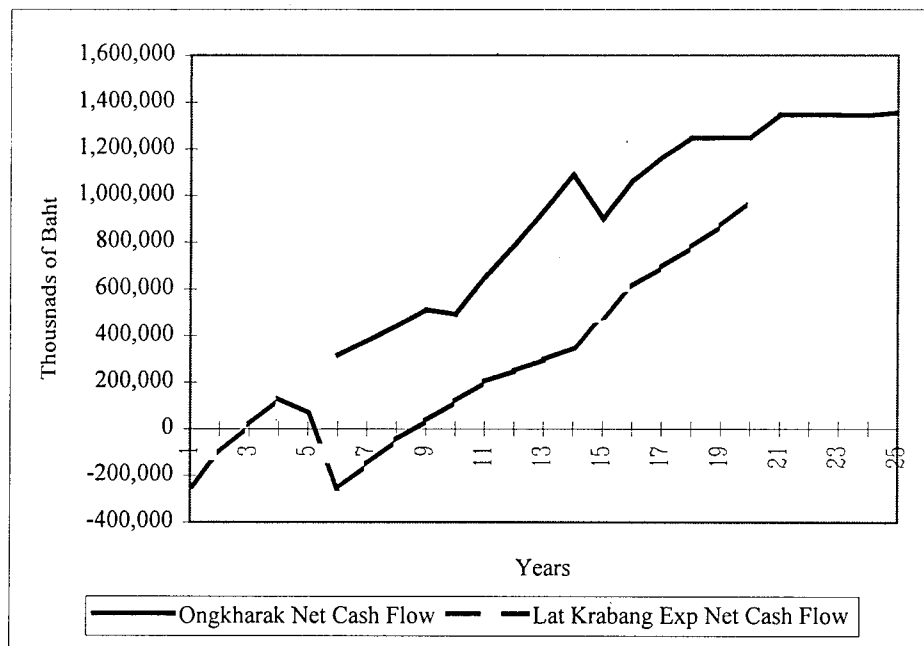
In addition to calculating operating and capital needs, the PB team calculated the effect of taxes on the private operators of each terminal, in order to better understand the effect on net cash flow. Taxes were based on a net income calculation, in which principal served as a proxy for depreciation expense, except for land purchases which were not depreciated.

Thailand's corporate income tax rate of 30% was used in the calculation. Since these facilities are providing domestic international and transportation services, they were not assessed Thailand's VAT of 10%. Only transport costs were assumed exempt from VAT; related services are not exempt.

3. Results of the Analysis

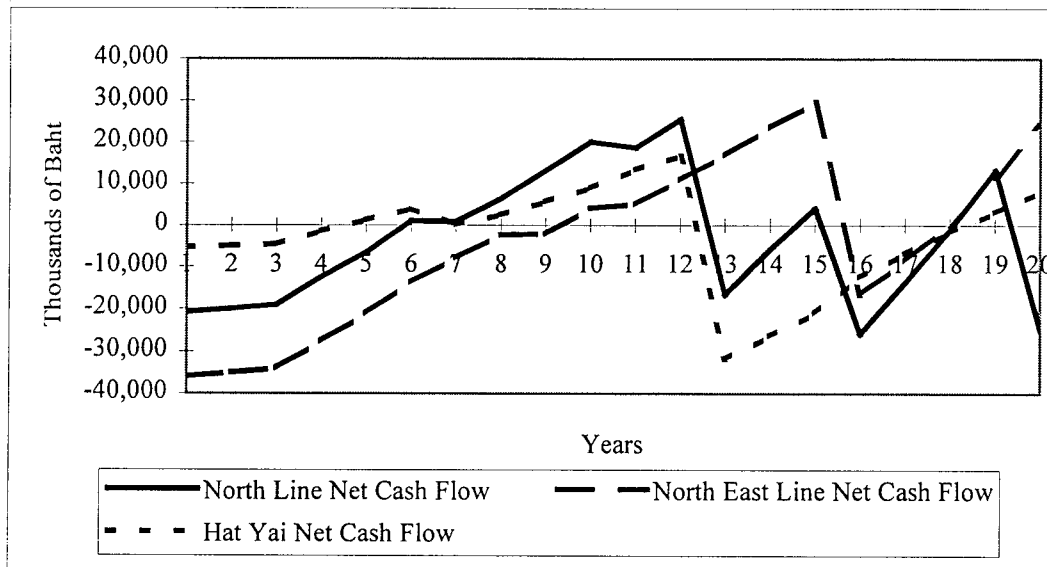
For the two proposed ICDs and the eight proposed CTs, cash flow statements were developed using the criteria and assumptions described above. As shown in Figure 48, Cash Flow for Lat Krabang ICD and Ongkharak ICD below, the revenues and profits from the proposed Lat Krabang ICD expansion and the new Ongkharak ICD are significant. By serving as inland port facilities, facilitating the quick and efficient transfer of goods through LC Port, each has a significant role it can play in Thailand's international trade.

Figure 48
Cash Flow for Lat Krabang ICD and Ongkharak ICD



In this figure, it is easy to see the phasing in of the Ongkharak ICD project, and the benefits Ongkharak will enjoy as it diverts cargo from Lat Krabang ICD at its start-up. The proposed CT systems present a far more complicated story. The three proposed CT systems, the Northern Line (Lamphun, Phitsanulok and Ban Phachi), Northeast Line (Khon Kaen, Ubon Ratchathani and Korat, with the Ongkharak CT being used for domestic moves), and the Southern Line (Hat Yai), experience much wider swings in their financial prospects as can be seen by Figure 49, Cash Flow for Proposed CT Systems below.

Figure 49
Cash Flow for Proposed CT Systems



Several critical points can be taken from this figure. First, these CTs operate on a scale much smaller than the proposed ICDs. Second, and more importantly, these CTs are anticipated to go through investment cycles which require long term investor involvement. The initial movement from positive to negative cash flows is due to the build up of scale within each system to where the CTs can operate profitably. A sharp decline in cash flow can be seen in each case, however, which is the result of necessary new spending, once the relatively low cost start-up and intermediate phases of CT development reach capacity. Projections indicate, however, that the CTs are able to quickly return to profitable operations once this drop-off occurs (within 2 - 5.5 years). As can be seen in the North Line cash flow, this cycle can repeat itself as different CTs in the system move from the intermediate phase to full scale development. The Northeast Line demonstrates by far the worst performance, as it includes two CTs with very low volumes, Korat and the Ongkharak CT for domestic freight.

It is important to remember, however, that each of these systems are made up of individual CTs with their own market dynamics. As mentioned earlier, a full financial analysis of each of the CTs and ICDs can be found on Tables F-1 to F-9 in Appendix F.

In order to compare the results of the financial analysis and measure the attractiveness of each of the projects to private investors, the PB team calculated the present value of each of the terminals in 20 year cash flow streams, using a 15% hurdle rate or implicit rate of return. A hurdle rate of 15% is likely to be the minimum acceptable return for companies considering investments in the ICDs and CTs, given the risk associated with such a venture - particularly the CTs which depend largely on the SRT becoming a far more effective intermodal service provider.

The present value method uses an investor's risk threshold (15% in this case) to discount future spending and income to current Baht, in order to determine whether the investment is worthwhile. A present value of 0 Baht means the 15% investment return minimum has been precisely achieved. A positive present value means the 15% hurdle has been exceeded, and positive numbers can be compared against one another to show which investment produces the highest return (highest return will have the greatest present value). A negative present value means the 15% return requirement has not been met. This does not mean the investment does not generate income, rather the return that it does generate is less than 15% and therefore may be unattractive to many investors, unless the investment is perceived to be very safe and a lower return is consequently acceptable.

The results of this present value analysis are presented in Table 48 below:

Table 48
Present Values of Proposed ICD/CT Projects
(Millions of Baht)

ICD/CT Site	Present Value @ 15%
Lat Krabang Expansion	245
Ongkharak	4,341
North Line	
Lamphun	(6)
Phitsanulok	(12)
Ban Phachi	(26)
Northeast Line	
Korat	(39)
Khon Kaen	(20)
Ubon Ratchathani	(11)
Ongkharak CT	(34)
South Line - Hat Yai	(12)

As can be seen from the above table, only the Lat Krabang ICD expansion and the Ongkharak ICD have significant positive present values at a 15% hurdle rate. This is due to the relatively large volumes that each of these facilities would attract versus the CTs. The Lat Krabang ICD expansion and Ongkharak ICD are projected for between 800,000 and 1,000,000 annual TEUs at each facility, while the largest CT is expected to draw only 35,000 annual TEUs within 20 years.

The table above also reflects a significant difference in the present values between the Lat Krabang ICD expansion and Ongkharak ICD. This is a product of the very large projected diversion of cargo from Lat Krabang ICD to Ongkharak ICD once it opens. As projected by the PB team, Ongkharak ICD, in fact, is expected to quickly experience strong start-up volumes of over 300,000 TEU/year. Lat Krabang ICD is also expected to be hindered in its growth, as it will run out of train capacity unless the double tracking program is completed in the next few years, or the lack of a storage yard is addressed.

In the case of both the Lat Krabang ICD expansion and Ongkharak ICD, the large present values present the opportunity to seek increased concession fees, particularly in the case of Ongkharak. These large present values also are the best indicator that competition to build and operate these facilities will be healthy, enlarging the SRT's privatization options.

Four of the CTs, Lamphun and Phitsanulok on the Northern Line, Ubon Ratchathani on the Northeastern Line, and Hat Yai on the Southern Line, have present values closest to 0, meaning their implicit rates of return are approaching 15%. Further analysis shows initial start up losses, as well as large losses at the beginning of full scale operation, in each of these cases. In order to get past these losses, these periods will either have to be subsidized or long term concessions granted (20 year) such that investors have adequate time to recoup early difficulties. These investments can be viewed as attractive over the long term, but probably do not generate sufficient cash flow to sustain a concession payment of any significance, unless the SRT or Thai government takes on the role of building the infrastructure. Additionally, the smaller volumes in the short term limits the number of effective privatization options.

Perhaps surprisingly, Khon Kaen has a very negative present value but nearly the same volumes as Phitsanulok. This is due the very expensive land at Khon Kaen (900 Baht/m²) compared with land values at Phitsanulok (75 Baht/m²). Khon Kaen has by far the most expensive land values to contend with, as the other CT sites range from 75 to 500 Baht/m².

The most financially difficult terminals to operate are projected to be at Ban Phachi, Korat and the Ongkharak CT. This is due to the very low projected volumes at each of these facilities, as each is relatively close to Bangkok. In addition, the natural market for Ban Phachi and the Ongkharak CT, domestic overnight intermodal freight to and from Bangkok, is projected to be very small compared to the international trade in which other CTs will play a much greater role. Each of these three lower-performing CTs was investigated for strategic reasons, particularly Ban Phachi and Ongkharak, which are needed operationally by SRT in order to provide overnight service. However, it would be worthwhile postponing the consideration of Korat and Ban Phachi terminal if operationally possible. Ban Phachi might be brought back into consideration quicker, however, if the service-oriented market strategies recommended for the SRT are able to quickly develop the domestic intermodal market.

Once development occurs at either of these facilities, it is likely that they will have to be heavily subsidized on an annual basis. If a private company is brought in through privatization, which remains an option even in such a situation, it will have to be paid to run the terminal(s).

4. Privatization Recommendations

As elaborated upon in the preceding financial analysis, the individual ICDs and CTs have very different financial outlooks which impact the privatization opportunities. In addition, the volumes at each of the facilities, as well as the volatility of their cash flows, also influence the optimal privatization path for each facility. Table 49 summarizes the privatization recommendations for the SRT facilities, with a separate discussion of ICDs and CTs following the table.

Table 49
Summary of Privatization Recommendations

ICD/CT Site	Building Method	Operations	SRT Role
Lat Krabang ICD Expansion	BOOT	BOOT Manager, Multiple Operators	Initial Policy/ Operational Guidance
Ongkharak ICD	BOOT	BOOT Manager, Multiple Operators	Initial Policy/ Operational Guidance
North Line			
Lamphun	BOOT	BOOT firm as Only Operator	Initial Policy/ Operational Guidance
Phitsanulok	BOOT	BOOT firm as Only Operator	Initial Policy/ Operational Guidance
Ban Phachi	SRT funded	Management Contracted Out	Provide Capital/ Oversee Contractor
Northeast Line			
Korat	SRT funded	Management Contracted Out	Provide Capital/Oversee Contractor
Khon Kaen	SRT funded	Management Contracted Out	Provide Capital/ Oversee Contractor
Ubon Ratchathani	BOOT	BOOT firm as Only Operator	Initial Policy/ Operational Guidance
Ongkharak CT	SRT funded	Management Contracted Out	Provide Capital/ Oversee Contractor
South Line - Hat Yai	BOOT	BOOT firm as Only Operator	Initial Policy/ Operational Guidance

a. ICDs

In Lat Krabang ICD, the SRT has established a viable working model of building an ICD and bringing in private concerns to ensure that operations are continually handled at peak efficiency.

The financial returns demonstrated by the Lat Krabang ICD expansion, and particularly those projected for Ongkharak ICD, however, indicate that the SRT and Thai Government may be able to remove itself entirely from the start-up process and turn that over to private firm(s).

The NPV analysis demonstrates the ability of a private developer or developer consortium to build and operate the Lat Krabang ICD and Ongkharak ICD at profitable levels. In order to maximize private involvement, therefore, the PB team recommends that the SRT proceed with a BOOT (Build Own Operate Transfer) approach, or some close variation, awarding the right to build and operate such facilities. This is not to say that the SRT should completely remove itself from this process. The SRT should help set the policies the private firm will follow, most importantly the hosting of several private operators at each facility. Also, the SRT should have an initial say in terminal design and operational standards, so as to ensure the most efficient connectivity with the rail service. It is also possible that the SRT could negotiate land leases or other fees with the developers, thus obtaining some small revenue stream through the BOOT contracts.

The benefits of the BOOT approach are the near complete reliance on private capital to build the facility, as well as leaving operational control in private hands where increasing market share, operating efficiently, and keeping costs low will continually be the primary goals. Through such an arrangement, the SRT minimizes both the various types of project risk (which will lay in private hands) and its required level of involvement. This allows the SRT to concentrate on its core activity - rail transportation - without requiring significant new resources. Apart from an asset sale where the SRT would effectively lose all control of the project, no privatization alternative mitigates risk and diminishes the SRT's need for additional resources as effectively as a BOOT program. Additionally, control of the facility will eventually revert to the SRT (estimated at 20 years, but possibly sooner in the case of Ongkharak where the return is greater and occurs much more quickly), and the operation can subsequently be leased out or sold as best fits the needs and goals of the SRT at that time.

b. CTs

Of the eight proposed CTs, four show the promise of reasonable financial returns: Lamphun; Phitsanulok; Ubon Ratchathani; and Hat Yai. Similar to Lat Krabang ICD and Ongkharak ICD, the PB team believes that these should build built and operated under a BOOT approach. There are some critical differences, however:

- First, the analysis does not indicate the financial strength in the CTs which is evident in the ICDs. The necessary result is that any payments for the right of the CTs will have to be small, if they exist at all (fees based on contingent profits is a possibility). The primary benefit to the SRT will have to be derived from the additional rail intermodal traffic which the CTs will be attracting to its system.
- Second, the low relative volumes at the CTs mean that only one operator at each facility will be able to provide cost effective service. Unlike the ICDs where the expectation would be for the BOOT firm to manage several independent operators at the modules within the ICD, in the case of a CT the BOOT firm will in effect be the sole operator, unless it chooses to subcontract the work out to another sole operator.
- Third, the volatility of the cash flows suggests that an operator will need sufficient time (potentially 20 years) to recoup its investment. Since the building of the CTs is phased, it may be prudent to reopen the concession at the time of the transition from the intermediate phase to the fully built CT. Based upon the financial analysis, such a move appears viable, and perhaps even preferable, and would allow the SRT the opportunity to step in and replace an under-performing operator.

Since each CT will only have one operator, it will be important to set rules which do not allow preference to be shown. For example, if the operator of an ICD module also operates one or more CTs, that firm cannot be allowed to use the CTs in such a way to solely benefit its own operation, or disadvantage other ICD module operators in the network.

Finally, there are four proposed CT sites which will have great difficulty achieving financial results which will be attractive to private investment. For these facilities - Khon Kaen, Korat, Ban Phachi, and the Ongkharak CT - it is recommended that the SRT play a more active role in their funding as they become operationally necessary. This would likely entail the SRT building the facility, then contracting out the management and operations of the CT to a private firm. While such an arrangement is not considered ideal, it does provide for the existence of the CTs when they become necessary, while introducing a private element to alleviate the SRT of operational responsibilities, and ensuring that the greatest possible efficiencies can be achieved through a private firm with a commercial stake in the facilities' success.

The SRT may even have to consider funding annual operational shortfalls, although this must be carefully considered and negotiated, as it would remove one of the primary drivers for the continual efficiency improvements the private firm will bring. These contracts can be short term (1 - 5 years), and be turned into a longer term operational agreement (such as a lease) with concessions flowing to the SRT once profitability is achieved.

In the case of Khon Kaen, the issue is primarily the cost of the land. The SRT may be able to remedy this, therefore, by buying and contributing the land in a BOOT arrangement. With Korat, Ban Phachi, and the Ongkharak CT, however, the issue is primarily volumes and when they will achieve the scale to be profitable. Korat is intended as an intermediate point on the Northeastern Line where traffic from Khon Kaen and Ubon Ratchathani can be combined. If the site does not draw sufficient traffic for a CT, the site could be developed as only a set of tracks for combining the blocks of cars from upcountry CTs.

With Ban Phachi, the strategic issue at stake is next day service from the North to Bangkok, a goal which is probably not achievable without a CT somewhere below Ban Phachi Junction. It might be possible to delay its development until the SRT is able to achieve some success in building the entire domestic intermodal market, but on the other hand, its absence might prevent the Northern Line intermodal service from being a success. This becomes an issue of policy.

The Ongkharak CT presents a similar dilemma to that of Ban Phachi. Its construction is strategic and necessary to provide next-day service on the Northeast Line, and its absence might endanger the viability of this service lane. The CT at this location is also intended to complement the future ICD at Ongkharak.

B. ECONOMIC ANALYSIS

1. Overview

The economic evaluation, as compared with the profitability-oriented perspective assumed by the financial analysis, focuses on the net economic benefits that result from the development of the various ICDs and regional CTs, as well as the additional SRT service needed to support them. In general, the economic analysis assumes that development of ICDs, supplemented by other SRT marketing strategies, will facilitate and result in the "capture" of significant container traffic moving within Thailand, most of which now moves by truck. The "diversion" of this containerized cargo, estimates of which have been derived from the market analysis, is the primary source of direct economic benefit, as such diversion will entail transportation cost savings due to the lower unit variable costs of rail versus truck ownership and operation, especially over long distances. In addition, other benefits will occur, including reduced highway congestion and associated environmental benefits, as well as additional benefits of utilizing ICDs and regional CTs, such as improved load-centering in the transport of manufactured and raw materials, and (for containers moving through the LC Port), improved efficiencies in off-site container handling. These benefits are also reflected in the benefit-cost analysis.

In addition, estimates of the incremental impacts of the proposed ICD and CT terminals on SRT revenues and costs have been made. Finally, more qualitative consideration is given to a number

of other economic impacts, such as employment generation, impacts on private sector trucking firms, and achievement of regional economic and social development goals.

2. Benefit-Cost Analysis

The core of the evaluation of transportation cost efficiencies is a formal benefit-cost analysis, including estimation of Net Present Value (NPV), the Benefit/Cost ratio (B/C), and the Economic Internal Rate of Return (EIRR) for the various proposed ICD/CT facilities. The benefit-cost analysis arrays project costs and benefits over an extended (30 year) time period, and considers the present worth of the ICD and CT investments over the life of each investment, assuming a reasonable range of discount rates for the Thai economy. Projects have been grouped for analysis purposes as follows:

a. ICDs serving the LC Port and the Bangkok metropolitan area

- Expansion of the existing Lat Krabang ICD
- Construction of a new ICD at Ongkharak

As is presently the case at the existing Lat Krabang ICD, both of these new ICD expansions would serve almost exclusively as "extensions" of LC Port, for containers that are either entering or leaving the country at that port. Moreover, as at present, most of the containers attracted to the ICDs would be sourced from, or destined for, final distribution to locations within the greater Bangkok metropolitan area, which is by far the largest production and consumption region in Thailand.

The incremental nature of the analysis means that the costs and benefits of these two projects are those that would be incurred over and above the optimum capacity of the existing facility at Lat Krabang. It will be recalled from previous sections that the existing facility could, given certain operational improvements and physical reconfigurations, handle as many as 1,000,000 TEU/year. Thus, the incremental benefits of expanding ICD capacity to serve the Bangkok-LC Port corridor are those that would occur at levels of demand in excess of 1,000,000 TEU/year.

b. Regional CTs

- Northern Region (encompassing CTs at Lamphun, Phitsanulok, and Ban Phachi)
- Northeastern Region (encompassing CTs at Khon Kaen, Ubon Ratchathani, Korat, and a small support CT at Ongkharak)
- Southern Region (including a single CT at Hat Yai)

c. Costs

In structuring the benefit-cost analysis, the costs of each project are relatively straightforward and include:

- Capital costs of ICD/CT construction;
- Capital costs of container handling equipment, including periodic replacement;
- Operations and maintenance costs for the container operation, including the operation and maintenance of container handling facilities and equipment;
- Incremental increases in SRT rail operations, and maintenance costs due to increased levels of service needed to transport the higher container volumes;
- Incremental increases in SRT equipment costs, also due to increased container volumes; and
- Costs of additional containers, for regional CT service only. Containers to supply international trade are assumed to be available from steamship and other transport firms along the international logistics transport chain.

Not included in this analysis are any increases in railroad system upgrade costs, which might be required to accommodate the projected increases in volumes over and above rolling stock acquisition. For the most part, however, the market analysis of increased rail container

throughput has been constrained by limitations on the "baseline" SRT system, these being primarily right-of-way limitations. The Market Analysis cited various recommendations which could be undertaken by SRT to increase its market share, including easing of any such capacity limitations through improved operating and administrative efficiencies.

Cost estimates relating to the above categories have been documented in previous sections of this report. On the basis of those estimates, Table G-1 in Appendix G details the thirty year cost streams for each facility (or system of facilities, in the case of the regional CTs), as they are utilized in the benefit-cost analysis.

A particularly important consideration in performing the benefit-cost analysis, which merits some explanation in this section, is the phasing and timing of investment costs. (Differences in the timing of costs are important, as present worth is sensitive to the time sequence of costs, that is, the farther into the future costs are incurred, the lower their discounted present worth.) On the basis of the Market Analysis, the following timing and phasing assumptions have been made, which are reflected in the cost stream:

- The first phase of expansion at Lat Krabang ICD would be completed and available in 2004. That expansion would provide a total capacity for an additional 500,000 TEU/year. Phase II would occur later, in accordance with increasing demand over time.
- The new ICD facility at Ongkharak is assumed to commence operation in 2010, based on projected levels of ICD container demand associated with LC Port.
- The new ICD facility at Ongkharak is assumed to open as an intermediate-sized facility of 500,000 TEU/year capacity. Given relatively rapid increases in demand, a full-sized ICD with a throughput capacity of at least 1,000,000 TEU/year could be constructed for an opening year of 2015.
- Each regional CT is assumed to commence operation in the year 2001, and since the volume of containers at each facility is low at the outset, each facility is assumed to commence as a start-up facility, with capacity to handle no more than 8,000 TEU/year.
- Individual CT facilities are phased according to the estimated market demand for container throughput. The engineering and cost analysis considered the physical requirements and costs of start-up, intermediate, and full-scale CT facilities. As noted above, this analysis assumes that each CT would begin in its first phase as a start-up facility due to low initial demand. Facilities would be expanded to an intermediate phase once demand exceeds 8,000 TEU/year, and to a full-sized CT after the 16,000 TEU/year mark is exceeded. These threshold levels are achieved at different times for different facilities.

Other assumptions related to costs include the following:

- All container-moving equipment as a group have a useful life of 12 years, and are replaced at that frequency.
- In order not to distort the analysis, a second new ICD facility (i.e., a facility needed after Ongkharak) is not included in the analysis. According to the market forecasts, such a facility could be needed by 2016. However, a second major ICD facility is beyond the scope of this study, and probably also beyond the reasonably foreseeable planning horizon.

In some cases, it was also necessary to convert U.S. dollar costs or prices to Thai Baht for purposes of estimating costs and benefits – for example, the costs of rail equipment, which were estimated using U.S. equipment price schedules. For this, a conversion rate of 40 Baht to the U.S. dollar was used. That rate, reflecting market conditions in March, 1998, occurs at a time of relative return to stability in Thai economic and financial conditions, and as a result, in the exchange rate.

No particular adjustments have been made to the costs for purposes of differentiating between "financial" (or expenditure) costs, versus "economic" costs, the latter intended by economists to

reflect the real opportunity costs of utilizing resources. Economic costs may sometimes differ from financial costs to the extent that prices, which are the basis of the financial cost estimates, reflect market distortions and imperfections such as taxes, import duties, government subsidies, monopolistic practices in local markets, excess labor supply, or foreign exchange rate distortions. Previous studies performed in connection with the development of transportation infrastructure in Thailand have used a general adjustment factor of 0.877 to convert financial to economic costs.

Adjustments have not been made in this case due to extreme uncertainties at present regarding the direction of the Thai economy, and its fiscal and monetary policy, financial and regulatory systems, and the fact that macro-economic and financial policies are evolving as this report is being written. Changes in tax policies, foreign exchange and international monetary policy, trade practices, etc. would render previous adjustment factors obsolete. More importantly, given the current financial crisis in Thailand and the devaluation of the Baht since the fall of 1997, it would probably be misleading to make downward adjustments to the costs of imported capital goods, such as container handling equipment, insofar as the currency devaluation has inflated the price of such import goods and driven prices up in general in Thailand. Upward adjustments, in fact, could be more appropriate, but the long term outlook remains uncertain. Accordingly, the prudent approach is to make no adjustments at all.

d. Benefits

Like the costs, benefit streams for each ICD and CT grouping have been arrayed over a 30 year time frame. Due to differences in assumed commencement year, the 30 year periods differ: analysis of the Lat Krabang ICD expansion covers the period 2004-2034; Ongkharak spans the period from 2010 to 2040; and the CTs are analyzed over a period extending from 2001 to 2030.

For purposes of the benefit-cost analysis, the following benefit categories have been incorporated in the estimates:

- The transportation cost savings resulting from the diversion of containers from trucks to rail;
- Reduced highway congestion and faster shipment of containers resulting from the diversion of containers from trucks to rail;
- A "residual" benefit associated with the use of ICDs or CTs, net of transportation cost and time savings. This category, which is derived based on the "willingness-to-pay" principle, would include such items as improved efficiency of container handling, more efficient load balancing for container transport, avoidance of time and out-of-pocket expenses associated with container handling at LC Port, and other shipper benefits.

Each of these benefit categories is amplified below.

- **Transportation Cost Savings:** In attracting containerized cargoes from truck to rail transport, net savings are incurred. In order to estimate the truck cost savings, it was necessary to develop an estimate of variable truck ownership and operations costs. Such savings would include driver costs, fuel, oil, tires, vehicle maintenance, as well as highway accidents and roadway maintenance.

In the market analysis, some data were identified regarding the variable costs of truck operations in Thailand, where "variable" means varying with miles driven. (See Table 4, Average Costs for Freight Truck between Bangkok and Various Cities and Table 5, Average Trucking Costs in Thailand). In general, that information indicates truck costs in the range of 14 Baht/truck kilometer, to as much as 88 Baht/kilometer for short hauls of less than 50 kms. Due to the range of costs, and the fact that these sources were obtained from anecdotal rather than rigorous sources, an independent estimate of the variable costs of truck ownership and operation was made (based on detailed cost studies conducted in the United States) of truck costs by the U.S. Federal Highway Administration. However, adaptations and adjustments were made to reflect local conditions. Adjustments included U.S.-Thai differences in vehicle operator labor rates, motor fuels and other taxes on vehicle operation, differences in government-imposed regulatory compliance, and differences in average truck-

vehicle type. In particular, since the majority of trucks hauling freight in Thailand are ten-wheelers, as compared with larger U.S. vehicles, adjustments were made for this difference as well.

Based on the adjusted U.S. data, the final estimate of the variable costs of truck ownership and operation was determined to be about 1.5 Baht per truck ton-kilometer. Assuming an average load of 12 tons per TEU, this translated into a cost of approximately 18 Baht per TEU-kilometer for the transport of containers by truck. In fact, this figure is well within the range of costs reported in the Thailand data, as noted above. This convergence of results from these two widely different sources, provided a high degree of confidence that the unit cost figure utilized in this analysis was reasonable and reliable.

- **Reduced Highway Congestion/Improved Transport Time:** Although average rail speeds, according to SRT schedules, are about 30 km/hour, this would be an improvement over truck travel times in the heavily congested Bangkok metropolitan area. Diversion of containers from truck to rail, particularly within the highly congested Bangkok area, would entail other benefits to society. A 20% upward adjustment was made to the direct transportation cost savings, in order to reflect both the more rapid delivery by rail of containers to and from LC Port and their point of origin or destination in the Bangkok metropolitan area, as well as other benefits associated with less truck traffic, including air pollution reductions and reduced delay of non-commercial vehicles.

Given the levels of congestion in Bangkok, the 20% adjustment is regarded as very conservative, particularly in light of the fact that there are presently restrictions imposed in Bangkok on the operation of trucks during the most heavily congested periods. No benefits of this type were assigned to containers moving by rail between Bangkok and the hinterland regions by way of the CTs, as highway congestion is not a significant problem outside of Bangkok and the other major metropolitan areas.

- **Residual Benefits:** Based on current tariff schedules prevailing at the existing Lat Krabang ICD facility, it is anticipated that the market would sustain an all-inclusive tariff of about 2,200 Baht per TEU at Lat Krabang ICD and the new facility at Ongkharak (as detailed in the financial analysis). For containers moving between the LC Port and Lat Krabang ICD, this translates into a rate of about 22 Baht per TEU-kilometer. That is nearly 4 Baht per TEU kilometer more than the transportation cost savings realized by shippers due to a shifting of mode from truck to rail (not including differences in line haul charges between rail and truck). This difference, between what shippers may be willing to pay versus savings realized from line haul transport, is regarded for purposes of this analysis as a "residual" benefit to shippers. These benefits, while not specifically identified, are thought to include improved efficiencies due to less handling within the more congested port, better load centering compared with the more distant port, and possibly other effects. To be conservative, only one-half of the residual is included as a benefit (i.e., an additional benefit per TEU-kilometer of about 2 Baht per TEUs is added to the benefits stream within the LC Port - Lat Krabang ICD corridor), due to uncertainties associated with the actual benefits. Residual benefits are applied to TEUs moving both by rail and by truck, as these benefits would be realized regardless of mode of access.

Benefit streams are detailed in Table G-2 in Appendix G.

It is important to note that the benefits streams are greatly effected by capacity constraints, both in total and in the ability of each facility to accommodate incoming and outgoing rail traffic. In particular, operational analyses indicate that an expanded Lat Krabang ICD, with an ability to handle a total of 2,000,000 TEUs within the facility, can accommodate no more than 750,000 TEU/year by rail (until the double-tracking program is completed). Thus, the incremental benefits to be derived from expanding Lat Krabang ICD are largely restricted to the additional 250,000 TEUs that can be handled by rail, over and above the yearly 500,000 TEU rail capacity of the existing Lat Krabang ICD (from the current train schedule). Some benefits are associated with containers trucked to the facility, but these are small compared with the benefits to be derived

from diverting containers from trucks to the rail system. By contrast, if the Ongkharak facility can be supplied by rail as indicated in the market projections, as discussed in the Railroad Operations Analysis, the incremental benefits would be very significant.

e. Benefit/Cost Results

Net benefit streams for ICD facilities are pictured below in Figure 50, ICD Net Benefit Streams while the net benefit streams for the CT systems are depicted in Figure 51, CT Net Benefit Streams. Annual cost, benefit, and net annual benefit streams are detailed in Table G-3 in Appendix G.

**Figure 50
ICD Net Benefit Streams**

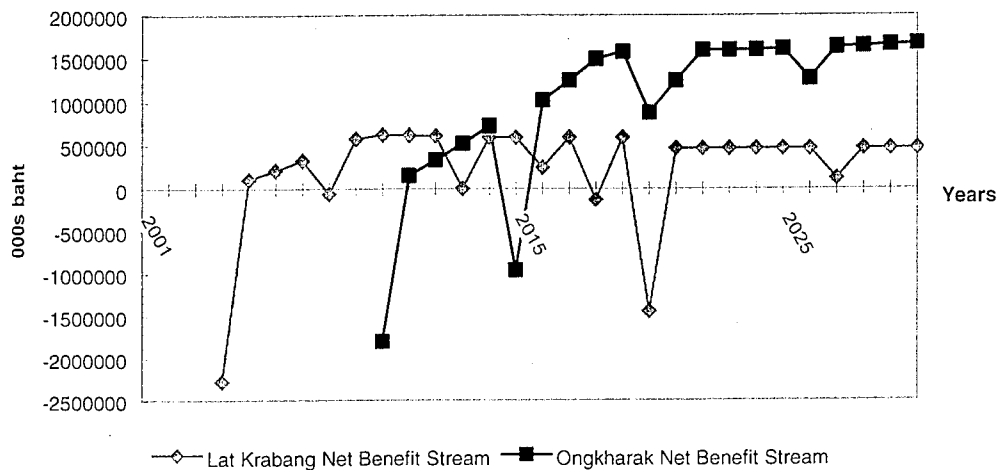
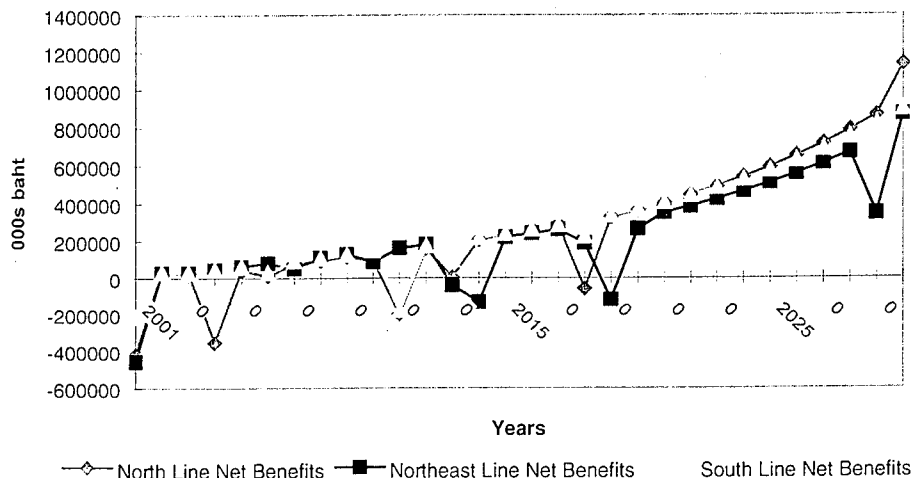


**Figure 51
CT Net Benefit Streams**

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The results of the benefit cost analysis, including the EIRR, NPV, and B/C, are summarized below in Table 50.

Table 50
Summary of Benefit-Cost Analysis

	EIRR	NPV¹ (millions, 1997 Baht)	B/C
ICDs (Bangkok area to LC Port)			
Lat Krabang Expansion	11.3%	265.5	1.05
Ongkharak	28.9%	6,440.8	2.00
Combined Lat Krabang and Ongkharak	17.3%	6,706.3	1.56
CTs			
Northern Region ²	9.3%	-76.6	0.96
Northeast Region ³	9.6%	-20.4	0.99
Southern Region ⁴	36.6%	1,568.5	2.50

1. Calculated using a 10% real discount rate.

2. CTs at Lamphun, Phitsanulok, and Ban Phachi.

3. CTs at Khon Kaen, Ubon Ratchathani, Korat, and Ongkharak.

4. CT at Hat Yai.

As shown, each of the proposed ICDs and CTs has an Economic Internal Rate of Return (EIRR) closer to or greater than 10%, a standard hurdle rate for the economic performance of projects employed by multinational lending and development agencies, among them the World Bank and the Asian Development Bank (ADB). Clearly, however, there are significant differences in the economic performance of individual facilities.

Looking first at the ICD projects (Lat Krabang ICD expansion and the new ICD facility at Ongkharak), it can be seen that a new facility at Ongkharak attains a much higher rate of return, as well as a higher net present value (NPV) and B/C ratio. On average, the economic performance of the new Ongkharak ICD is more than double that of the expansion of Lat Krabang. In large part, this comes about as a consequence of two factors:

- The costs of both are roughly the same, as would be expected given that they are both of a sufficient size to accommodate 1,000,000 TEU/year:
- The benefits of the new facility are substantially higher, since it was assumed to have nearly twice the rail TEU capacity as the expanded Lat Krabang ICD, which as noted above, is constrained to an incremental increase of no more than 250,000 TEU/year (over and above the 500,000 TEUs rail capacity of the existing facility). By contrast, Ongkharak ICD has an incremental rail capacity of about 650,000 TEU/year.

This result is important, in that it suggests that, from a purely economics standpoint, the SRT may wish as a matter of policy to place a higher priority on the development of a new facility at Ongkharak, with expansion of Lat Krabang coming later. From a less theoretical perspective, the benefits of constructing a new facility in a new location makes good intuitive sense, for instance in providing a more balanced system of goods distribution within the Bangkok metro area. A second load center point, which Ongkharak would provide, offers increased choice for shippers, consignees, freight forwarders, and other intermodal transportation firms, as a collection point where containerized cargoes may be collected from producers for export or distributed to consumers and other final users on the import side. It should be noted that this conclusion is predicated on the undertaking and completion of enhancements to the existing Lat Krabang ICD facility, which would expand its throughput capacity to 1,000,000 TEU/year. That level of capacity would be equalized by a 1,000,000 TEU facility at Ongkharak, providing a good geographic balance within the region.

In addition to these economic reasons for constructing the Ongkharak ICD before expanding the Lat Krabang ICD, the operational analysis in Chapter III presented a number of reasons from a rail operations perspective.

Over the longer run construction of both facilities, if phased properly, would jointly deliver substantial economic benefits, as indicated by the combined average EIRR for the two projects of nearly 19 percent. Different phasing from that which is assumed in the analysis (i.e., building Ongkharak ICD first and then expanding Lat Krabang ICD after that) could possibly deliver an even higher rate of economic return.

A somewhat similar pattern is observed for the regional CTs, which as indicated earlier are evaluated on a "system" basis, rather than individual facilities. By this, it is meant that all costs and benefits for each facility are combined as they occur over time, to yield a present worth for both benefit and cost streams. Systemwide analysis is necessary, since operations at one facility are largely dependent on operations at the others, in terms of both terminal operations and rail operations. For example, in the North region, Ban Phachi essentially serves as the Bangkok terminal for goods moving through Lamphun and Phitsanulok.

As seen in the table above, each system performs moderately well, with the highest returns observed in the southern corridor, which comprises the Hat Yai facility only. In terms of the method of analysis, this result is due to:

- The relatively high container volumes projected for Hat Yai (Hat Yai receives more containers by 2018 than any other individual CT)
- The longer distance to Bangkok of about 1,000 km (which results in the model in greater truck transport cost savings and higher benefits per TEU transported, as well as lower average costs of rail service)
- The fact that only one facility is assumed, which results in a lower overall system cost, when compared with the other two regional corridors which require three.

In reality, a single facility located at such a distance from Bangkok may not be as attractive to shippers and consignees in the southern corridor as would a system comprising several facilities, each located at lower average distances from point of origin or destination to railhead. Some adjustments were made in the model to reflect this, but insufficient data about the real distribution of population, manufacturing, agricultural production, etc., were available to estimate the true transportation cost savings in the corridor, beyond the general estimate that was made. In conclusion, the Hat Yai result may be somewhat overstated, and the true IRR may be closer to 10-15%.

Overall, the results of economic benefit-cost analysis tend to support and buttress the findings of the financial analysis: namely, that the ICDs yield significant positive benefits and profits, and deliver substantial returns on invested costs. It is reasonable to expect such consistency, insofar as prices that shippers are willing to pay to utilize ICDs (and to deliver containers to and from ICDs by means of the railroad) ought to mirror the transportation cost savings that result from not shipping by truck. In the absence of such savings, shippers would generally not be willing to utilize the ICD-rail intermodal combination.

With regard to the CTs, the correlation between economic and financial outcomes is also close, with the exception of the Hat Yai (Southern region) CT. Both the North and Northeast CT system achieve 30-year economic rates of return close to 10.0%, nearing the IBRD hurdle rate. By contrast, the economic return on the Southern system, including Hat Yai CT, is above 35%. The reasons for the high economic returns for Hat Yai have already been discussed.

3. Impacts on SRT Revenues and Costs, and Tariff Recommendations

In order to provide a more complete picture of economic performance and financial feasibility, and to assist the SRT, an analysis was also made of the impacts of the proposed new ICD and

CT systems on SRT's own financial balance sheet, both on the capital and operating sides of the ledger. The impacts on SRT's finances are a significant consideration, insofar as diversion of containers (and other bulk or general cargoes) from the highway system to the railroad, as a consequence of investments in ICDs and CTs (spurred also by service, pricing, and marketing initiatives), will increase revenues, but also increase costs as additional rolling stock will have to be purchased and additional service operated, adding to SRT's expenses.

a. Revenues

Incremental increases in SRT freight revenues were estimated for the Lat Krabang ICD expansion, the new facility at Ongkharak, and for the three regional CT systems. Utilizing the market forecasts, which are presented in the Market Analysis, line haul revenues were estimated for incremental increases in rail container traffic shifting from truck to SRT carriage. In the case of the ICDs, incremental increases are defined as those containers moving by rail over and above the rail capacity of the existing (enhanced) ICD at Lat Krabang, which as noted several times earlier, is currently 500,000 TEU/year. As also noted earlier, the maximum additional rail capacity for the Lat Krabang expansion is 250,000 TEU/year, and at Ongkharak ICD, the maximum throughput would be 650,000 TEU/year. All containers utilizing the regional CTs are assumed to have been diverted from truck to rail, by definition.

Table 51 below summarizes the estimation of additional SRT earnings for selected years, by facility. Shown in the table are estimated increases in containers by rail (which are also the basis for the estimation of economic benefits). Also shown are the assumed line-haul rail rates, per TEU and per TEU-kilometer. A uniform rate of 8.26 Baht/TEU-km was assumed for all origin-destination pairs. This assumption was provided by SRT, and reflects their current actual optimized line haul rate.

Table 51
SRT Revenue Summary

	Distance (kms)	Rail Rate Baht/ TEU	Baht/ km	Containers/ Year (1st year)	Containers/ Year (2020)	Revenue (1st year) (millions, 1997 Baht)	Revenue (2020) (millions, 1997 Baht)
ICDs							
Lat Krabang Expansion	109 (to LC Port)	900	8.26	38,000 ¹	300,000	34.2	270.1
Ongkharak	133 (to LC Port)	1,099	8.26	187,000 ²	650,000	205.4	711.9
CTs							
North	727 (Lamphun-Ongkharak)	6,005	8.26	4,250 ³	56,331 ³	16.8	214.2
Northeast	503 (Ubon Ratchathani-Ongkharak)	4,155	8.26	3,800 ⁴	49,216 ⁴	13.4	170.4
South	1021 (Hat Yai-Ban Phachi)	8,433	8.26	2,600 ⁵	35,000 ⁵	21.8	295.0

Notes:

1. 2004

2. 2010

3. Combined volume and revenue for Lamphun, Phitsanulok, and Ban Phachi.

4. Combined volume and revenue for Khon Kaen, Ubon Ratchathani, Korat, and Ongkharak.

5. Hat Yai.

b. Costs

Costs for additional rolling stock (including containers for domestic CT service) and yearly operations and maintenance, were obtained directly from the Railroad Operational Analysis carried out as part of this study. Costs for other capital improvements on the railroad itself (for example, to double track or to enhance the right of way or other systems) are not included in the costs. Moreover, no provision has been made for marketing or any other incidental costs which may be needed to effectuate the diversion of containers from truck to rail, over and above acquisition of new rolling stock, and the costs of operating and maintaining increased service levels.

The definition of marginal operations and maintenance costs provided to the consultants by the SRT may be considered a narrow definition, in that some categories of operations and maintenance costs that may vary with substantial increases in service were not included. Below, a sensitivity test on the SRT revenue-cost results is performed, using a more expansive definition of marginal operations and maintenance costs.

Also not included among the costs to be borne by the SRT are any infrastructure or land purchase costs which, as a practical matter, SRT may wish to undertake in connection with the construction of ICD or CT facilities. Assumption of such costs by the public sector may, however, be appropriate inasmuch as the power to acquire land for purposes of transportation infrastructure development is much more easily exercised by the government. Moreover, it may be necessary to do this in order to enhance the feasibility of private investment in ICD and CT facilities, and also because private investors in transportation infrastructure have come to expect this incentive as a condition for public-private partnerships. It is important to remind the reader that land costs, while excluded from the analysis of SRT's finances, are included in the private sector financial analysis of the ICDs and CTs presented in Section IV.A above. In other words, our financial analysis allocates the land acquisition costs for ICD/CTs to the private developer, rather than to the SRT. As suggested earlier, it may be advisable for the SRT to acquire the necessary land at the outset, in order to lock in land prices.

c. Results

The results of the analysis are summarized in Table 52 below.

Table 52
Summary of SRT Revenues and Costs
(Million, 1997 Baht)

	PV Rev.	PV Cost, Total	NPV	FIRR	Avg. Annual Oper. Profit/loss	Avg. Annual Oper. Ratio
ICDs						
LK Expansion	1,814.8	1,101.8	713.0	75.0%	44.9	3.9
Ongkharak	4,682.2	1,919.4	2,762.7	62.3%	115.6	3.9
Regional CTs						
North	837.2	1,092.7	-255.5	Negative	8.5	1.4
Northeast	681.2	863.5	-182.4	4.6%	9.9	1.8
South	1,136.7	712.9	423.8	23.5	22.1	2.4

In the table above, the FIRR, or financial internal rate of return, refers to the total impact of additional container traffic on the net costs and revenues of the SRT. That is, it is the twenty year rate of return, comparing the additional line haul tariff revenues with the additional annual operations and maintenance costs as well as the additional equipment acquisition costs. By contrast, the Average Annual Operating Profit/Loss and the Average Annual Operating Ratio refer

to the average annual impact on SRT's operating budget only; these measures do not include the additional equipment acquisition costs, which would accrue to the authority's capital budget.

The analysis indicates the potential for some improvements at the margin in SRT's financial condition as a result of a concerted effort to attract containers to its rail network. This includes facilitating development of the ICDs and CTs, as proposed, and also by means of improved marketing, operations, security, and possibly adjustments to its pricing schedule. In all cases, revenues resulting from diversions to rail more than fully compensate for the additional operating expenses, in some cases by a considerable margin. In particular, the ICDs are estimated to be able to help generate substantial net financial benefits for the SRT, by a margin or more than two to one (i.e., total present value of revenues over 30 years is more than twice the present value of costs, including both annual operations and maintenance and rolling stock acquisition). In other words, the revenues earned by the SRT in transporting containers to the ICDs would more than pay for the additional costs of operating the service.

These results should be viewed with some caution, as they entail estimation error. However, at the same time, they should also be viewed by SRT as encouraging, in the sense that the results provide reasonable assurance that an ICD investment and rail marketing program will not result in financial losses for the agency, and that, in fact, it may result in an improvement in SRT's overall financial condition. The proposed domestic system, including CT facilities would cover operating costs, but would not result in full cost recovery. Only the CT system to the south, serving Hat Yai, would earn a rate of return in excess of 10%. The system to the north, serving Lamphun, would actually result in a net deficit. In light of these estimated returns, the construction of a system of CTs would thus need to be considered in terms of long-range objectives for the SRT system and the Thai government.

d. Sensitivity Tests

As noted previously, the SRT prescribed a relatively restrictive definition of incremental operations and maintenance costs for use in this study. However, it is useful – and SRT has requested – that this definition be expanded to include cost items not in the baseline operations and maintenance cost model, in the form of a sensitivity analysis. Accordingly, three test cases have been analyzed which incorporate a larger number of cost categories within the definition of incremental cost.

Figure 52, SRT O&M Cost Categories, shown below, summarizes the SRT accounting cost categories included in the baseline operations and maintenance cost analysis, as summarized in Table 52, and the three sensitivity tests requested subsequently by the SRT.

Figure 52
SRT O&M Cost Categories

	Baseline	Sensitivity Analysis		
		Case 1	Case 2	Case 3
Fuel & supplies locomotive	X	X	X	X
Trainmen & enginemen bonus	X	X	X	X
Train supplies				X
Locomotive maintenance	X	X	X	X
Wagon maintenance	X	X	X	X
Shunting				X
Damage & Loss				X
Salary & other pay, train crews		X	X	X
Dispatching train crews				X
Roadway maintenance			X	X
Signal and telecommunication maintenance			X	X
Station & building maintenance				X
Shops & engines expenditures				X
Salary & other pay for stations				X
Administrative expenditure (train performance)				X
Administrative expenditure				X

X indicates that cost category is included.

The results of the sensitivity tests are summarized below in Table 53.

Table 53
Sensitivity Tests, Incremental O&M Cost Model

	PV Costs, Total (million, 1997 Baht)	FIRR	Avg. Annual Operating Ratio
LK ICD Expansion			
Case 1	1,223.3	61.3%	3.08
Case 2	1,516.7	33.1%	2.06
Case 3	1,958.7	Negative	1.37
Ongkharak ICD			
Case 1	2,234.2	55.5%	3.06
Case 2	2,994.8	40.4%	2.05
Case 3	4,140.6	19.9%	1.36
North CT System			
Case 1	1,245.7	Negative	1.14
Case 2	1,611.5	Negative	0.76
Case 3	2,162.6	Negative	0.51
Northeast CT System			
Case 1	973.5	Negative	1.43
Case 2	1,218.9	Negative	0.95
Case 3	1,588.6	Negative	0.64
South CT System			
Case 1	846.0	20.6%	1.94
Case 2	1,147.8	11.2%	1.30
Case 3	1,602.5	Negative	0.86

In general, the sensitivity tests indicate a substantial, even dramatic, deterioration in the estimated financial results for SRT when the operations and maintenance cost model is greatly

expanded to include most of the categories in the above figure (e.g, Case 3). By contrast, SRT's financial performance continues to look strong in Case 1, where the operations and maintenance cost model is not dramatically expanded. It will be recalled that in Case 1, salary and other pay for train crews is included in the cost analysis. This category was not included in the baseline cost analysis.

e. Refinement of Pricing for Intermodal Moves

The revenue streams estimated as part of the preceding analysis may be regarded as somewhat generic, in that they are based on rail line haul rates made available to the PB team by the SRT which are not fully tested under market conditions. This section represents a further elaboration of that analysis, the purpose of which is to clarify SRT's pricing policies, and to identify ways in which pricing may be combined with intermodal infrastructure development to achieve greater market share.

In order to help assess the impact on the SRT of moving to a more intermodal-focused system, tariff recommendations were developed for the rail moves which will help feed the proposed ICD/CT system. As previously discussed in the Marketing Strategy section, the SRT must be prepared to beat both truck service and truck prices to win a chance at securing new business. SRT pricing, therefore, will be set more by truck market-place dynamics than the SRT's own costs in the short term, as it attempts to gain market share. Using the data developed in Chapter II, a recommended price structure is proposed in Table 54 below. These price recommendations were derived from estimated per kilometer truck rates for various types of hauls, less 10% as an inducement for shippers to try rail.

Table 54
Rail Line Haul Rates for Movements of Containers
Between Bangkok and the Provinces

Terminal Location	Distance to Bangkok (km) (Ban Phachi)	Rail Rate (B/km)	Total (Baht)	Drayage * allowance (Baht)	Line Haul Rail Rate (Baht)
Lamphun - Ban Phachi	639	14.2	9,073	3,200	5,873
Phitsanulok - Ban Phachi	306	16.7	5,110	3,200	1,910
Khon Kaen - Ongkharak	387	16.7	6,463	3,200	3,263
Korat - Ongkharak	192	20.9	4,013	3,200	813
Ubon Ratchathani - Ongkharak	503	11.4	5,734	3,200	2,534
Hat Yai - Ban Phachi	1,032	12.2	12,590	3,200	9,390

* Drayage allowance was assumed to be 1,600 Baht at the origin and also the destination as an average. Some moves may be less, depending on the distance from the terminal.

** Movements to and from Korat must be limited to moves where drayage is much less than the average used for the other terminals, that is, generally distances which are within 2 to 3 km from the terminals on each end.

Not only does the rail portion itself have to be competitive with a truck movement, but the combined rail and drayage costs to pick up/deliver cargo must equate or be less than the price of a truck movement. The drayage cost is essentially fixed regardless of the line haul distance, and the SRT must expect to share this portion of the total revenue. Therefore, it can be seen that the rail moves prove more beneficial to the SRT when longer distances are involved.

Unlike the domestic market, movements of international containers will take place between the provinces and LC Port by way of Lat Krabang and Ongkharak ICDs. For these moves the distances will be different, and the drayage needs to be included only on one end of the move. Although this potentially increases the distance from which SRT can draw freight to and from the terminals in the provinces, the same average of 1,600 Baht drayage will be used to be conservative. The SRT will need to absorb terminal costs (gate charges, lift on and lift off, limited free time, and others) in the line haul rate, so the cost of the move should include this cost, as shown in Table 55.

Table 55
Rail Line Haul Rates for Movements of Containers
to and from LC Port

Terminal Location	Distance to LC Port (km)	Rail Rate (B/km)	Total (Baht)	Drayage * allowance (Baht)	Line Haul Rail Rate (Baht)
Lamphun	863	14.2	12,255	1,600	10,655
Phitsanulok	530	16.7	8,851	1,600	7,251
Khon Kaen	527	16.7	8,801	1,600	7,201
Korat	319	20.9	6,667	1,600	5,067
Ubon Ratchathani	637	11.4	7,262	1,600	5,662
Hat Yai	1,099	12.2	13,408	1,600	11,808

* Drayage allowance was assumed to be 1600 Baht for the terminal in the province. Lift on and lift off costs have been assumed to be included in the line haul rail rate.

Note: For the purposes of this table, all international traffic is routed via Lat Krabang ICD, until Ongkharak ICD is constructed. Distances reflect these routings.

f. Truck Competition/Potential for Cooperation

While the market projections indicate relatively low container volumes at regional CTs in the early years of proposed development, several marketing and pricing strategies may be explored which could enhance the potential for rail container capture in these outlying areas.

The first of these is the potential for formation of strategic alliances between the SRT and domestic trucking firms, within a given rail corridor or province. It is not unreasonable to expect that some trucking firms may be persuaded to enter into strategic business agreements with the SRT, to provide multi-modal truck to rail transport for customers within a corridor, where efficiencies may be realized. Instances of this may occur where next day line haul service by rail could be provided at rates comparable to or less than the costs of trucking. This opportunity would exist where direct rail services are available, and where significant amounts of manufactured goods can be assembled in one location.

On the SRT's part, such alliances could be furthered by means of price discounting initiatives, such as volume discounts. Data provided by the SRT indicate that container volumes and capture percentages are quite sensitive to changes in rail rates in Thailand. For example, it was found that following a late 1997 increase of 12.5% by the SRT in its carriage charge for containers between Lat Krabang ICD and LC Port, the rail share of container traffic fell by some 7% in the short run. This provides some evidence that price discounting could result in a substantial increase in volumes in other corridors. One option which has been suggested would be to charge on a flat per car or per train basis rather than per container, so that average rates per container would fall as shipment size increases.

Additional note must be made of the lack of enforcement controls on domestic trucking, and the underpricing of truck transport compared with most other countries. The loose regulatory controls on trucking, and truck's underpricing, are primary factors in the SRT's difficulties in competing with long and intermediate haul trucking in Thailand.

First, with regard to regulatory structures, our discussions and interviews with those most familiar with the transportation environment in Thailand indicate that trucks typically exceed weight restrictions, and that enforcement of these violations is lax at best.

Equally important, the cost of owning and operating trucks in Thailand is far below what it costs in other countries, reflecting a significant underpricing of the trucking industry in Thailand. Elsewhere, a substantial share of the costs of truck ownership and operation are in the form of taxes, fees, and government regulatory mandates, all of which represent society's efforts to put a price tag on the high environmental and social costs which trucks impose. These include air pollution, accidents, and highway congestion – costs that would otherwise not be reflected in direct ownership, operating, and maintenance expenses. To illustrate this, Table 56 below highlights the much higher level of taxes, fees, and mandates imposed on trucks in the United States.

Table 56
U.S. Truck Taxes, Fees, Regulatory Costs

TYPE OF TAX OR FEE	ANNUAL COST/ TRUCK (US\$)	COST/VEHICLE KILOMETER (US\$)	% OF TRUCK GROSS RECEIPTS
Taxes, Fees			
Fuel Tax	7,932	0.050	7.2
Vehicle Use, Insurance, Registration Taxes	4,931	0.031	4.5
Corporate, Business Taxes	1,297	0.008	1.2
Employment Taxes	6,351	0.040	5.8
Tolls	865	0.005	0.8
Other	1,203	0.075	1.1
Total Taxes, Fees	22,579	0.141	20.5
Government Regulatory Mandates			
Tax Compliance	1,058	0.007	1.0
Reductions in Vehicle Emissions	1,202	0.008	1.1
Environmental Compliance	1,153	0.007	1.1
Labor Mandates	1,451	0.009	1.3
Vehicle Standards	1,047	0.007	1.0
Safety	596	0.004	0.5
Workers Compensation	8,800	0.055	8.0
Total Regulatory Mandates	15,307	0.096	13.9
Total Taxes, Fees, Mandates	37,886	0.237	34.4

Source: American Trucking Association

In fact, the full costs of truck ownership and operation in the United States are well below that of most other industrialized nations, such as in Western Europe, where highway pricing is generally substantially higher than in the U.S.

Underpricing and regulation of the trucking industry in Thailand is further compounded by the much greater emphasis by the government on financing expansion of the highway network, which as noted earlier in the report, is far more extensive than the rail network.

4. Other Economic Impacts

The ICDs, as crucial extensions to LC Port, are highly critical to the overall economic well being of the country, in particular as export and import activity are a significant and growing share of total economic activity. In particular, recovery from the current financial and currency crises facing the country will rely heavily on the export sector. That recovery, and a continued healthy economy, must not be hampered by bottlenecks at the port, nor for that matter in the intermodal network within the country.

Within the nation's interior, more balanced economic development of the regions outside of Bangkok are critical not only to those regions, but to the national economy as a whole. As noted earlier, during the fifth National Economic and Social Development Plan period of 1982-86, regional development was a top priority, and it continues to be. The current Eighth National Economic and Social Development Plan places emphasis on the social rather than the economic aspects of development, but it does this by means of the stated goal of "coordination and integration of all transport modes into a unified system". Strengthening of industrial estate areas is also an important objective of regional economic development, and the development of the CT station at Lamphun Industrial Estate may prove to accomplish this in that particular location.

Finally, although not in the foreseeable future, strengthening of the rail sector will play an important role in economic integration of the region as a whole, in particular as Thailand's immediate neighboring nations emerge more fully into the global economy.

V. SUMMARY AND RECOMMENDATIONS

This section summarizes the major findings from this report, with recommendations provided at the end for specific actions on the part of SRT.

A. MARKET ANALYSIS

1. General

Despite the fact that the SRT does not enjoy the geographic advantages of other rail systems (i.e., transportation distances in Thailand are relatively short), there are still considerable opportunities for increasing its intermodal market share. The following are the pertinent issues with regard to SRT's existing situation:

- **Historical Investment.** Investment by the government of Thailand in the transportation infrastructure has overwhelmingly focused on the highway network, and continues to do so. This has placed the SRT at a disadvantage with regard to competing against its highway competitors.
- **Infrastructure.** The SRT system has a hub-and-spoke design that reaches most major areas of the country, but does not provide adequate coverage into many of the newly industrialized areas, such as the Eastern Seaboard. The overall capacity of the railroad is low, given that most of the system consists of single track territory with outdated signal systems. In addition, the railroad presently serves its customers only through sidings at its stations, and does not have any direct access into industrial estates or the manufacturing facilities.
- **Competitors.** The dominant carrier of freight in Thailand is the trucking industry, with most of the trucks being ten wheelers. ISO containers are standard for the international port trade, but that is not true for the domestic market, where goods are loaded typically by pallet onto the ten wheelers. The trucking firms provide generally reliable service at relatively low cost, with next day delivery being the norm throughout Thailand.
- **Perceptions of shippers and receivers.** In general, the shippers interviewed as part of this study did not view the railroad as a serious competitor for transporting manufactured goods, probably the largest market for intermodal service. Reasons cited were unreliable service, price, and loss and damage problems. It should be stressed, however, that many of these firms have never used the SRT's services and they were speaking of their perceptions, rather than their experiences. It is these perceptions that the SRT must change if it is to successfully compete in the intermodal transportation market.

2. Market Projections

While the above comments were objective statements with regard to the existing situation, nonetheless the PB team feels there are significant opportunities for the SRT, if aggressive and focused actions are taken. An analysis of the freight transportation market in Thailand was developed, ultimately resulting in estimates for the amount of freight likely to be containerized, the amount of those containers likely to be captured by the SRT, and finally market projections for both the international (port-related) and domestic container traffic. These projections resulted in the following conclusions:

- The current Lat Krabang ICD will reach capacity by 2006 (current capacity for this ICD is defined as 1,000,000 TEUs, given certain improvements to the existing facility). To meet growing demand, by 2006 either the existing Lat Krabang ICD needs to be significantly expanded, or a new ICD needs to be constructed (recommended site is Ongkharak). By

2010, a second ICD will be needed at one of those two locations. Demand after 2010 is shared between Lat Krabang ICD and Ongkharak ICD.

- Traffic demand at the CTs will be small in the early years (less than 8,000 TEU/year), growing as the use of containers in the provinces increases. The projected market share for the new CTs is highly dependent on the implementation of reliable next-day service by SRT from each of these facilities.

3. Market Development Plan

PB developed a Market Development Plan (MDP), included in Chapter I, which summarizes the actions which should be taken by the SRT in order to develop a significant intermodal market share. The four elements of the MDP were:

- **Infrastructure.** Development of the required infrastructure to adequately serve the intermodal market is of highest importance. This report defines recommendations for improvements to the existing Lat Krabang ICD, conceptual plans for expanding that ICD, conceptual plans for a second ICD at Ongkharak, and conceptual plans for CTs at eight locations in the provinces. A discussion of the limitations of the existing rail capacity is also included, primarily for the LC Port to Lat Krabang ICD corridor.
- **Reliable Service.** Establishing reliable service to the new CTs is considered critical if SRT is to change perceptions and gain market share. Once competitive prices are established by the SRT, there is no consideration more important for the potential shippers than reliable service, and this will probably be the SRT's greatest challenge. Four parameters of reliable service, which need to be a focus for the SRT, are on-time performance, next-day service, loss and damage issues, and service guarantees.
- **Competitive Pricing.** Typical freight rates from the trucking industry are discussed, and the point is made that the SRT pricing structure must be set by the market rates. These rates have been established by the truckers, through their existing market share and their position as the most competitive transportation mode in Thailand.
- **Customer Base.** Expanding the customer base is one of the most important actions to be taken by the SRT, given the current perceptions of shippers. Customer forums are recommended as an important method for the SRT to develop a better understanding of the needs of each particular industry, and to gather the background information needed to develop a marketing strategy for each industry or firm. The target customers for the SRT should include: industrial and consumer goods companies; large trucking companies; warehousing and distribution companies; and freight forwarders who assemble shipments for movements to the ports.

The market projections for both international and domestic traffic show a significant increase over the next 20 years. This potential increase depends on the SRT implementing an MDP which entails serious changes.

B. IMPLEMENTING THE MDP

1. Site Selection

PB performed extensive site investigations and performed a comparison of the sites against established criteria. The following conclusions were reached regarding the development of ICDs and CTs.

- **ICDs.** To meet the projected demand from LC Port, the expansion of Lat Krabang ICD and the development of a new ICD at Ongkharak are recommended. The Ongkharak location is advantageous for its proximity to the Bangkok metropolitan area, its highway connections, and its ability to act as a distribution point for shipments to and from the CTs on the Northeastern Line.

- **CTs.** The following eight locations were recommended as sites for new CTs:
 - Lamphun Industrial Estate
 - Phitsanulok - Highway 12 bypass north of the city
 - Ban Phachi - Highway 329 crossing south of the railroad junction
 - Khon Kaen - Sam Ran station north of the city
 - Ubon Ratchathani - Highway 24 south of the city
 - Korat - small highway approximately 7 km west of the city
 - Hat Yai - Highway 43 overpass south of the city
 - Ongkharak (in addition to an ICD, a CT is required to handle domestic traffic)

2. Terminal Site Development

An evaluation was made of the operations at the ICDs and CTs, and conceptual designs were developed for an expansion of the existing Lat Krabang ICD, the new ICD at Ongkharak, and then a standard design (in three phases) for each of the CTs. This was followed by the development of capital and operating costs for these terminals.

The analysis of the existing Lat Krabang ICD revealed that the overall capacity could reach 1,000,000 TEU/year with improvements in five areas:

- Changes in the current pattern of container storage
- Utilization of both sides of the CFS
- Repartitioning of the module space
- Adding a fifth track in the facility for operating flexibility
- Construction of a storage yard

These recommendations for the existing facility were then incorporated into the design for the expansion of Lat Krabang ICD, after which the capacity would reach 2,000,000 TEU/year.

A standard container terminal module was developed to aid in the overall conceptual design effort, based on information gathered from Lat Krabang ICD. This standard module was then utilized for developing the designs, capital costs, and operating costs for both ICDs and CTs.

- **ICDs.** Two ICD designs were developed, one for the expansion of Lat Krabang ICD, and one for the new ICD at Ongkharak. These conceptual designs are shown on Figures 17 and 18.
- **CTs.** Since the market projections for the CTs show quite low traffic demand in the initial years, capital costs should also be kept low. To meet that goal, the conceptual design for the CTs envisions a start-up facility which is at a “bare bones” level, that is, a facility which is not paved (until later phases), a basic CFS, and a single reach stacker for moving the containers. This type of operation is considered sufficient until demand grows, and operating costs can be kept commensurately low. The intermediate and full-scale phases will be compatible with, and build on, the start-up facilities.

3. Railroad Operational Analysis

A broad evaluation of the existing SRT rail operation was performed, in order to define the range of operating issues involved in starting up the new intermodal service. These issues were defined as:

- **Service lanes and schedules.** For each ICD and CT, example schedules were developed within the limitations of the existing SRT infrastructure and operation. These schedules were intended to prove that reliable service for shippers was possible, and that the initial market projections could be met.
- **Rolling stock requirements.** The amount of locomotives and flatcars required to provide the new services were estimated, and capital costs were then estimated. It was

shown that the SRT probably has sufficient rolling stock to operate the new trains at least through 2003, after which new equipment will be required.

- **Operating costs.** Utilizing unit costs from the existing SRT operation, estimates were made of operating costs for the new intermodal train services. It was shown that the equipment costs were more of a determining factor in the overall costs than labor, and it was recommended that the SRT make a study to thoroughly evaluate its costs, so that steps can be taken to control them (in preparation for being competitive in price with trucks).
- **Work rules and operating practices.** The train crews on SRT consist of four employees, two each from two different departments, the Mechanical and Traffic departments. It is recommended that certain initiatives be explored, such as the unification of operating practices and crew districts to permit a uniform workday.
- **Line capacity.** While constrained by the single track situation, the length of passing tracks, and maximum allowable trailing tonnage, the existing infrastructure can support the trains to the CTs for the next few years. However, the most important rail capacity constraint that should be addressed is between LC Port and Lat Krabang ICD. This line segment is reaching its capacity and will limit the amount of rail service (and thus SRT revenue) to Lat Krabang ICD, and possibly the new ICD at Ongkharak.
- **Operating philosophy.** The future operation of intermodal service, beyond the existing service to Lat Krabang ICD, will involve a shift in operating philosophy for the SRT. The major points to be addressed are: the need to operate the COFC trains as a premium service on fast schedules; raising the priority of COFC trains comparable to passenger trains; providing delivery times comparable to trucks; increasing the awareness level of the SRT employees with regard to the requirements of the new service; and increasing the reliability of the rolling stock.
- **Customer interface.** To attract and keep new intermodal customers, the SRT should implement a number of initiatives, such as providing real-time information on shipments to customers, developing a set of policies and guidelines for the new services, holding customer forums to better understand the needs of the customers, and establishing better communication channels with customers.
- **New technology.** The use of new technology holds the promise of improvements in productivity for SRT, and while they are not the top priority recommended, they should be explored further by the SRT. This new technology includes: End of Train (EOT) devices to replace brake vans; Automatic Equipment Identification (AEI) system; Electronic Data Interchange (EDI) equipment and waybilling systems; and specialty containers.

4. Privatization Alternatives Summary

The privatization alternatives open to the SRT were summarized in this section, with actual recommendations coming in the Financial Analysis section of Chapter IV. The five alternatives discussed were:

- Service contracting
- Management contracting
- Leasing
- Build Operate and Transfer (BOT)
- Asset sale

Examples were cited in each of the sections to illustrate past experiences. From interviews with terminal operators who have experience on an international scale, they confirmed that there was no typical terminal operating agreement, and the agreements were location-specific. They did cite the following factors as being the most important in determining the form of the agreement:

- Availability of property
- Existing proprietary arrangements (e.g., equipment leases, labor agreements)

- Economies of scale (e.g., cooperation with other carriers)

In a discussion of risk allocation, the major categories of risk were identified as commercial, operational, investment, regulatory, and third party, and each were discussed.

Two other factors were discussed which will impact on the SRT decision regarding privatization: the level of SRT's involvement with each type of privatization, and the financial obligations associated with each type. In the latter discussion, a summary was made of the four types of financial transactions involved in privatization: tariffs; concessions; investments; and fixed fees.

C. ECONOMIC AND FINANCIAL ANALYSIS

1. Financial Analysis

In this section the PB team performed a financial feasibility analysis to determine the financial merits of the recommended CT and ICD sites, and then determined the attractiveness of each facility to private, stand-alone terminal developers. The analysis included the following components:

- Revenue streams
- Operating costs
- Capital costs and associated financing
- Taxes

The results covered three areas:

- **Cash Flow.** The cash flow projected for the two ICDs (Lat Krabang and Ongkharak) was quite favorable, with significant revenues and profits generated by the LC Port traffic. The cash flow for the CTs showed wide swings in their financial prospects, resulting from their smaller scale operations, and also the investment cycles which will come from the growth of the facilities through start-up, intermediate, and full buildout phases. The results showed that the CTs did return to profitability within 2 to 5.5 years after these investments were made.
- **Present Value.** Again, the results were favorable for the ICDs, in particular Ongkharak ICD since it will experience significant growth in its initial year from traffic diverted from Lat Krabang ICD. These favorable results will allow the SRT to seek increased concession fees for these sites.

The CTs are again a more complicated story. Four CTs (Lamphun, Phitsanulok, Ubon Ratchathani, and Hat Yai) yield solid long term rates of return of about 15%, but in the short term they will either need to be subsidized or else have a long term concession granted (for investors to recoup early losses). The CTs at Khon Kaen, Ban Phachi, Ongkharak, and Korat did not yield as favorable results, but for varying reasons. At Khon Kaen, for instance, the price of the land greatly influenced the results.

- **Privatization Recommendations.** The final recommendations for the privatization of the facilities was shown in Table 49 on page 108. For those ICDs and CTs which had good financial results, the BOOT approach was recommended as the best contractual arrangement. However, certain conditions were placed on the concessioning of the CTs versus the ICDs. It was also recommended that, for the four CTs with less favorable results, the SRT may have to fund their development.

2. Economic Analysis

The economic evaluation, as compared with the profitability-oriented perspective assumed by the financial analysis, focuses on the net economic benefits that result from the development of the various ICDs and regional CTs. In general, the economic analysis assumed that development of ICDs, supplemented by other SRT marketing strategies, will facilitate and result in the "capture"

of significant container traffic moving within Thailand, most of which now moves by truck. The "diversion" of this containerized cargo, estimates of which have been derived from the market analysis, is the primary source of direct economic benefit, as such diversion will entail transportation cost savings due to the lower unit variable costs of rail versus truck ownership and operation, especially over long distances. In addition, other benefits will occur, including reduced highway congestion and associated environmental benefits, as well as additional benefits of utilizing ICDs and regional CTs, such as improved load-centering in the transport of manufactured and raw materials, and (for containers moving through the LC Port), improved efficiencies in off-site container handling. These benefits are also reflected in the benefit-cost analysis.

In addition, estimates of the incremental impacts of the proposed ICD and CT terminals on SRT revenues and costs were made. Finally, more qualitative consideration were given to a number of other economic impacts, such as employment generation, impacts on private sector trucking firms, and achievement of regional economic and social development goals.

- **Benefit/Cost Analysis.** Benefit streams were developed for the ICDs and CTs, and then a benefit/cost ratio was developed. Overall, the results of economic benefit-cost analysis tend to support and buttress the findings of the financial analysis: namely, that the ICDs yield positive benefits and profits, and deliver substantial returns on invested costs, particularly Ongkharak ICD with its significant volumes in the early years. For the CTs, there is a bigger distinction between the results of the economic and financial analyses: the economic analysis indicates generally higher rates of return than does the financial analysis. The reasons for this discrepancy can be understood by the following comments:
 - Other economic benefits, in addition to direct shipper cost savings, are included in the economic results, such as congestion cost savings, reduced need for highway maintenance, improved load balancing, and avoidance of congestion within LC Port, quantities that are not reflected in the financial analysis.
 - While the individual CTs do not generally exceed the assumed financial hurdle rate of 15% rate of return, the best CT performers (Lamphun, Phitsanulok, Ubon Ratchathani, and Hat Yai) come very close. This is indicative of a good, although not necessarily stellar, financial result. As noted in the finance section, some (small) level of additional government support may be needed to spur privatization of these facilities, but not a great deal.
- **Impacts on SRT Revenues and Costs, and Tariff Recommendations.** An analysis was also made of the impacts of the proposed new ICD and CT systems on SRT's own financial balance sheet, both on the capital and operating sides of the ledger. A summary of projected revenues and costs were developed as part of this analysis.

The analysis indicates the potential for substantial improvements at the margin in SRT's financial condition as a result of a concerted effort to attract containers to its rail network. This includes facilitating development of the ICDs and CTs, as proposed, and also by means of improved marketing, operations, security, and possibly adjustments to its pricing schedule. In all cases, revenues resulting from diversions to rail more than fully compensate for the additional capital and operating expenses, in some cases by a considerable margin. In particular, the Ongkharak ICD is estimated to be able to help generate substantial net financial benefits for the SRT, by a margin of more than two to one (i.e., total present value of revenues over 30 years is more than twice the present value of costs, including both annual operations and maintenance and rolling stock acquisition.)

While these results should be viewed with some caution, given the estimation error, at the same time they should also be viewed by SRT as encouraging, in the sense that the results provide reasonable assurance that an ICD investment and rail marketing program will not result in financial losses for the agency, and that, in fact, it may result in an improvement in SRT's overall financial condition. Indeed, the proposed CT facilities may yield positive economic benefits and may also help to enhance SRT's own market and financial goals.

- **Pricing for intermodal Moves.** With regard to the pricing of its intermodal services, an analysis was performed and the recommendation is made that the SRT must be prepared to beat both truck service and truck prices to win a chance at securing new business. SRT pricing, therefore, will be set more by truck market-place dynamics than the SRT's own costs in the short term, as it attempts to gain market share. A table of recommended line haul rates is included in the Economic Analysis.
- **Other Economic Impacts.** The ICDs, as crucial extensions to LC Port, are highly critical to the overall economic well being of the country, in particular as export and import activity are a significant and growing share of total economic activity. In particular, recovery from the current financial and currency crises facing the country will rely heavily on the export sector. That recovery, and a continued healthy economy, must not be hampered by bottlenecks at the port, nor for that matter in the intermodal network within the country.

Within the nation's interior, more balanced economic development of the regions outside of Bangkok are critical not only to those regions, but to the national economy as a whole. As noted earlier, during the fifth National Economic and Social Development Plan period of 1982-86, regional development was a top priority, and it continues to be. The current Eighth National Economic and Social Development Plan places emphasis on the social rather than the economic aspects of development, but it does this by means of the stated goal of "coordination and integration of all transport modes into a unified system". Strengthening of industrial estate areas is also an important objective of regional economic development, and the development of the CT station at Lamphun Industrial Estate may prove to accomplish this in that particular location.

Finally, although not in the foreseeable future, strengthening of the rail sector will play an important role in economic integration of the region as a whole, in particular as Thailand's immediate neighboring nations emerge more fully into the global economy.

D. RECOMMENDATIONS

The previous section summarized the results of the entire effort by the PB team. Taken as a whole, the results show a strong argument for the development of an improved SRT intermodal system of ICDs and CTs to serve the entire country.

Aside from the detailed results, the bigger reality is that the future of the SRT may depend on developing the intermodal systems, in that its existing market share is dropping and new highway investments will further erode its position. Bold action is therefore necessary to make the changes required to shape the future of the SRT.

Building upon the four areas cited in the MDP, it is recommended that the SRT take the following actions:

1. Infrastructure

- A top priority is the implementation of the changes recommended by the PB team to make the existing Lat Krabang ICD more efficient. This would involve increasing its overall (ground-based) capacity to 1 million TEU/year, and making improvements to the track system to raise its rail capacity to at least 750,000 TEU/year. The initial ground-based system improvements would be operational, but the rail capacity improvements would require changes in infrastructure.
- Steps should be taken for the privatization and development of Ongkharak ICD, as well as the expansion of Lat Krabang ICD, in the two stages recommended in this report. Property should be acquired for each of the facilities, and a process begun for their privatization and development. With regard to which facility should be developed first, from an economic standpoint it would appear that Ongkharak would be the better choice, and also from a rail operations viewpoint, considering the scope of the track improvements which are necessary to increase Lat Krabang's rail capacity.

Another reason for the development of Ongkharak ICD as soon as possible is the dual nature of the proposed facility. A CT is recommended for Ongkharak in the short term (2001), in order to handle the domestic traffic from the provinces. Until an ICD is constructed at Ongkharak, however, the international traffic from the provinces would need to be shuttled through Lat Krabang ICD, making this an inefficient and costly operation in the short term. An ICD and CT together at Ongkharak would provide a significant focus and cost-efficient operation for the SRT.

The BOOT concept is recommended as the contractual arrangement for the development of these ICDs, considering the significant traffic volumes which are expected.

- The double tracking program from LC Port to Lat Krabang ICD should be completed as soon as possible, but no later than 2006 (in anticipation of the expanded Lat Krabang ICD). This initiative is critical for increasing the rail capacity in this corridor, which is necessary to supply both the Lat Krabang ICD and Ongkharak ICD.
- Another high priority is the development of a phased program for the CTs, similar to the conceptual designs in this report. The facilities should be developed under the BOOT scenario, with consideration given to the PB privatization recommendations given in this report. Despite the financial projections in the initial years, the CTs should be viewed as "engines" of regional economic development, and as necessary starting points for the SRT intermodal services.

The CTs at Lamphun, Phitsanulok, Ubon Ratchathani, and Hat Yai should be the first constructed. CTs at Khon Kaen, Korat, Ongkharak, and Ban Phachi, whose financial summary was less favorable, should be reviewed for their particular circumstances:

- Khon Kaen. The single factor which influenced the financial projections for this site was the cost of the land. Since this was an early real estate price given to PB by the SRT, this price should be evaluated to see if it can be reduced, in which case the CT should be developed since it is the only location serving the Upper Northeast region of Thailand.
- Korat. The CT site at Korat was explored with the goal of it being an intermediate point where trains from the Upper and Lower Northeast Lines would be combined, in addition to collecting further container traffic from the Korat area. If the traffic projections at Korat do not warrant a CT, then at least the infrastructure necessary to reliably and efficiently combine the intermodal trains from Khon Kaen and Ubon Ratchathani should be in place.
- Ongkharak. The CT site at Ongkharak is the termination point for the container traffic from the Northeast Line. This traffic will have both international and domestic containers, and a CT at Ongkharak is intended to be the distribution point for the overnight domestic traffic. In addition, the future ICD would become the focal point for all international traffic from the provinces. If the Customs Department regulations can be modified, such that a single facility could be built with separate sections for the two types of traffic, then there would be a considerable savings in capital costs.
- Ban Phachi. The important issue for the Northern Line was next day service to and from Bangkok. Ban Phachi, or a CT in an area close by, was considered critical to that goal. If it is possible, therefore, to provide next day service without Ban Phachi, then it does not need to be developed, but otherwise not constructing this CT may mean that the traffic projections for Lamphun and Phitsanulok may be somewhat less than anticipated in the market forecast. It should be added, however, that in the initial years of operation the large majority of the containers moving through Lamphun and Phitsanulok will be destined for import or export by way of LC Port, bypassing Ban Phachi. Over time, the demand for interregional container shipments between the northern regions will increase, and that segment of the rail container market would not be easily satisfied in the absence of a terminal at Ban Phachi.

The financing of these sites could follow a number of scenarios, such as the SRT directly subsidizing the construction and contracting the operation. Alternatively, future development of these CTs could be made optional as part of the BOOT contract or contracts for the CTs at

Lamphun, Phitsanulok, Ubon Ratchathani, and Hat Yai. Linking the development of these more profitable CTs to the less profitable interior CTs may be justified and could be taken up by developers to the extent that the latter expand the market share of the former.

2. Reliable Service

In line with developing the ICDs and CTs, the SRT should take the steps necessary to establish reliable train service to the facilities:

- **Train Schedules.** Develop specific train schedules which take advantage of the nighttime windows for moving intermodal freight to and from the provinces.
- **Rolling Stock.** Evaluate the SRT rolling stock required for the increased services, particularly the flat cars and locomotives. In addition, a preventative maintenance program should be established to increase the reliability of the fleet.
- **Operating Costs.** An evaluation should be made of the SRT internal costs as they relate to freight service. Certain cost reduction measures may be necessary in order to begin controlling costs and being price-competitive with trucks.
- **Work Rules.** If it is considered necessary for providing reliable service, the daily working hours and reporting locations of the Traffic and Mechanical Departments should be unified.
- **Operating Philosophy.** The greatest challenge here will be the orientation of the SRT personnel toward the importance of the new intermodal service. Accordingly, training programs should be started to engage the crews who will actually be operating the trains, station masters need to understand the importance of efficient movements on a daily basis, and other training as required.
- **Customer Interface.** Policies and guidelines should be developed for the new service, particularly with providing real time information on shipments to customers. Information system improvements should be implemented as necessary to supply such information.
- **New Technology.** The SRT should strongly consider the use of end-of-train devices (EOT) for the elimination of Brake Vans on intermodal trains. The issue is not so much reducing labor costs, as it is increasing the efficiency of the train movements in the new CTs and ICDs.

3. Competitive Pricing

It is recommended that the SRT adopt a pricing level similar to that suggested in Chapter IV.B the Economic Analysis. It is further recommended, however, that the SRT perform significant research into the competitive pricing levels of various trucking firms, both regionally and locally, and create a database with this information, which can be regularly updated to evaluate their pricing levels. Another aspect of pricing that may need to be reevaluated is short haul rates applicable to service between LC Port and Lat Krabang ICD (and in the future, between LC Port and Ongkharak ICD). While the shorter distance means that rail costs and thus rates will be higher than for longer hauls, this market is also subject to intense competition from trucks. Providing discounts for larger volume customers, or special pricing for full service contracts from LC Port to point-of-delivery, may provide one way for the SRT to compete with trucks, which are subject to greater competitive pressures and excess capacity within the industry.

4. Customer Base

Comments were provided in the MDP with regard to the target customers for the SRT intermodal service, and what actions the SRT should take to attract their business. It is recommended that these actions be taken.

The highest priority should be given, however, to the SRT staff adopting a new approach to the marketplace and its future customers. Customer forums should be held in order to help the SRT

staff understand the needs of potential customers, and then a marketing strategy for each industry needs to be developed, targeted to their specific transportation requirements. The SRT needs to change perceptions of the shippers and show that it can add value to their distribution system.

In addition, the SRT should form strategic partnerships with the Customs Department, Port Authority of Thailand and the IEAT. With this partnership, the planning for new facilities can be achieved in a coordinated effort, and the resolution of institutional issues (barriers between agencies or departments) can be addressed efficiently. These partnerships are considered critical for building an improved inland container transport system.

Finally, it is also recognized by the PB team that the privatization of the entire SRT is being discussed, as with most other nationalized railroads. While this larger issue was not specifically evaluated by PB, it is worth noting that the increase in revenues from a successful intermodal operation, and the changes to a more customer-focused service, will benefit the SRT in many ways, including enhancing the privatization potential of SRT services.

The two most important tasks facing the SRT management, as with any other business, will be controlling its costs while increasing revenues, and this will be true whether the railroad system is privatized or not. While the PB effort primarily concerned the development of a strategy for increasing revenue through the new intermodal services, it is recommended that the SRT should seriously address the issue of controlling costs if it is to be successful in the long term.



Appendix A
Inventory of Project Data

A-1 SUMMARY OF INTERVIEWS 2

A-2 SUMMARY OF MATERIAL RECEIVED 8

A-1 Summary of Interviews

Date	Attendees (and firms)	Location	Author of Mtg. Minutes	PB Distrib.	SRT Distrib.	Remarks
10/22/97	SRT - S. Sirivedhin, V. Mala; PB - D. Pumhirun, G. Hoffman	SRT Headquarters	G. Hoffman	10/28/97	10/31/97	Kickoff meeting
10/22/97	PB - D. Pumhirun; G. Hoffman	PB offices	G. Hoffman	10/28/97	10/31/97	Reviewed capital projects across Thailand, particularly mass transit projects in Bangkok.
10/24/97	SRT - V. Mala, N. Yodrak, W. Areewong, other Lat Krabang staff; PB - D. Pumhirun, G. Hoffman	Lat Krabang ICD	G. Hoffman	10/28/97	10/31/97	Site visit
10/27/97	SRT - V. Mala, S. Dechakhum; PB - D. Pumhirun, G. Hoffman	SRT Headquarters	G. Hoffman	10/28/97	10/31/97	Discussed the entire list of information requested by PB, and the potential list of interviews
10/29/97	Express Transportation Organization - Khun Term; PB - D. Pumhirun, G. Hoffman	ETO Headquarters	G. Hoffman	11/5/97	11/5/97	Discussed the ETO business and visited the loading/unloading facilities
10/31/97	Laem Chabang Port (PAT) - K. Tantivejakul; PB - D. Pumhirun, G. Hoffman	Laem Chabang Port offices	G. Hoffman	11/6/97	11/7/97	Discussed LC Port issues
11/3/97	SRT - V. Mala; PB - D. Pumhirun, G. Hoffman	SRT Headquarters	G. Hoffman	11/6/97	11/7/97	Received much of the information requested in the 10/27/97 meeting, and discussed other issues.

Date	Attendees (and firms)	Location	Author of Mtg. Minutes	PB Distrib.	SRT Distrib.	Remarks
11/3/97	Inspector General of MOTC - C. Chaimankong; PB - D. Pumhirun, G. Hoffman	Ministry Headquarters - Mr. Chaimankong's office	G. Hoffman	11/25/97	11/26/97	Discussed MOTC's views on the SRT study, and other concurrent efforts to study ICDs for the port system.
11/3/97	Nestle - S. Autamapanyanan, P. Pasawat; PB - D. Pumhirun, G. Hoffman	Nestle's offices on Ploenchit Road	G. Hoffman	11/25/97	11/26/97	Discussed Nestle's distribution system
11/4/97	Thailand Development Research Institute - N. Snitbhan; PB - D. Pumhirun, G. Hoffman	TDRI offices	G. Hoffman	11/25/97	11/26/97	Received a tour and discussed TDRI's previous work for the MOTC and SRT
11/4/97	Industrial Estate Authority of Thailand - Dr. S. Thinaphong (Governor), N. Vimuktanon, C. Clark; PB - D. Pumhirun, G. Hoffman	IEAT Headquarters	G. Hoffman	11/25/97	11/26/97	Discussed IEAT initiatives and received basic information on the location of estates, etc.
11/6/97	National Economic and Social Development Board - S. Wongvithayakarnjorn, S. Bunyasiri; PB - D. Pumhirun, G. Hoffman	NESDB offices	G. Hoffman	11/25/97	11/26/97	Discussed NESDB oversight role for governmental investment in transportation projects
11/6/97	Proctor & Gamble - G. Robbins; PB - D. Pumhirun, G. Hoffman	P&G offices (Klong Toey)	G. Hoffman	11/25/97	11/26/97	Reviewed P&G distribution system in Thailand
11/19/97	SRT - V. Mala, S. Dechakhum, U. Opas, M. Pantawan, Y. Luxsitanon; PB - D. Pumhirun, F. Teifeld	SRT Headquarters	F. Teifeld	12/3/97	12/19/97	Discussed methodology of freight operations. Obtained answers to specific questions impacting establishment of COFC service.
11/26/97	Banpu Public Company Ltd. - V. Pienpitak, R. Siwadechatep, A. Taifayongvichit; PB - D. Pumhirun, F. Teifeld.	Banpu Headquarters	F. Teifeld	12/3/97	12/19/97	Discussed Banpu's experiences with Roadtrailer equipment on SRT

Date	Attendees (and firms)	Location	Author of Mtg. Minutes	PB Distrib.	SRT Distrib.	Remarks
12/3/97	SRT - S. Srivedhin, W. Chaisiri; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	SRT Headquarters	R. DeGennaro	12/23/97	12/19/97	Review of various project issues
12/4/97	Nestle - S. Autamapanyanan, P. Pasawat; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	Nestle's offices on Ploenchit Road	R. DeGennaro	12/23/97	12/19/97	Discussion of Nestle's distribution network and handling of raw materials and imported goods
12/4/97	SRT - N. Yodrak, P. Reungsap, S. Koomprapan; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	SRT Lat Krabang ICD	F. Teifeld	12/11/97	12/19/97	Familiarization meeting concerning the operations at Lat Krabang ICD
12/8/97	BMT - C. Soraj; PB - D. Pumhirun; BAH - R. DeGennaro	Bangkok Modern Terminal Ltd. Bangkok Port	R. DeGennaro	12/24/97	12/19/97	Discussion of BMT's operations
12/9/97	Colgate - C. Nantapat; PB - D. Pumhirun; BAH - R. DeGennaro	Colgate-Palmolive offices	R. DeGennaro	12/24/97	12/19/97	Discussion of Colgate Palmolive's distribution system
12/11/97	CP Group - V. Kitiroachwattana, S. Rojponpradit; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	C.P. Group (Dynamic Intertransport Co. C.P. Intertrade Co.) offices	R. DeGennaro	12/24/97	12/19/97	Charon Pokphand Group. Discussed CP's transport logistics and methodologies for raw materials and finished goods.
12/12/97	NESDB - K. Madhyamankura, D. Webster, R. Suthakavatin; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	National Economic and Social Development Board offices	R. DeGennaro	12/24/97	12/19/97	Discussed NESDB's plans for development of transport corridors within Thailand and connections with ASEAN nations
12/15/97	Customs Dept., Kingdom of Thailand - B. Choekvivat; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	Lat Krabang ICD	R. DeGennaro	12/24/97	1/19/98	Discussed volumes of import goods moving through Lat Krabang ICD

Date	Attendees (and firms)	Location	Author of Mtg. Minutes	PB Distrib.	SRT Distrib.	Remarks
12/15/97	Toyota - P. Prawalpat, P. Sangnark; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	Toyota Motor Thailand Samut Prakan Assembly Plant	R. DeGennaro	12/24/97	1/19/98	Developed understanding of Toyota assembly operations in Thailand and logistics of parts supplies
12/16/97	MOTC - S. Skulratana; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	MOTC headquarters	R. DeGennaro	12/24/97	1/19/98	Received overview of MOTC's position on future of SRT
12/16/97	MOTC - C. Chaimankong; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	MOTC headquarters	R. DeGennaro	12/24/97	1/19/98	Further discussion of MOTC's perspective on transportation system
12/16/97	Land Transport Department - P. Talaenoi; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	LTD offices	R. DeGennaro	12/24/97	1/19/98	Discussion of LTD's issues
12/16/97	IEAT - N. Vimuktanon, C. Clark; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	IEAT Headquarters	R. DeGennaro	12/24/97	1/19/98	Discussion of IEAT's policies, estates, etc.
12/17/97	Sahachoke - P. Thonkongtoon, P. Anurat; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	Sahachoke offices	R. DeGennaro	2/24/98	2/25/98	Discussion of Sahachoke's operations
12/18/97	Federation of Thai Industry - P. Kmonwatananisa; PB - D. Pumhirun, F. Teifeld; BAH - R. DeGennaro	FTI offices	R. DeGennaro	2/24/98	2/25/98	Discussion of the Federation and its membership, and their lack of use of SRT
12/18/97	SRT - S. Sirivedhin, V. Mala; PB - D. Pumhirun; BAH - R. DeGennaro	SRT Headquarters	R. DeGennaro	2/24/98	2/25/98	Briefing of SRT officials on the results of interviews with industries
1/21/98	SRT - S. Sirivedhin, W. Chaisiri, V. Mala; PB - D. Pumhirun, G. Hoffman	SRT Headquarters	G. Hoffman	1/26/98	2/5/98	Discussed Inception Report and the Subtask B.1 Report (on suggested geographical locations for new terminals).

Date	Attendees (and firms)	Location	Author of Mtg. Minutes	PB Distrib.	SRT Distrib.	Remarks
1/26/98	SRT - V. Mala, S. Dechakhum; PB - G. Hoffman, F. Teifeld	SRT Headquarters	G. Hoffman	2/5/98	2/5/98	Discussed various issues such as right of way maps, etc.
1/26/98	SRT - S. Balyore, S. Dechakhum; PB - G. Hoffman, F. Teifeld	SRT Headquarters	G. Hoffman	2/5/98	2/5/98	Discussed the SRT signal system
1/26/98	SRT - P. Phaobsaeng (and staff), U. Opas; PB - G. Hoffman, F. Teifeld	SRT Headquarters	G. Hoffman	2/5/98	2/5/98	Discussed the unit costs for SRT labor, locomotive use, etc.
1/27/98	Ngow Hock Agency Co. - P. Lohaviriyasiri; Regional Container Lines Group - T. Chantarangkul; PB - D. Pumhirun, G. Hoffman	RCL Headquarters	G. Hoffman	2/10/98	2/25/98	Discussed Ngow Hock and RCL company, its shipping interests, etc.
1/27/98	Siam Stevedoring Services - K. Akkarekajit; SRT - V. Mala, M. Pantawan; PB - F. Teifeld; JWD - R. Woodman	Lat Krabang ICD	F. Teifeld	2/5/98	2/5/98	Discussion of Lat Krabang ICD facility and activities
1/27/98	SRT - V. Mala, M. Pantawan; PB - F. Teifeld; JWD - R. Woodman	Lat Krabang ICD	F. Teifeld	2/5/98	2/5/98	Discussion of Lat Krabang facility and activities
1/28/98	Dauids Distribution - S. Costello; PB - I. Hirschman, S. Prakunhungsit	Dauids offices	I. Hirschman	2/5/98	2/5/98	Discussion of Dauids operations
1/28/98	SRT - V. Mala, K. Krongboonying; PB - I. Hirschman, S. Prakunhungsit	SRT Headquarters	I. Hirschman	2/5/98	2/5/98	Discussion of SRT financial issues
1/29/98	SRT - W. Areewong; PB - I. Hirschman, S. Prakunhungsit	Lat Krabang ICD	I. Hirschman	2/5/98	2/5/98	Discussion of Lat Krabang financial issues
1/29/98	APL/NOL - N. Wijeratne; PB - I. Hirschman, S. Prakunhungsit	APL/NOL offices	I. Hirschman	2/5/98	2/5/98	Discussion of APL's activities in Thailand

Date	Attendees (and firms)	Location	Author of Mtg. Minutes	PB Distrib.	SRT Distrib.	Remarks
2/3/98	Bangkok Terminal Services - K. Chongsiriwanchai, Khun Suwanna, Khun Amphol; PB - I. Hirschman, S. Prakunhungsit	BTS offices	S. Prakunhungsit	2/5/98	2/5/98	Discussion of BTS services
2/5/98	SRT - V. Mala; PB - F. Teifeld, G. Hoffman	SRT Headquarters	G. Hoffman	2/10/98	2/23/98	Discussed various issues such as right of way maps, etc.
2/5/98	SRT - K. Sriyoudh, V. Mala, and others; Transportation Association - C. Pojananuphap, T. Kanivichaporn; PB - D. Pumhirun, I. Hirschman, F. Teifeld, G. Hoffman	SRT Headquarters	G. Hoffman	2/10/98	2/23/98	Discussed the trucker's association and major issues such as tariff rates, the use of containers, etc.
6/16/98	SRT - K. Sriyoudh, V. Mala, and others; PB - I. Hirschman, D. Pumhirun, and G. Hoffman	SRT Headquarters	G. Hoffman	6/30/98	6/30/98	Reviewed the draft final report in detail and discussed the various comments submitted by the SRT
6/18/98	Final presentation by PB to SRT staff and other. Presenters - I. Hirschman and G. Hoffman	SRT Headquarters	No meeting minutes			

A-2 Summary of Material Received

Item	Source	Document Type	Doc. Date	English/ Thai
1	Asian Development Bank (Author -PB)	Songkhla and Phuket Ports Development Project; Final Report - Volumes 1 and 2	Feb-96	English
2	Thailand Development Research Institute	SRT Master Development Plan Study - Final Report	Feb-93	English
3	Thailand - Ministry of Transport and Communications	Final Report for Analysis of Transport Demand and Supply in Thailand (Phase 1)	Oct-95	English
4	SRT (Author - Japan Railway Technical Service JARTS)	Report on Preliminary Study of Container Transport System for SRT	Mar-95	English
5/5A	SRT	Statistics at Laem Chabang Port for fiscal years 1991-1997	NA	Both
		Graph of Container Cargo Traffic Prediction for Laem Chabang and Bangkok Ports (1994 - 2025)	NA	English
		Track diagram of Lat Krabang	NA	
		General Layout sheet for Lat Krabang (1:2000)	Oct-93	Thai
6	SRT	SRT Operating Rules	Jan-92	Thai
7/7A	SRT	SRT Information Booklet 1996 (7); draft of updated booklet for 1997 (7A)		English
8/8A	SRT	Train schedules (passenger) for the major lines (5 separate ones)	Aug-97	Thai
9/9A	SRT	1996 Summary of freight goods movements by SRT	Mar-97	Both
10/10A	SRT	1997 Summary of capacity for each line	Jan-97	Thai
11	SRT	1994 edition of Leading Particulars of Rolling Stock (SRT)	NA	English
12	SRT Construction Department	Infrastructure Development Program	Aug-97	English
13	SRT	Single page summary of freight tariff rates (effective 7/97) by distance	Jul-97	English
14 14A 14B	SRT	Freight tariff summaries (more complete versions in Thai) by commodity, distance, and many specific origin/destination pairs	Aug-97	Thai
15	SRT	Traffic projections for SRT (1997 to 2003)	Jul-97	Thai

Item	Source	Document Type	Doc. Date	English/ Thai
16	IEAT	Summary of companies in each industrial estate, with notes on their business, phone number, etc.	Current	Thai
17	SRT	Agreement between SRT and APL for the operation of an intermodal terminal	Jun-94	English
18	SRT	Concession contract for the operation of a module at Lat Krabang ICD	Mar-96	English
19	SRT (Mechanical Department)	Leading Particulars for SRT fleet (update from 1994 document, item 11 above)	Aug-97	English
20/20A	SRT	Industrial Estate Authority of Thailand - Summary	NA	Thai
21 21A 21B	Thailand Development Research Institute	Transportation Master Plan (in Thai) plus separate Executive Summary in English (written for MOTC - all modes)	Aug-97	Both
22	Thailand Development Research Institute	Annual Report 1996	Dec-96	English
23	Thailand Development Research Institute	Report to the MOTC - Summary of responsibilities of departments under MOTC	Aug-97	Both
24/24A	Thailand Development Research Institute	Report to SRT - Strategic plan for the future	Aug-97	Thai
25	Thailand Development Research Institute	TDRI Publication List	Dec-96	English
26	Industrial Estate Authority of Thailand	Brochure which explains IEAT	Dec-91	English
27	Industrial Estate Authority of Thailand	Summary of industrial estates - area, price, utilities, etc.	Sep-97	English
28	Industrial Estate Authority of Thailand	Brochures from the various industrial estates (of which there are 30, but PB did not receive all brochures)	Current	Both
29	SRT	Summary of track standards - <u>Confidential</u>	Dec-86	English
30/30A	SRT	Annual Statistic Report - 1995	NA	Thai
31	SRT (Author - DECONS)	Report - Strategic plan for increasing containerization (on the SRT)	Aug-88	Thai
32	Laem Chabang Port	Summary of LC Port activities during fiscal year 1997 (containers, revenue, etc.)	Sep-97	Thai
33	Express Transportation Organization	Directory for ETO district personnel (phone numbers, etc.)	NA	Thai

Item	Source	Document Type	Doc. Date	English/ Thai
34	National Economic and Social Development Board (NESDB)	Infrastructure Development Report	Jun-97	English
35	NESDB	Summary of 8th NESD Plan (1997 to 2001)	Current	English
36	NESDB	The 8th NESD Plan (1997-2001)	Current	English
37	TDRI	Thailand Economic Information Kit	Mar-97	English
38/38A	TDRI	Updated Transportation Master Plan (written for MOTC - all modes)	Oct-97	Thai
39	Nestle	Truck Company information	Nov-97	English
40/40A	SRT	The Joint Operation of Cargo Train Service	Jul-97	Thai
41	SRT	Lat Krabang ICD General Information	NA	Both
42	SRT	Railroad Structure (specifications)	NA	Thai
43	SRT	SRT Passenger/Freight Train timetable	Feb-97	English
44	SRT	Specification of diesel train rolling stock for each route (Trailing tonnage by loco class and line segment)	NA	Thai
45	SRT	Availability of railcar FY 1990-1996	NA	Thai
46	SRT	Railcar availability and roundtrip time for May 1996	Jun-96	Thai
47	SRT	SRT stringline diagrams (Seventeen large drawings)	NA	Both
48	SRT	SRT information booklet (Same as 7/7A, but marked to show fueling locations)	NA	English
49	Industrial Estate Authority of Thailand	Faxed sheets detailing land use and nature of businesses located in industrial estates	Dec-96 Jun-97	Both
50	SRT	Certain station maps - large format blueprints	Various	Thai
51	SRT	Traffic statistics for Laem Chabang ICD (by module)	Various	Thai
52	Nestle	Map of key consumer products distribution warehouses in BKK area	NA	English
53	Nestle	Descriptive literature for new Bangkok truck terminals	8/97 and 10/97	Both
54	Nestle	Existing and proposed operating hour restrictions for trucks	NA	English

Item	Source	Document Type	Doc. Date	English/ Thai
55	MOTC - Department of Land Transport	Study on Greater Bangkok Truck Terminals in Kingdom of Thailand	Jul-92	English
56	IEAT	IEAT 24th Anniversary Brochure	NA	English
57	IEAT	Annual Report	95/96	Both
58	IEAT	Descriptive brochure (Lists 23 estates with map of locations)	NA	English
59	IEAT	Descriptive brochure - Industrial Estates of Eastern Seaboard (List private industrial estates developed by Hemaraj Land and Development Public Company)	NA	English
60	Sahachoke Transport	Advertising brochure	NA	English
61/61A	Customs Department	Import volumes through Lat Krabang ICD	96/97	Thai
62	SRT	Final report for feasibility study: track realignment and railway improvements between Map Kabao and Lad Buakao: Executive Summary	Jun-97	English
63	SRT	Main report for No. 62 above	Jun-97	English
64	SRT	Appendices B, C, F for report from No. 62 above	Jun-97	English
65	SRT	Appendices G, H, I, J for report from No. 62 above	Jun-97	English
66	SRT	Appendices A, D, E for report from No. 62 above	Jun-97	English
67	APL	Advertising brochure	NA	English
68	Federation of Thai Industries	Information about the Federation; summary of industry clubs	1997	Thai/ English
69	SRT	Spreadsheet of Lat Krabang marketing staff and salaries	1997/98	Thai
70	SRT	Various: map of dispatching territories; map of mechanical department territories; map of fuel tank capacity and consumption per day (SRT system)	1997	Thai/ English
71	SRT	Additional SRT station maps	Various	Thai
72	Regional Container Lines (RCL)	RCL 1996 Annual Report	1997	Thai/ English
73	Thai Military	Maps for various areas in Thailand	Latest versions	Thai/ English
74	SRT	Details of space/area usage at Lat Krabang	1995	Thai

Item	Source	Document Type	Doc. Date	English/ Thai
75	APL	Description of Lat Krabang operation for APL (confidential)	Nov-97	English
76	Siam Shoreside Services	Tariff summary for Lat Krabang	1997	English
77	Evergreen	Tariff summary for Lat Krabang	1997	English
78	SRT	Summary of container flows (import/export) for Lat Krabang for fiscal year 1997	1997	Thai
79	SRT	Summary of O&M costs at Lat Krabang for fiscal year 1997	1997	Thai
80	SRT	Summary of freight cost allocations for FY 1996	1997	Thai
81	SRT	Summary of current and projected concession revenues for Lat Krabang	1996	Thai
82	SRT	Lat Krabang - Tender for concession of the ICD modules	Mar-95	English
83	Department of Highways	Annual Report for 1996	1996	Thai/ English
84	SRT	List of approximate areas for cement facilities at Bang Sue	Current	Thai
85	SRT	List of distances of various SRT stations from Ongkharak	Current	Thai
86	SRT	List of rough cost estimates for signalling improvements to recommended new CTs		Thai
87	SRT	Schematic of ten wheel truck on SRT flatcar (for approximating the volume of the truck)		Thai
88	SRT	Table - Volume and Revenue of Freight at Bang Sue	Jun-05	Thai

Appendix B

Freight Flows and Forecasts in Thailand, By Region

B-1	ESTIMATE OF MAJOR FREIGHT MOVEMENTS IN THAILAND (1997) (THOUSANDS OF TONS).....	2
B-2	FREIGHT MOVEMENT FROM BANGKOK TO THE MAJOR REGIONS OF THAILAND 1998 TO 2018 (THOUSANDS OF TONS).....	3
B-3	FREIGHT MOVEMENT TO BANGKOK FROM THE MAJOR REGIONS OF THAILAND 1998 TO 2018 (THOUSANDS OF TONS).....	4

B-1

Estimate of Major Freight Movements in Thailand (1997) (Thousands of Tons)

Region	Commodity	Tons To Bangkok	Tons From Bangkok
Central	Const Mat'l	12,219	334
	Mining Prod	50	1,268
	Ag Prod	2,626	688
	Mfg Goods	266	792
	Total	15,161	3,082
North	Const Mat'l	193	249
	Mining Prod	314	1,534
	Ag Prod	2,530	712
	Mfg Goods	209	1,342
	Total	3,245	3,837
Northeast	Const Mat'l	89	179
	Mining Prod	9	1,448
	Ag Prod	2,502	858
	Mfg Goods	191	1,018
	Total	2,791	3,503
East	Const Mat'l	7,219	388
	Mining Prod	306	428
	Ag Prod	1,925	923
	Mfg Goods	457	970
	Total	9,907	2,709
South	Const Mat'l	70	128
	Mining Prod	9	191
	Ag Prod	1,320	397
	Mfg Goods	401	852
	Total	1,799	1,567
West	Const Mat'l	24,368	357
	Mining Prod	88	1,678
	Ag Prod	4,569	994
	Mfg Goods	591	1,091
	Total	29,616	4,119
Total Country	Const Mat'l	44,157	1,636
	Mining Prod	776	6,547
	Ag Prod	15,472	4,571
	Mfg Goods	2,114	6,064
	Total	62,520	18,818

B-2

Freight Movement from Bangkok to the Major Regions of Thailand 1998 to 2018 (Thousands of tons)

Region	Commodity	1998	2003	2008	2013	2018
Central	Const Mat'l	346	423	525	639	779
	Mining Prod	1351	1860	2561	3525	4852
	Ag Prod	713	870	1079	1315	1602
	Mfg Goods	821	1003	1244	1516	1847
	Total	3232	4156	5409	6995	9080
North	Const Mat'l	255	292	346	411	487
	Mining Prod	1635	2251	3098	4265	5871
	Ag Prod	728	833	989	1173	1391
	Mfg Goods	1372	1571	1864	2211	2622
	Total	3990	4947	6297	8059	10371
Northeast	Const Mat'l	183	207	244	285	332
	Mining Prod	1544	2125	2925	4027	5543
	Ag Prod	875	991	1168	1362	1589
	Mfg Goods	1037	1175	1385	1615	1884
	Total	3638	4499	5722	7288	9347
East	Const Mat'l	398	463	556	655	772
	Mining Prod	456	628	864	1190	1638
	Ag Prod	945	1099	1321	1557	1834
	Mfg Goods	993	1156	1389	1637	1928
	Total	2792	3345	4131	5039	6173
South	Const Mat'l	130	147	171	196	225
	Mining Prod	203	280	386	531	731
	Ag Prod	404	457	532	610	700
	Mfg Goods	868	980	1142	1310	1502
	Total	1606	1863	2231	2647	3158
West	Const Mat'l	365	423	508	605	720
	Mining Prod	1789	2463	3390	4666	6423
	Ag Prod	1017	1177	1415	1684	2005
	Mfg Goods	1117	1293	1554	1849	2201
	Total	4288	5355	6867	8805	11349
Total Country	Const Mat'l	1677	1954	2350	2791	3315
	Mining Prod	6979	9607	13224	18203	25058
	Ag Prod	4682	5428	6505	7702	9121
	Mfg Goods	6209	7177	8577	10137	11984
	Total	19547	24166	30657	38833	49478

B-3

Freight Movement to Bangkok from the Major Regions of Thailand 1998 to 2018 (Thousands of tons)

Region	Commodity	1998	2003	2008	2013	2018
Central	Const Mat'l	12714	15823	20040	24888	30907
	Mining Prod	54	74	102	140	193
	Ag Prod	2732	3400	4306	5348	6641
	Mfg Goods	276	344	435	541	672
	Total	15776	19640	24884	30916	38413
North	Const Mat'l	197	229	276	333	402
	Mining Prod	335	461	634	873	1201
	Ag Prod	2593	3008	3627	4375	5276
	Mfg Goods	214	248	299	361	435
	Total	3339	3946	4837	5941	7314
Northeast	Const Mat'l	91	104	125	147	175
	Mining Prod	10	13	19	25	35
	Ag Prod	2555	2931	3508	4154	4918
	Mfg Goods	195	224	268	317	376
	Total	2850	3272	3919	4644	5503
East	Const Mat'l	7412	8748	10705	12816	15343
	Mining Prod	327	449	619	852	1172
	Ag Prod	1977	2333	2855	3418	4092
	Mfg Goods	469	554	678	811	971
	Total	10184	12084	14857	17897	21578
South	Const Mat'l	71	81	96	112	130
	Mining Prod	9	13	17	24	33
	Ag Prod	1347	1539	1821	2116	2459
	Mfg Goods	409	467	553	642	747
	Total	1836	2100	2487	2894	3369
West	Const Mat'l	25000	29356	35926	43486	52637
	Mining Prod	94	129	178	244	336
	Ag Prod	4688	5504	6736	8154	9869
	Mfg Goods	607	712	872	1055	1277
	Total	30388	35701	43712	52939	64120
Total Country	Const Mat'l	45485	54341	67169	81782	99593
	Mining Prod	828	1139	1568	2158	2971
	Ag Prod	15891	18714	22854	27563	33255
	Mfg Goods	2170	2549	3105	3728	4478
	Total	64373	76743	94695	115232	140297

Appendix C

Details of ICD and CT Cost Estimates

C-1	UPDATED COST ESTIMATE OF CURRENT LAT KRABANG ICD	2
C-2	COST ESTIMATE OF LAT KRABANG ICD EXPANSION, PHASE 1	3
C-3	COST ESTIMATE OF LAT KRABANG ICD EXPANSION, PHASE 2	4
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C-8	COST ESTIMATE FOR FULL-SCALE PHASE (ADD TO START-UP & INTERMEDIATE PHASES FOR TOTAL COST)	9

C-1 Updated Cost Estimate of Current Lat Krabang ICD

Capital Cost		(Million Baht)
Land	Land Acquisition (800m x 1,400m)	2,520.0
	Land Fill up to 1.35 MSL	313.6
Structure	CFS	302.9
	ICD Office	90.2
	Gate	23.7
	Work Shop	40.5
Area	Container Yard Area	542.4
	Washing Area	1.5
	Car Park & Misc. Area	80.1
Road	Paved Road Area	221.9
Rail	Turnout x 13	31.6
	Track (4,800m)	74.9
	Grading (20m x 1,200m)	1.2
	Railhead Operating Area	118.8
Total		4363.3
Equipment Capital Cost		
41-ton Reach Stacker x 18		360.0
Sidepick x 18		180.0
Yard Tractor x 36		115.2
Yard Chassis x 72		43.2
Total		698.4
Annual Operating Cost		
Labor	Management x 18	4.3
	Non-mgmt x 558	67.0
	SRT Personnel x 13	2.3
Facility		3.7
Equipment (@ 1,000,000 TEU/yr)	41-ton Reach Stacker	114.4
	Sidepick	17.6
	Yard Tractor	92.6
	YT Chassis	-
		-
Total		301.9

Note: All costs in 1997 Bahts

C-2

Cost Estimate of Lat Krabang ICD Expansion, Phase 1

Capital Cost		(Million Baht)
Land	Land Acquisition (450m x 1,100m)	1,113.8
	Land Fill up to 1.35 MSL	138.4
Structure	CFS	151.4
	ICD Office	45.1
	Gate	11.8
	Work Shop	20.3
Area	Container Yard Area	239.4
	Washing Area	0.8
	Car Park & Misc. Area	40.1
Road	Paved Road Area	95.9
Rail	Turnout x (9 + 5)	34.0
	Track (3,850m + 1,300m)	80.3
	Grading (20m x 1,100m)	1.1
	Railhead Operating Area	54.5
Total		2,026.9
Equipment Capital Cost		
41-ton Reach Stacker x 9		180.0
Sidepick x 9		90.0
Yard Tractor x 18		57.6
Yard Chassis x 36		21.6
Total		349.2
Annual Operating Cost		
Labor	Management x 9	2.2
	Non-mgmt x 279	33.5
	SRT Personnel x 7	1.2
Facility		1.9
Equipment (@ 1,500,000 TEU/yr)	41-ton Reach Stacker	57.2
	Sidepick	8.8
	Yard Tractor	46.3
	YT Chassis	-
		-
Total		151.1

Note: All costs in 1997 Bahts

Rail cost includes 5 turnouts and 1,300 meters trackage for adding fifth track in current Lat Krabang ICD

C-3

Cost Estimate of Lat Krabang ICD Expansion, Phase 2

Capital Cost		(Million Baht)
Land	Land Acquisition (350m x 1,100m)	886.3
	Land Fill up to 1.35 MSL	108.0
Structure	CFS	151.4
	ICD Office	45.1
	Gate	11.8
	Work Shop	20.3
Area	Container Yard Area	186.8
	Washing Area	0.8
	Car Park & Misc. Area	40.1
Road	Paved Road Area	95.9
Rail	Turnout x 8	19.4
	Track (2,250m)	35.1
	Grading	-
	Railhead Operating Area	54.5
Total		1,655.5
Equipment Capital Cost		
41-ton Reach Stacker x 9		180.0
Sidepick x 9		90.0
Yard Tractor x 18		57.6
Yard Chassis x 36		21.6
Total		349.2
Annual Operating Cost		
Labor	Management x 9	2.2
	Non-mgmt x 279	33.5
	SRT Personnel x 6	1.1
Facility		1.9
Equipment (@ 2,000,000 TEU/yr)	41-ton Reach Stacker	57.2
	Sidepick	8.8
	Yard Tractor	46.3
	YT Chassis	-
		-
Total		151.1

Note: All costs in 1997 Bahts

C-4 Cost Estimate of Ongkharak ICD, Phase 1

Capital Cost		(Million Baht)
Land	Land Acquisition (450m x 1,100m)	154.7
	Land Fill up to 1.35 MSL	138.4
Structure	CFS	151.4
	ICD Office	45.1
	Gate	11.8
	Work Shop	20.3
Area	Container Yard Area	239.4
	Washing Area	0.8
	Car Park & Misc. Area	40.1
Road	Paved Road Area	95.9
Rail	Turnout x 9	21.9
	Track (3,850m)	60.1
	Grading (20m x 1,100m)	1.1
	Railhead Operating Area	54.5
Total		1,035.5
Equipment Capital Cost		
41-ton Reach Stacker x 9		180.0
Sidepick x 9		90.0
Yard Tractor x 18		57.6
Yard Chassis x 36		21.6
Total		349.2
Annual Operating Cost		
Labor	Management x 9	2.2
	Non-mgmt x 279	33.5
	SRT Personnel x 7	1.2
Facility		1.9
Equipment (@ 500,000 TEU/yr)	41-ton Reach Stacker	57.2
	Sidepick	8.8
	Yard Tractor	46.3
	YT Chassis	-
		-
Total		151.1

Note: All costs in 1997 Bahts

C-5 Cost Estimate of Ongkharak ICD, Phase 2

Capital Cost		(Million Baht)
Land	Land Acquisition (350m x 1,100m)	120.3
	Land Fill up to 1.35 MSL	108.0
Structure	CFS	151.4
	ICD Office	45.1
	Gate	11.8
	Work Shop	20.3
Area	Container Yard Area	186.8
	Washing Area	0.8
	Car Park & Misc. Area	40.1
Road	Paved Road Area	95.9
Rail	Turnout x 8	19.4
	Track (2,250m)	35.1
	Grading	-
	Railhead Operating Area	54.5
Total		889.5
Equipment Capital Cost		
41-ton Reach Stacker x 9		180.0
Sidepick x 9		90.0
Yard Tractor x 18		57.6
Yard Chassis x 36		21.6
Total		349.2
Annual Operating Cost		
Labor	Management x 9	2.2
	Non-mgmt x 279	33.5
	SRT Personnel x 6	1.1
Facility		1.9
Equipment (@ 1,000,000 TEU/yr)	41-ton Reach Stacker	57.2
	Sidepick	8.8
	Yard Tractor	46.3
	YT Chassis	-
		-
Total		151.1

Note: All costs in 1997 Bahts

C-6

Cost Estimate for Start-Up CT

Capital Cost		(Million Baht)
Land	Land Acquisition	-
	Land Fill (84mx200m)	5.88
Structure	CFS (20mx12m)	0.96
	Office + Gate (Modular Trailer)	0.80
	Work Shop	-
Area	Container Yard (Gravel)	8.57
	Washing Area	-
	Car Park & Misc. Area	-
Road	Paved Road Area (2,840m ²)	1.70
Rail	Turnout x 4	9.72
	Track (1200m)	18.72
	Grading (2,750m ²)	0.14
	Railhead Operating Area	-
Total		46.49
Equipment Capital Cost		
	41-ton Reach Stacker x 1	20.00
	Sidepick	-
	Yard Tractor	-
	Yard Chassis	-
Total		20.00
Annual Operating Cost		
Labor	Terminal Management x 1	0.24
	Terminal Non-mgmt x 4	0.48
	SRT Personnel x 1	0.18
Facility		0.02
Equipment (@ 8,000 TEU/yr)	41-ton Reach Stacker	1.08
	Sidepick	-
	Yard Tractor	-
	YT Chassis	-
		-
Total		2.00

Note: All costs in 1997 Bahts

C-7

Cost Estimate for Intermediate Phase (Add to Start-Up Phase for Total Cost)

Capital Cost		(Million Baht)
Land	Land Acquisition	-
	Land Fill (84mx200m)	5.88
Structure	CFS	-
	Office + Gate (Modular Trailer)	-
	Work Shop	-
Area	Container Yard (Gravel)	8.57
	Washing Area	-
	Car Park & Misc. Area	-
Road	Paved Road Area	-
Rail	Turnout x 2	4.86
	Track (260m)	4.06
	Grading	-
	Railhead Operating Area	-
Total		23.36
Equipment Capital Cost		
41-ton Reach Stacker x 1		20.00
Sidepick		-
Yard Tractor		-
Yard Chassis		-
Total		20.00
Annual Operating Cost		
Labor	Terminal Management x 1	0.24
	Terminal Non-mgmt x 4	0.48
	SRT Personnel x 1	0.18
Facility		-
Equipment (@ 16,000 TEU/yr)	41-ton Reach Stacker	1.08
	Sidepick	-
	Yard Tractor	-
	YT Chassis	-
		-
Total		1.98

Note: All costs in 1997 Bahts

C-8

Cost Estimate for Full-Scale Phase (Add to Start-Up & Intermediate Phases for Total Cost)

Capital Cost		(Million Baht)
Land	Land Acquisition	-
	Land Fill (327mx400m)	45.78
Structure	CFS	37.92
	Office	13.37
	Gate	3.51
	Work Shop	6.00
Area	Container Yard (Paved)	103.40
	Washing Area	0.23
	Car Park & Misc. Area	15.60
Road	Paved Road Area	-
Rail	Turnout	-
	Track	-
	Grading	-
	Railhead Operating Area	19.80
Total		245.60
Equipment Capital Cost		
	41-ton Reach Stacker x 1	20.00
	Sidepick x 3	30.00
	Yard Tractor x 6	19.20
	Yard Chassis x 12	7.20
Total		76.40
Annual Operating Cost		
Labor	Terminal Management x 1	0.24
	Terminal Non-mgmt x 85	10.20
	SRT Personnel x 1	0.18
Facility		0.49
Equipment	(@ 80,000 TEU/yr)	
	41-ton Reach Stacker	7.00
	Sidepick	1.40
	Yard Tractor	7.40
	YT Chassis	-
Total		26.91

Note: All costs in 1997 Bahts



Appendix D

SRT Train Operations and Costs

D-1 TRAIN CAPACITY BY LINE SEGMENT NORTH LINE	2
D-1 (CONTINUED) TRAIN CAPACITY BY LINE SEGMENT NORTHEAST AND EAST LINES ..	3
D-1 (CONTINUED) TRAIN CAPACITY BY LINE SEGMENT SOUTH LINE	3
D-2 TRAINS REQUIRED FOR CT SERVICE	5
D-3 ROLLING STOCK RQUIRED FOR CT SERVICES	6
D-4 INLAND CONTAINER SERVICE OPERATING COST	7

D-1 Train Capacity By Line Segment North Line

	Scheduled						Actual		
	Max.	Total Pass.	Other	Fr't	Total	Rem.* Cap. Per Sched.	Actual Freight	Actual Pass.& Freight	Actual Track Cap.
NORTH LINE									
Bangkok - Bang Sue Jct.	252	140	6	50	196	56	14	168	84
Bang Sue Jct - Don Muang	252	116		57	173	79	10	160	92
Don Muang - Rangsit	168	112		57	169	-1	10	156	12
Rangsit - Chiangrak	202	92		57	149	53	10	136	66
Chiangrak - Ayutthaya	168	90		59	149	19	10	136	32
Ayutthaya - Ban Phachi Jct	183	85		59	144	39	10	131	52
Ban Phachi Jct - Ban Moh	67	45		43	88	-21	10	73	-6
Ban Moh - Lop Buri	72	47		32	79	-7	7	72	0
Lop Buri - Ban Takli	72	40		36	76	-4	7	65	7
Ban Takli - Nakonsawan	63	36		28	64	-1	5	59	4
Nakonsawan - Tapanhin	72	36		26	62	10	5	59	13
Tapanhin - Phitsanulok	84	36		26	62	22	5	59	25
Phitsanulok - Sila At	63	28		16	44	19	5	41	22
Sila At - Denchai	50	22		17	39	11	5	36	14
Denchai - Lampang	37	18		17	35	2	2	29	8
Lampang - Chiang Mai	44	16		6	22	22	0	18	26

Source: SRT Capacity Tables

* Remaining Capacity Per Schedule

D-1 (continued) Train Capacity By Line Segment Northeast and East Lines

	Max. Track Cap.	Total Pass.	Other	Frts.	Sched. Freight	Total	Rem.* Cap. Per Sched.	Actual Freight	Actual Pass.& Freight	Actual Track Cap.
NORTHEAST LINE										
Ban Phachi Jct-Kaeng Khoi Jct.	126	38		36	14	88	38	9	83	43
Kaeng Khoi Jct.-Map Kabao	44	28		22	16	66	-22	9	59	-15
Map Kabao-Pak Chong	59	28		11	7	46	13	4	43	16
Pak Chong-Nakhon Ratchasima	72	28		10	6	44	28	4	42	30
Nakhon Ratchasima-Surin	53	26		4	2	32	21	2	32	21
Surin-Si Saket	53	22		4	2	28	25	2	28	25
Si Saket-Ubon Ratchathani	56	22		4	2	28	28	2	28	28
Kaeng Khoi Jct.-Ban Chong Tai	101	12		16	8	36	65	8	36	65
Ban Chong Tai-Lumnarai	40	12		6	8	26	14	8	26	14
Lumnarai-Bamnetnarong	46	12		6	8	26	20	8	26	20
Bamnetnarong-Bua Yai Jct.	32	10		6	8	24	8	8	24	8
Nakorn Ratchasima-Bua Yai Jct.	44	12		4	2	18	26	2	18	26
Bua Yai Jct.-Khon Kaen	33	16		8	8	32	1	8	32	1
Khon Kaen-Udon Thani	48	14		6	4	24	24	4	24	24
Udon Thani-Nong Khai	16	8		4		12	4	0	12	4
EAST LINE										
Chitlada-Makkasan	78	5	2	10	40	57	21	20	37	41
Yommarat-Makkasan	84	36	2			38	46	0	38	46
Makkasan-Hua Mak	92	43	4		24	71	21	20	67	25
Hua Mak-Lat Krabang	84	40	4		26	70	14	20	64	20
Lat Krabang-Hua Takhe	78	40	4		26	70	8	20	64	14
Hua Takhe-Chachoengsao	63	32	4		36	72	-9	20	56	7
Chachoengsao Jct.-Prachinburi	34	14		6	14	34	0	0	20	14
Prachinburi-Kabin Buri	63	8			2	10	53	0	8	55
Kabin Buri-Aranyaprathet	28	4			2	6	22	0	4	24
Chachoengsao Jct.-Siracha	44	2		6	52	60	-16	20	28	16
Siracha-Bang Lamung	59	2		2	10	14	45	5	9	50
Bang Lamung-Sattahip	59	2				2	57	0	2	57
Siracha-Laem Chabang	44	0		4	38	42	2	20	24	20
Makkasan-Mae Nam	78	0		10	14	24	54	0	10	68
Kao Chichan-Map Ta Phut	67	0		2		2	65	0	2	65
Khlong Sip Kao-Kaeng Khoi Jct.	28	0		6	14	20	8	5	11	17

Source: SRT Capacity Tables

* Remaining Capacity Per Schedule

D-1 (continued) Train Capacity By Line Segment South Line

	Max. Track Cap.	Total Pass.	Other	Fr't	Sched. Freight	Total	Rem.* Cap. Per Sched.	Actual Freight	Actual Pass.& Freight	Actual Track Cap.
SOUTH LINE										
Bang Sue-Taling Chan Jct.	46	28	4	8	14	54	-8	2	42	4
Thonburi-Taling Chan Jct.	67	16		4	4	24	43	0	20	47
Taling Chan Jct.-Nakhon Pathom	126	44	4	8	10	66	60	2	58	68
Nakhon Pathom-Nong Praduk	92	42	4	8	10	64	28	2	56	36
Nong Praduk-Ratchaburi	84	32	2	8	8	50	34	2	44	40
Ratchaburi-Hua Hin	67	30	2	8	8	48	19	2	42	25
Hua Hin-Prachuab Kirikhan	67	28		8	6	42	25	2	38	29
Prachuab Kirikhan-Chum Phon	48	28		8	6	42	6	2	38	10
Chum Phon-Lang Suan	72	30		8	6	44	28	2	40	32
Lang Suan-Surat Thani	56	26		8	6	40	16	2	36	20
Surat Thani-Ban Song	59	26		8	6	40	19	2	36	23
Ban Song-Thun Song Jct.	84	26		10	8	44	40	2	38	46
Thun Song Jct-Kao Chum Thong Jct.	67	20		8	6	34	33	2	30	37
Kao Chum Thong Jct.-Phattalung	50	22		8	6	36	14	2	32	18
Phattalung-Hat Yai Jct.	56	22		8	6	36	20	0	30	26
Hat Yai Jct.-Padang Besar	28	6		4	1	11	17	0	10	18
Hat Yai Jct.-Yala	44	20		4	2	26	18	0	24	20
Yala-Sungai Kolok	44	16		2		18	26	0	18	26
Kao Chum Thong Jct.- Nakhon Si Thammaratt	44	10				10	34	0	10	34
Thung Song Jct.-Kan Tang	24	8				8	16	0	8	16
Thung Pho Jct.-Kiri Rattani Khom	17	2				2	15	0	2	15
Nong Praduk Jct.-Suphan Buri	8	6				6	2	0	6	2
Nong Praduk Jct.-Kanchanaburi	40	6	2			8	32	0	8	32
Kanchanaburi-Nam Tok	33	6	2			8	25	0	8	25

Source: SRT Capacity Tables

* Remaining Capacity Per Schedule

Trains Required for Service

	Region	2001				2005				2010				2015				2020				Line Limit (tons) per Loco	Max. Cars/Loco Based on Trailing Tonnage
		TEU Volume	Equivalent Cars	# Locomotives	Percent of Full Train (Based on Max. Cars/Loco)	TEU Volume	Equivalent Cars	# Locomotives	Percent of Full Train (Based on Max. Cars/Loco)	TEU Volume	Equivalent Cars	# Locomotives	Percent of Full Train (Based on Max. Cars/Loco)	TEU Volume	Equivalent Cars	# Locomotives	Percent of Full Train (Based on Max. Cars/Loco)	TEU Volume	Equivalent Cars	# Locomotives	Percent of Full Train (Based on Max. Cars/Loco)		
Origin Destination Pair																							
Ban Phachi-Hat Yai	South	5	3	1	15.79%	9	5	1	26.32%	21	11	1	57.89%	39	20	2	105.26%	59	30	2	157.89%	655	19
Hat Yai-Ban Phachi	South	6	3	1	15.79%	14	7	1	36.84%	33	17	1	89.47%	54	27	2	142.11%	81	41	3	215.79%	655	19
Ubon Ratchathani-Ongkharak	LNE	4	2	1	14.29%	10	5	1	35.71%	25	13	1	92.86%	38	19	2	135.71%	55	28	2	200.00%	500	14
Ongkharak-Ubon Ratchathani	LNE	4	2	1	20.00%	7	4	1	40.00%	17	9	1	90.00%	29	15	2	150.00%	44	22	3	220.00%	360	10
Khon Kaen-Ongkharak	UNE	4	2	1	14.29%	10	5	1	35.71%	25	13	1	92.86%	38	19	2	135.71%	55	28	2	200.00%	500	14
Ongkharak-Khon Kaen	UNE	4	2	1	20.00%	7	4	1	40.00%	17	9	1	90.00%	30	15	2	150.00%	44	22	3	220.00%	360	10
Lamphun-Ban Phachi	North	9	5	1	55.56%	21	11	2	122.22%	51	26	3	288.89%	80	40	5	444.44%	119	60	7	666.67%	300	9
Ban Phachi-Lamphun	North	9	5	1	55.56%	15	8	1	88.89%	37	19	3	211.11%	69	35	4	388.89%	107	54	6	600.00%	300	9
Total Daily Equipment Requirements			24	8			49	9			117	12			190	21			285	28			

		TEU Volume	Equivalent Cars	# Locomotives	Number of Full Trains	TEU Volume	Equivalent Cars	# Locomotives	Number of Full Trains	TEU Volume	Equivalent Cars	# Locomotives	Number of Full Trains	TEU Volume	Equivalent Cars	# Locomotives	Line Limit (tons) per Loco	Max. Cars/Loco Based on Trailing Tonnage
Daily Train Movements																		
	I/B	541	271	8	7.96	818	409	12	12.03	914	457	13	13.44	1096	548	17	16.12	34
	O/B	541	271	8	7.96	818	409	12	12.03	914	457	13	13.44	1096	548	17	16.12	34
	I/B									256	128	4	3.76	506	253	8	13.06	34
	O/B									256	128	4	3.76	506	253	8	13.06	34
					16				25				36				62	

1. Line limit based on Hitachi locomotive numbers 4501-4522.

1. Line limit based on Rimacini locomotive numbers 4501-4522.
2. Maximum train length = 500m or 34 cars + locomotive.
3. Daily TEU volumes calculated by dividing projected annual volumes by 250 for CTs, and by 365 for ICDs, based on assumption that international container port works every day of the year.
4. Loading based on 15 tons tare + 10 tons per TEU, or 35 tons per fully loaded car.
5. Trailing tonnages based on most restrictive line segment, as indicated in data from SRT.
6. Carloadings on UPPER N.E. service lane/LOWER N.E. service lane based on UNE service lane handling Korat traffic.
7. Carloadings on NORTH service lane include Phitsanulok traffic.
8. Lat Krabang ICD volumes based on 50-50 split I/B-O/B of BAH projections.
9. Ongkharak ICD volumes based on 50-50 split I/B-O/B of BAH projections.
10. Equivalent Cars based on two (2) TEUs per car.

D-3 Rolling Stock Requirements for CT Service

ORIGIN-DESTINATION PAIR	Region	2001		2005		2010		2015		2020	
Ban Phachi-Hat Yai	South	Railcars	Locos	Railcars	Locos	Railcars	Locos	Railcars	Locos	Railcars	Locos
Ubon Ratchathani-Ongkharak	Lower Northeast	6	2	12	2	28	2	47	4	71	5
Khon Kaen-Ongkharak	Upper Northeast	4	2	9	2	22	2	34	4	50	5
Lamphun-Ban Phachi*	North	4	2	9	2	22	2	34	4	50	5
Laem Chabang-Lat Krabang	Port	10	2	19	3	45	6	75	9	114	13
Laem Chabang-Ongkharak	Port	271	8	409	12	457	13	548	17	548	17
TOTAL EQUIP. DEMAND											
Available Fleet		295	16	458	21	702	29	991	46	1277	59
Net Equipment Deficit		305		305		458		549		707	
Assumed Purchases		0	0	153	5	91	8	198	17	128	13
Acquisition Cost (millions of baht)		0	0	153	5	91	8	198	17	128	13
		0.00	0.00	229.50	375.30	136.50	600.47	297.00	1276.00	192.00	975.77

Notes:

1. Available Railcar Fleet based on service life and % availability (see Table 34), plus Assumed Purchases.
2. Equipment needs may be understated, as % availability was not applied to Assumed Purchases in the years after their purchase.
3. No differentiation was made between vacuum and air brake equipment.
4. Due to cycle times, one round trip/trainset/day assumed for Lat Krabang and Ongkharak (CD O/D pairs).
5. See Table D-2 for railcar and locomotive estimates for each line.
6. Net Railcar Equipment Deficit after 2001 determined by subtracting the Available Fleet from the Total Equip. Demand and then subtracting the sum of the prior years' Assumed Purchases.
7. Net Locomotive Equipment Deficit after 2001 determined by subtracting the 2001 equipment demand from the new estimate (assumption is that the existing locomotive fleet is sufficient for 2001 requirements).
8. The service life and % availability of the current locomotive fleet (see Table 33) was not factored into determination of the Equipment Deficit.
9. Acquisition Cost for railcar (container flat car of 14 m. length and 60 gross tons capy.) based on typical U.S. 4-axle 50 foot flat car purchased in 1995. Unit price = 1.5m baht/car.
10. Acquisition Cost for locomotive based on 1993 SRT purchase of locomotive series 4501-4522. Unit price = 75.059m baht/loco.

**Table D-4
Inland Container Service Operating Costs**

OUR MAN CREW												
Origin-Destination	Km	Locomotive Crews	Train Crews	Cars per Locomotive	Number Locomotives	Locomotive Variable (baht/train-km)	Car (baht/km)	Locomotive Driver Variable (baht/km)	Asst. Locomotive Driver Variable (baht/km)	Guard (Conductor) Variable (baht/km)	Brakeman Variable (baht/km)	Totals (1997 baht)
Init Costs						76.85	0.914	0.31	0.25	0.25	0.185	
INE LOCOMOTIVE												
an Phachi-Hat Yai	1021	3	3	19	1	78464	17731	950	766	766	567	99242
ne Way Operating Costs						78464	17731	950	766	766	567	
at Yai-Ban Phachi	1021	3	3	19	1	76677	17731	950	766	766	567	
ne Way Operating Costs						76677	17731	950	766	766	567	97455 196698
ound Trip Operating Costs						155141	35461	1899	1532	1532	1133	
bon Ratchathani-Ongkharak	503	2	2	14	1	38656	6436	312	252	252	186	
ne Way Operating Costs						38656	6436	312	252	252	186	46093
ngkharak-Ubon Ratchathani	503	2	2	10	1	38656	4597	312	252	252	186	
ne Way Operating Costs						38656	4597	312	252	252	186	
ound Trip Operating Costs						77311	11034	624	503	503	372	44254 90347
hon Kaen-Ongkharak	387	1	1	14	1	29741	4952	120	97	97	72	
ne Way Operating Costs						29741	4952	120	97	97	72	
ngkharak-Khon Kaen	387	1	1	10	1	29741	3537	120	97	97	72	35078
ne Way Operating Costs						29741	3537	120	97	97	72	
ound Trip Operating Costs						59482	8489	240	194	194	143	
amphun-Ban Phachi	639	2	2	9	1	49107	5256	396	320	320	236	55635
ne Way Operating Costs						49107	5256	396	320	320	236	
an Phachi-Lamphun	639	2	2	9	1	49107	5256	396	320	320	236	
ne Way Operating Costs						49107	5256	396	320	320	236	55635 111270
ound Trip Operating Costs						98214	10513	792	639	639	473	
aem Chabang-Lat Krabang	109	1	1	34	1	8377	3387	34	27	27	20	
at Krabang-Laem Chabang	109	1	1	34	1	8377	3387	34	27	27	20	11872 11872 23745
ound Trip Operating Costs						16753	6775	68	55	55	40	
aem Chabang-Ongkharak	133	1	1	34	1	10221	4133	41	33	33	25	
ngkharak-Laem Chabang	133	1	1	34	1	10221	4133	41	33	33	25	14486 14486 28973
ound Trip Operating Costs						20442	8266	82	67	67	49	

**Table D-4
Inland Container Service Operating Costs**

OUR MAN CREW		Km	Locomotive Crews	Train Crews	Cars per Locomotive	Number Locomotives	Locomotive Variable (baht/train-km)	Car (baht/km)	Locomotive Driver Variable (baht/km)	Asst. Locomotive Driver Variable (baht/km)	Guard (Conductor) Variable (baht/km)	Brakeman Variable (baht/km)	Totals (1997 baht)
Origin-Destination Unit Costs							76.85	0.914	0.31	0.25	0.25	0.185	
WO LOCOMOTIVES													
an Phachi-Hat Yai		1021	3	3	34	2	156928	31729	317	766	766	567	191704
ne Way Operating Costs							156928	31729	950	766	766	567	
at Yai-Ban Phachi		1021	3	3	34	2	156928	31729	317	766	766	567	
ne Way Operating Costs							156928	31729	950	766	766	567	191704
ound Trip Operating Costs							313855	63457	1899	1532	1532	1133	383408
bon Ratchathani-Ongkharak		503	2	2	28	2	77311	12873	156	252	252	186	91185
ne Way Operating Costs							77311	12873	312	252	252	186	
ngkharak-Ubon Ratchathani		503	2	2	20	2	77311	9195	156	252	252	186	
ne Way Operating Costs							77311	9195	312	252	252	186	87507
ound Trip Operating Costs							154622	22068	624	503	503	372	178692
non Kaen-Ongkharak		387	1	1	28	2	59482	9904	0	97	97	72	69651
ne Way Operating Costs							59482	9904	0	97	97	72	
ngkharak-Khon Kaen		387	1	1	20	2	59482	7074	120	97	97	72	
ne Way Operating Costs							59482	7074	120	97	97	72	66941
ound Trip Operating Costs							118964	16978	120	194	194	143	136592
amphun-Ban Phachi		639	2	2	18	2	98214	10513	198	320	320	236	109999
ne Way Operating Costs							98214	10513	396	320	320	236	
an Phachi-Lamphun		639	2	2	18	2	98214	10513	198	320	320	236	
ne Way Operating Costs							98214	10513	396	320	320	236	109999
ound Trip Operating Costs							196429	21026	792	639	639	473	219997

NOTES

An average speed of 50 kph. was used in determining the number of locomotive and train crews. This average speed was calculated by adding the overall average speed of SRT freight trains (28 kph.) and the maximum allowable freight train speed (70 kph.) and dividing by 2. The result

Appendix E

Proposed COFC Service Schedule

E-1	LAMPHUN TO KAENG KHOI JCT.	2
E-2	KAENG KHOI AND BAN PHACHI TO LAMPHUN	3
E-3	KHON KAEN CT (SAM RAN STATION) TO ONGKHARAK.....	4
E-4	ONGKHARAK TO KHON KAEN CT (SAM RAN STATION).....	5
E-5	UBON RATCHATHANI TO KORAT	6
E-6	KORAT TO UBON RATCHATHANI	7
E-7	BAN PHACHI CT TO HAT YAI.....	8
E-8	HAT YAI TO BAN PHACHI CT	9

ASSUMPTIONS

- Schedules were developed based on operational priority over existing freight services.
- Average operating speed figured at 70 km/hr.
- Initial terminal inspection, brake test, etc. requires 30 minutes following last lift.
- Pickup or setoff at intermediate point require 30 minutes .
- Pickup and setoff at intermediate point requires 1 hour.
- Schedules developed without necessity of adjustments to passenger movements (per SRT stringlines).
- Some existing freight schedules may require minor adjustments due to meets or overtakes.

E-1

Lamphun to Kaeng Khoi Jct.

(block of cars then attached to the train from Korat bound for Ongkharak)

TRAIN: CMBK

OPERATES: DAILY

Crew Call		17:30	Day 1
Cutoff For Receipt of Containers		18:00	Day 1
Depart	Lamphun	17:00	
Arrive	Phitsanulok	03:07	Day 2
Takes Cars	Ban Phachi; Ongkharak		
Depart	Phitsanulok	04:32	Day 2
Arrive	Ban Phachi Jct.	11:23	Day 2
Depart	Ban Phachi Jct.		
Arrive	Ban Phachi CT		Day 2
Set Off (cars)	Block 1 (Cut off power, run around train, perform brake test)		
Depart	Ban Phachi CT	11:45	Day 2
Pass	Ban Phachi Jct.	14:25	Day 2
Terminate	Kaeng Khoi Jct.	15:30	Day 2

Notes:

1. Train block makeups at Lamphun and Phitsanulok would be as follows:
 - Ban Phachi (Bangkok proper destinations)
 - Ongkharak (international)
2. Train activity at Ban Phachi would be as follows:
 - a. Setoff for delivery of containers, with grounding and availability at 10:25 on Day 2.
 - b. Remaining train block makeup at Ban Phachi would be as follows:
 - Ongkharak (international)
3. Train activity at Kaeng Khoi Jct.:
 - a. Setoff Block 2, for connection to train NKLC 04:00 on Day 3

E-2 Kaeng Khoi and Ban Phachi to Lamphun

TRAIN: BKCM

OPERATES: DAILY

Crew Call		16:35	Day 1
Cutoff For Receipt of Containers		17:05	Day 1
Takes Cars	Lamphun, Phitsanulok		
Depart	Kaeng Khoi Jct.	19:25	Day 1
Arrive	Ban Phachi Jct.	20:12	Day 1
Pass	Ban Phachi Jct.		Day 1
Arrive	Ban Phachi CT		Day 1
Set Off (cars)	Block 3 (Cut off power, run around train, perform brake test)		
Takes Cars	Lamphun, Phitsanulok		
Depart	Ban Phachi CT	22:18	Day 1
Arrive	Phitsanulok	08:05	Day 2
Set Off (cars)	Block 2		
Depart	Phitsanulok	09:05	Day 2
Terminate	Lamphun	19:15	Day 2

Notes:

1. Train makeup at Kaeng Khoi Jct. blocked as follows:
 - Lamphun
 - Phitsanulok

Cars received from train LCKK 17:10 Day 1
2. Train block makeup departing Ban Phachi CT as follows:
(Cutoff for receipt of containers 18:10 Day 1)
 - Lamphun
 - Phitsanulok
3. Train activity at Phitsanulok as follows:
 - a. Setoff block 2, with grounding and availability of containers at 03:20 on Day 2.
 - b. Train block makeup departing Phitsanulok would be as follows:
 - Lamphun
4. Train activity at Lamphun would be as follows:
 - a. Setoff block 1, with grounding and availability of containers at 10:55 on Day 2

E-3

Khon Kaen CT (Sam Ran Station) to Ongkharak

TRAIN: KKLC

OPERATES: DAILY

Crew Call		21:00	Day 1
Cutoff For Receipt of Containers		21:30	Day 1
Takes Cars	Ongkharak (domestic and international)		
Depart	Khon Kaen CT	20:45	Day 1
Arrive	Nakhon Ratchasima (Korat)	00:42	Day 2
Takes Cars	Ongkharak		
Depart	Nakhon Ratchasima (Korat)	01:26	Day 2
Arrive	Kaeng Khoi Jct.	05:47	Day 2
Takes Cars	Ongkharak (from connection with CMBK 12:40 Day 1)		
Depart	Kaeng Khoi Jct.	07:19	Day 2
Arrive	Ongkharak (set off blocks for CT and ICD)	08:12	Day 2

Notes:

1. Train block makeup at Khon Kaen CT as follows:
 - Ongkharak CT (domestic)
 - Ongkharak ICD (international)
2. Train activity at Nakhon Ratchasima (Korat) as follows:
 - a. Takes cars received from train URLC 22:35 Day 1 blocked the same as above
3. Train activity at Kaeng Khoi Jct. as follows:
 - a. Takes cars on head end received from CMBK on 11:00 Day 1, also blocked the same as above.
4. Train activity at Ongkharak as follows:
 - a. Set off block for CT, followed by set off of block for ICD

E-4 Ongkharak to Khon Kaen CT (Sam Ran Station)

TRAIN: LCKK

OPERATES: DAILY

Crew Call		14:25	Day 1
Cutoff For Receipt of Containers		14:55	Day 1
Takes Cars	Khon Kaen, Ubon Ratchathani		
Depart	Ongkharak	15:25	Day 1
Arrive	Kaeng Khoi Jct.	16:15	Day 1
Set Off (cars)	Blocks 4 and 5. For Connection to train BKCM 17:30 Day 1		
Depart	Kaeng Khoi Jct.	17:16	Day 1
Arrive	Nakhon Ratchasima (Korat)	21:09	Day 1
Set Off (cars)	Block 3		
Depart	Nakhon Ratchasima (Korat)	22:26	Day 1
Pass	Bua Yai Jct.		Day 2
Arrive	Khon Kaen CT	03:12	Day 2
Set Off (cars)	Block 2		

Notes:

1. Train block makeup at Ongkharak would be as follows:
 - Khon Kaen
 - Ubon Ratchathani
 - Lamphun
 - Phitsanulok
2. Train activity at Kaeng Khoi Jct. would be as follows:
 - a. Setoff Blocks 3 and 4 for connection to train BKCM 17:30 Day 1. Train block makeup departing Kaeng Khoi Jct. would be as follows:
 - Khon Kaen
 - Ubon Ratchathani
3. Train activity at Nakhon Ratchasima (Korat) would be as follows:
 - a. Setoff Block 2 for connection to LCUR. Train block makeup departing Nakhon Ratchasima (Korat) would be as follows:
 - Khon Kaen
4. Train activity at Khoñ Kaen CT would be as follows:
 - a. Setoff Block 1, with grounding and availability of containers at 02:24 on Day 1

E-5 **Ubon Ratchathani to Korat**

TRAIN: URLC

OPERATES: DAILY

Crew Call		16:30	Day 1
Cutoff For Receipt of Containers		17:00	Day 1
Depart	Ubon Ratchathani	18.35	Day 1
Terminate	Nakhon Ratchasima (Korat)	01:11	Day 1

Notes:

1. Train block makeup at Ubon Ratchathani would be as follows:
 - Ongkharak CT (domestic)
 - Ongkharak ICD (international)
2. Train activity at Nakhon Ratchasima would be as follows:
 - a. Blocks 1 and 2 connect to train NKLC departing 01:15 Day 2

E-6 **Korat to Ubon Ratchathani**

TRAIN: LCUR

OPERATES: DAILY

Crew Call		22:30	Day 1
Depart	Nakhon Ratchasima (Korat)	22:22	Day 1
Terminate	Ubon Ratchathani	05:43	Day 2

Notes:

1. Train block makeup at Nakhon Ratchasima (Korat):
 - Ubon Ratchathani (Block 1 connects from train LCNK arriving 21:30 Day 1)
2. Train activity at Ubon Ratchathani would be as follows:
 - a. Setoff block 1, with grounding and availability of containers at 05:00 on Day 2.

E-7 **Ban Phachi CT to Hat Yai**

TRAIN: BKHY

OPERATES: DAILY

Crew Call		19:00	Day 1
Depart	Ban Phachi CT	19:40	Day 1
Pass	Bang Sue Jct	22:00	Day 1
Pass	Nong Pla Duk Jct.	23:20	Day 1
Pass	Bang Saphan Yai	07:02	Day 2
Arrive	Chum Phon	08:57	Day 2
Depart	Chum Phon	09:32	Day 2
Pass	Surat Thani	12:59	Day 2
Pass	Thung Song Jct	16:58	Day 2
Pass	Phatthalung	20:12	Day 2
Terminate	Hat Yai Jct. (Bang Klam)	21:40	Day 2

Notes:

1. Train block makeup at Ban Phachi would be as follows:
 - Hat Yai
2. Train activity at Hat Yai (Bang Klam) would be as follows
 - a. Setoff block 1, with grounding and availability of containers at 15:32 on Day 2.

E-8 **Hat Yai to Ban Phachi CT**

TRAIN: HYBK

OPERATES: DAILY

Crew Call		17:00	Day 1
Cutoff For Receipt of Containers		17:30	Day 1
Depart	Hat Yai	19:55	Day 1
Pass	Phatthalung	21:33	Day 1
Pass	Thung Song Jct.	00:01	Day 1
Pass	Surat Thani	02:07	Day 1
Arrive	Khao Suan Thurion	06:07	Day 2
Depart	Khao Suan Thurion	07:38	Day 2
Arrive	Na Cha Ang	09:10	Day 2
Depart	Na Cha Ang	10:00	Day 2
Pass	Bang Saphan Yai	11:52	Day 2
Pass	Ratchaburi	18:17	Day 2
Arrive	Nong Pla Duk Jct.	19:12	Day 2
Depart	Nong Pla Duk Jct.	19:39	Day 2
Pass	Bang Sue Jct.	00:22	Day 2
Terminate	Ban Phachi	02:15	Day 2

Notes:

1. Train block makeup at Hat Yai would be as follows:
 - Ban Phachi CT
2. Train activity at Ban Phachi would be as follows
 - a. Setoff block 1, with grounding and availability of containers at 14:22 on Day 2.



Appendix F

Details of ICD, CT Financial Analysis

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Assets and Capital Expenditures - Ongkharak ICD

Terminal Operator Perspective - Ongkharak ICD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year																				
Volume (000s)																				
Tariffs	327	374	424	477	533	618	721	829	945	800	868	940	1000	1000	1000	1000	1000	1000	1000	1000
Price Increase	B	2,200	B	2,200	B	2,200	B	2,310	B	2,310	B	2,426	B	2,426	B	2,547	B	2,547	B	2,547
Inflation																				
5.0% every 5 years																				
1.5%																				
Net (000s) in 000s of Baht																				
Revenues																				
Use	B	719,294	B	822,388	B	1,049,115	B	1,173,647	B	1,428,378	B	1,664,463	B	1,915,894	B	2,183,668	B	2,448,000	B	2,719,381
Fixed																				
Rentals																				
TOTAL	B	719,294	B	822,388	B	1,049,115	B	1,173,647	B	1,428,378	B	1,664,463	B	1,915,894	B	2,183,668	B	2,448,000	B	2,719,381
Operating Costs																				
Labor																				
Mgmt	B	1,439	B	1,669	B	2,194	B	2,691	B	3,467	B	4,050	B	4,685	B	5,261	B	5,940	B	6,639
Non-Mgmt	B	21,906	B	25,421	B	33,410	B	37,936	B	44,631	B	52,788	B	61,673	B	71,347	B	81,308	B	92,528
Rail	B	785	B	911	B	1,048	B	1,197	B	1,359	B	1,599	B	1,891	B	2,257	B	2,657	B	3,093
Facility	B	1,242	B	1,442	B	1,659	B	1,895	B	2,152	B	2,531	B	2,994	B	3,476	B	4,023	B	4,681
Equipment																				
Reach Stacker	B	37,403	B	43,406	B	57,046	B	64,775	B	76,206	B	90,133	B	105,305	B	121,843	B	138,830	B	157,172
Sideline	B	5,754	B	6,678	B	8,776	B	9,965	B	11,724	B	13,667	B	15,201	B	17,423	B	19,483	B	21,359
Yard Tractor	B	30,276	B	35,134	B	46,175	B	52,631	B	61,684	B	72,957	B	85,238	B	98,608	B	112,714	B	127,507
Yard Chassis	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-
TOTAL	B	98,805	B	114,661	B	150,693	B	171,099	B	201,306	B	238,096	B	278,174	B	321,808	B	366,716	B	413,531
Operating Margin	B	620,489	B	707,727	B	898,422	B	1,002,548	B	1,227,072	B	1,426,367	B	1,637,720	B	1,861,859	B	2,082,284	B	2,305,850
Less: Costs																				
Equipment																				
Reach Stacker	B	13,758	B	15,966	B	20,983	B	23,926	B	28,030	B	33,153	B	38,274	B	44,399	B	50,511	B	56,621
Sideline	B	6,879	B	7,983	B	10,691	B	11,913	B	14,015	B	15,577	B	17,329	B	19,245	B	21,316	B	23,543
Yard Tractors	B	4,833	B	5,609	B	7,371	B	8,370	B	9,847	B	11,607	B	13,607	B	15,405	B	17,244	B	19,208
Yard Chassis	B	2,238	B	2,597	B	3,413	B	3,876	B	4,560	B	5,393	B	6,301	B	7,289	B	8,347	B	9,486
TOTAL LEASE COSTS	B	27,708	B	32,154	B	42,259	B	47,684	B	56,452	B	66,770	B	78,009	B	90,245	B	102,844	B	116,554
Capital Costs																				
Principal	B	55,585	B	55,585	B	55,585	B	55,585	B	55,585	B	55,585	B	55,585	B	55,585	B	55,585	B	55,585
Interest	B	80,617	B	76,170	B	71,723	B	67,276	B	62,829	B	58,382	B	53,935	B	49,488	B	45,041	B	40,594
Taxes																				
Net Cash Flow	B	139,294	B	165,466	B	222,111	B	277,660	B	344,301	B	406,899	B	477,034	B	546,553	B	614,166	B	680,717
NPV	B	317,285	B	378,352	B	510,991	B	603,554	B	709,250	B	829,313	B	953,313	B	1,082,628	B	1,216,638	B	1,355,325
15%	B	4,340,705																		

use payment of

Assets and Capital Expenditures - Ongkharak ICD

Capital Schedule - in 000s																
Interest Rate:																
8%																
PHASE I (up to 500m teu)																
Year																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Land																
Acquisition	20	B	146,905	B	130,230	B	131,495	B	123,760	B	116,025	B	108,290	B	100,555	B
Principal			7,735		7,735		7,735		7,735		7,735		7,735		7,735	
Interest			12,067		11,448		10,829		10,210		9,591		8,973		8,354	
Improvement	30	B	131,480	B	124,560	B	117,640	B	110,720	B	103,800	B	96,880	B	89,960	B
Principal			6,920		6,920		6,920		6,920		6,920		6,920		6,920	
Interest			10,795		10,235		9,688		9,134		8,581		8,027		7,474	
Buildings	15	B	151,400	B	131,213	B	121,027	B	110,841	B	100,655	B	90,469	B	80,283	B
Principal			10,093		10,093		10,093		10,093		10,093		10,093		10,093	
Interest			11,708		10,901		10,093		9,286		8,478		7,671		6,863	
Office	15	B	45,100	B	39,087	B	36,080	B	33,073	B	30,067	B	27,060	B	24,053	B
Principal			3,007		3,007		3,007		3,007		3,007		3,007		3,007	
Interest			3,488		3,247		3,007		2,766		2,526		2,285		2,045	
Gate	15	B	11,800	B	10,227	B	9,440	B	8,653	B	7,867	B	7,080	B	6,293	B
Principal			787		787		787		787		787		787		787	
Interest			913		850		787		724		661		598		535	
Shop	15	B	20,300	B	17,593	B	16,240	B	14,887	B	13,533	B	12,180	B	10,827	B
Principal			1,353		1,353		1,353		1,353		1,353		1,353		1,353	
Interest			1,570		1,462		1,353		1,245		1,137		1,029		920	
Area	20	B	227,430	B	215,460	B	203,490	B	191,520	B	179,550	B	167,580	B	155,610	B
Principal			11,970		11,970		11,970		11,970		11,970		11,970		11,970	
Interest			18,673		17,716		16,758		15,800		14,843		13,885		12,928	
Washing	20	B	800	B	720	B	640	B	560	B	480	B	400	B	320	B
Principal			40		40		40		40		40		40		40	
Interest			62		59		56		53		50		46		43	
CarPark/Misc	20	B	40,100	B	36,090	B	34,085	B	32,080	B	30,075	B	28,070	B	26,065	B
Principal			2,005		2,005		2,005		2,005		2,005		2,005		2,005	
Interest			3,128		2,967		2,807		2,647		2,486		2,326		2,165	
Rail	20	B	21,900	B	19,710	B	18,615	B	17,520	B	16,425	B	15,330	B	14,235	B
Principal			1,095		1,095		1,095		1,095		1,095		1,095		1,095	
Interest			1,708		1,621		1,533		1,445		1,358		1,270		1,183	
Track	20	B	60,100	B	54,090	B	51,085	B	48,080	B	45,075	B	42,070	B	39,065	B
Principal			3,005		3,005		3,005		3,005		3,005		3,005		3,005	
Interest			4,688		4,447		4,207		3,967		3,726		3,486		3,245	
Grading	20	B	1,100	B	990	B	935	B	880	B	825	B	770	B	715	B
Principal			55		55		55		55		55		55		55	
Interest			86		81		77		73		68		64		59	
Railhead Op Area	20	B	54,500	B	49,050	B	46,525	B	44,000	B	41,475	B	38,950	B	36,425	B
Principal			2,725		2,725		2,725		2,725		2,725		2,725		2,725	
Interest			4,251		4,033		3,815		3,597		3,379		3,161		2,943	
Paved Road	20	B	95,900	B	86,310	B	81,515	B	76,720	B	71,925	B	67,130	B	62,335	B
Principal			4,795		4,795		4,795		4,795		4,795		4,795		4,795	
Interest			7,480		7,097		6,713		6,329		5,946		5,562		5,179	
PHASE I - TOTAL CAPITAL COSTS			979,915	B	868,745	B	813,160	B	757,575	B	701,990	B	646,405	B	590,820	B
Principal			55,585		55,585		55,585		55,585		55,585		55,585		55,585	
Interest			80,617		76,170		71,723		67,276		62,829		58,383		53,936	

1

Note: $VEOS$ means Year End (Outstanding principal remaining at the end of the year). This is calculated by dividing the total loan amount by the number term of the loan (which gives the annual payment amount) and subtracting the result each year until the OS equals 0 (the loan is repaid). Interest also has a timely collection for noted with size assumed at 8%.

**Assets and Capital Expenditures -
Lat Krabang ICD**

Terminal Operator Perspective - Lat Krabang ICD																					
	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Volumes (000s)																					
Tariffs																					
Avg Rev/TEU	B	2,200	B	2,200	B	2,200	B	2,200	B	2,200	B	2,200	B	2,200	B	2,200	B	2,200	B	2,200	B
Price Increase																					
Initiation																					
every 5 years																					
1.5%																					
NUMBERS IN 000s of Baht																					
Revenues																					
Use	B	19,800	B	184,800	B	550,000	B	360,800	B	360,800	B	360,800	B	360,800	B	360,800	B	360,800	B	360,800	B
Fixed																					
Rentals																					
TOTAL	B	19,800	B	184,800	B	550,000	B	360,800	B	360,800	B	360,800	B	360,800	B	360,800	B	360,800	B	360,800	B
Operating Costs																					
Lease																					
Equipment																					
Manit	B	40	B	375	B	1,150	B	743	B	743	B	743	B	743	B	743	B	743	B	743	B
Non-Mgmt	B	603	B	5,712	B	11,320	B	11,320	B	11,320	B	11,320	B	11,320	B	11,320	B	11,320	B	11,320	B
Rail	B	22	B	205	B	627	B	874	B	874	B	874	B	874	B	874	B	874	B	874	B
Facility	B	34	B	324	B	993	B	642	B	642	B	642	B	642	B	642	B	642	B	642	B
Equipment																					
Reach Stacker	B	1,070	B	9,754	B	29,906	B	19,329	B	19,329	B	19,329	B	19,329	B	19,329	B	19,329	B	19,329	B
Sidelpick	B	158	B	1,501	B	4,601	B	6,407	B	6,407	B	6,407	B	6,407	B	6,407	B	6,407	B	6,407	B
Yard Tractor	B	833	B	7,895	B	15,645	B	24,207	B	33,711	B	33,711	B	33,711	B	33,711	B	33,711	B	33,711	B
Yard Chassis	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B
TOTAL	B	2,720	B	25,766	B	51,059	B	37,439	B	53,531	B	71,004	B	90,213	B	110,916	B	125,205	B	136,339	B
Operating Margin	B	17,080	B	159,034	B	470,999	B	307,741	B	307,741	B	307,741	B	307,741	B	307,741	B	307,741	B	307,741	B
Lease Costs																					
Equipment																					
Reach Stacker	B	379	B	3,588	B	11,000	B	7,110	B	7,110	B	7,110	B	7,110	B	7,110	B	7,110	B	7,110	B
Sidelpicks	B	189	B	1,794	B	5,555	B	7,659	B	7,659	B	7,659	B	7,659	B	7,659	B	7,659	B	7,659	B
Yard Tractors	B	133	B	1,260	B	3,864	B	5,382	B	5,382	B	5,382	B	5,382	B	5,382	B	5,382	B	5,382	B
Yard Chassis	B	62	B	584	B	1,157	B	1,769	B	2,492	B	3,448	B	4,848	B	6,669	B	9,259	B	12,806	B
TOTAL LEASE COSTS	B	763	B	7,225	B	22,154	B	14,318	B	14,318	B	14,318	B	14,318	B	14,318	B	14,318	B	14,318	B
Capital Costs																					
Principal	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B
Interest	B	157,946	B	149,533	B	132,709	B	121,242	B	109,785	B	98,328	B	86,871	B	75,414	B	63,957	B	52,500	B
Taxes	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B
Net Cash Flow	B	(246,793)	B	(102,879)	B	(102,879)	B	(102,879)	B	(102,879)	B	(102,879)	B	(102,879)	B	(102,879)	B	(102,879)	B	(102,879)	B
NPV	B	244,635	B	244,635	B	244,635	B	244,635	B	244,635	B	244,635	B	244,635	B	244,635	B	244,635	B	244,635	B

**F.2
Assets and Capital Expenditures -
Lat Krabang ICD**

Capital Schedule - in 000s																					
Interest Rate:																					
8%																					
PHASE I Expenditure (1,000m - 1,500m rev)																					
	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Land	Acquisition	Cost																			
		B	1,058,110	B	1,002,420	B	946,730	B	891,040	B	835,350	B	779,660	B	721,970	B	668,280	B	612,590	B	556,900
		B	55,690	B	55,690	B	55,690	B	55,690	B	55,690	B	55,690	B	55,690	B	55,690	B	55,690	B	55,690
B	86,876	B	82,421	B	77,966	B	73,511	B	69,056	B	64,600	B	60,145	B	55,690	B	51,235	B	46,780	B	42,325
Improvement	Principal	B	131,480	B	124,560	B	117,640	B	110,720	B	103,800	B	96,880	B	89,960	B	83,040	B	76,120	B	69,200
		B	6,920	B	6,920	B	6,920	B	6,920	B	6,920	B	6,920	B	6,920	B	6,920	B	6,920	B	6,920
		B	10,795	B	10,242	B	9,688	B	9,134	B	8,580	B	8,027	B	7,474	B	6,920	B	6,366	B	5,813
Buildings	CFS	B	141,307	B	131,213	B	121,120	B	111,027	B	100,933	B	90,840	B	80,747	B	70,653	B	60,560	B	50,467
		B	10,093	B	10,093	B	10,093	B	10,093	B	10,093	B	10,093	B	10,093	B	10,093	B	10,093	B	10,093
		B	11,708	B	10,901	B	10,093	B	9,286	B	8,478	B	7,671	B	6,863	B	6,056	B	5,249	B	4,441
Office	Principal	B	42,093	B	39,087	B	36,080	B	33,073	B	30,067	B	27,060	B	24,053	B	21,047	B	18,040	B	15,033
		B	3,007	B	3,007	B	3,007	B	3,007	B	3,007	B	3,007	B	3,007	B	3,007	B	3,007	B	3,007
		B	3,488	B	3,247	B	3,007	B	2,766	B	2,526	B	2,285	B	2,045	B	1,804	B	1,563	B	1,323
Gate	Principal	B	11,013	B	10,227	B	9,440	B	8,653	B	7,867	B	7,080	B	6,293	B	5,507	B	4,720	B	3,933
		B	787	B	787	B	787	B	787	B	787	B	787	B	787	B	787	B	787	B	787
		B	913	B	850	B	787	B	724	B	661	B	598	B	535	B	472	B	409	B	346
Shop	Principal	B	18,947	B	17,593	B	16,240	B	14,887	B	13,533	B	12,180	B	10,827	B	9,473	B	8,120	B	6,767
		B	1,353	B	1,353	B	1,353	B	1,353	B	1,353	B	1,353	B	1,353	B	1,353	B	1,353	B	1,353
		B	1,570	B	1,462	B	1,353	B	1,245	B	1,137	B	1,029	B	920	B	812	B	704	B	595
Area	CY	B	227,430	B	215,460	B	203,490	B	191,520	B	179,550	B	167,580	B	155,610	B	143,640	B	131,670	B	119,700
		B	11,970	B	11,970	B	11,970	B	11,970	B	11,970	B	11,970	B	11,970	B	11,970	B	11,970	B	11,970
		B	18,673	B	17,716	B	16,758	B	15,800	B	14,843	B	13,885	B	12,928	B	11,970	B	11,013	B	10,055
Washing	Principal	B	760	B	720	B	680	B	640	B	600	B	560	B	520	B	480	B	440	B	400
		B	62	B	59	B	56	B	53	B	50	B	46	B	43	B	40	B	37	B	34
		B	38,095	B	36,090	B	34,085	B	32,080	B	30,075	B	28,070	B	26,065	B	24,060	B	22,055	B	20,050
CurPav/Misc	Principal	B	2,005	B	2,005	B	2,005	B	2,005	B	2,005	B	2,005	B	2,005	B	2,005	B	2,005	B	2,005
		B	3,128	B	2,967	B	2,807	B	2,647	B	2,486	B	2,326	B	2,165	B	2,005	B	1,845	B	1,684
		B	32,300	B	30,600	B	28,900	B	27,200	B	25,500	B	23,800	B	22,100	B	20,400	B	18,700	B	17,000
Rail	Turnout x (6 + 5)	B	1,700	B	1,700	B	1,700	B	1,700	B	1,700	B	1,700	B	1,700	B	1,700	B	1,700	B	1,700
		B	2,652	B	2,516	B	2,380	B	2,244	B	2,108	B	1,972	B	1,836	B	1,700	B	1,564	B	1,428
		B	76,285	B	72,270	B	68,255	B	64,240	B	60,225	B	56,210	B	52,195	B	48,180	B	44,165	B	40,150
Track	Principal	B	4,015	B	4,015	B	4,015	B	4,015	B	4,015	B	4,015	B	4,015	B	4,015	B	4,015	B	4,015
		B	6,263	B	5,942	B	5,621	B	5,300	B	4,979	B	4,657	B	4,336	B	4,015	B	3,694	B	3,373
		B	1,045	B	990	B	935	B	880	B	825	B	770	B	715	B	660	B	605	B	550
Grading	Principal	B	86	B	81	B	77	B	73	B	68	B	64	B	59	B	55	B	51	B	46
		B	51,775	B	49,059	B	46,325	B	43,600	B	40,875	B	38,150	B	35,425	B	32,700	B	29,975	B	27,250
		B	4,251	B	4,033	B	3,815	B	3,597	B	3,379	B	3,161	B	2,943	B	2,725	B	2,507	B	2,289
Railhead Op Ar	Principal	B	91,105	B	86,310	B	81,515	B	76,720	B	71,925	B	67,130	B	62,335	B	57,540	B	52,745	B	47,950
		B	4,795	B	4,795	B	4,795	B	4,795	B	4,795	B	4,795	B	4,795	B	4,795	B	4,795	B	4,795
		B	7,480	B	7,097	B	6,713	B	6,329	B	5,946	B	5,562	B	5,179	B	4,795	B	4,411	B	4,028
Paved Road	Principal	B	1,921,745	B	1,816,590	B	1,711,435	B	1,606,280	B	1,501,125	B	1,395,970	B	1,290,815	B	1,185,660	B	1,080,505	B	975,350
		B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155
		B	157,946	B	149,533	B	141,121	B	132,709	B	124,296	B	115,884	B	107,471	B	99,059	B	90,647	B	82,234
PHASE I - TOTAL CAPITAL COSTS																					
YE O/S	Principal	B	1,921,745	B	1,816,590	B	1,711,435	B	1,606,280	B	1,501,125	B	1,395,970	B	1,290,815	B	1,185,660	B	1,080,505	B	975,350
		B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155
		B	157,946	B	149,533	B	141,121	B	132,709	B	124,296	B	115,884	B	107,471	B	99,059	B	90,647	B	82,234
YE O/S	Interest	B	1,921,745	B	1,816,590	B	1,711,435	B	1,606,280	B	1,501,125	B	1,395,970	B	1,290,815	B	1,185,660	B	1,080,505	B	975,350
		B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155	B	105,155
		B	157,946	B	149,533	B	141,121	B	132,709	B	124,296	B	115,884	B	107,471	B	99,059	B	90,647	B	82,234

Assets and Capital Expenditures -
Lat Krabang ICD

PHASE II Expansion (1,500m - 1,000m TEU)																						
		Year																				
	Payback	Cost	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Land																						
Acquisition	20 B	866,300	YE O/S																			
			Principal																			
			Interest																			
Improvement	20 B	108,000	YE O/S																			
			Principal																			
			Interest																			
Buildings																						
CFPS	15 B	151,400	YE O/S																			
			Principal																			
			Interest																			
Office	15 B	45,100	YE O/S																			
			Principal																			
			Interest																			
Gate	15 B	11,800	YE O/S																			
			Principal																			
			Interest																			
Shop	15 B	20,300	YE O/S																			
			Principal																			
			Interest																			
Area																						
CY	20 B	186,800	YE O/S																			
			Principal																			
			Interest																			
Washing	20 B	800	YE O/S																			
			Principal																			
			Interest																			
CarPark/Misc	20 B	40,100	YE O/S																			
			Principal																			
			Interest																			
Ro3																						
Turnout x 8	20 B	19,400	YE O/S																			
			Principal																			
			Interest																			
Track	20 B	35,100	YE O/S																			
			Principal																			
			Interest																			
Grading	20 B	-	YE O/S																			
			Principal																			
			Interest																			
Railhead Op Ac	20 B	54,500	YE O/S																			
			Principal																			
			Interest																			
Paved Road	20 B	95,900	YE O/S																			
			Principal																			
			Interest																			
PHASE II - TOTAL CAPITAL COSTS			YE O/S																			
			Principal																			
			Interest																			
Note: YE O/S means Year End Outstanding Principal remaining at the end of the year. This is calculated by dividing the total loan amount by the number term of the loan (which gives the annual payment amount) and subtracting the result each year until the O/S equals 0 (the loan is repaid).																						
Interest also has a simple calculation (as noted, rate was assumed at 8%): Interest = (previous years loan balance (x 3) - 1/2 of the annual payment amount) (gives you average outstanding for that year) x interest rate																						

back to the owner -- the term equates to the period the terminal operator would use the equipment for after which it would be worth the residual value denoted

Operating lease payments are payments to the equipment owner while (30% - the portion of the equipment cost the user never pays for).

Assets and Capital Expenditures - Lamphun CT

Capital Schedule - in 000's																				
Interest Rate:																				
PHASE I - (\$,000 ru)																				
	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Land																				
Acquisition	20	B	2,520																	
Principal			2,520																	
Interest			126																	
Improvement	20	B	5,880																	
Principal			5,880																	
Interest			294																	
Buildings																				
CFS	15	B	960																	
Principal			960																	
Interest			48																	
Office/Date	15	B	800																	
Principal			800																	
Interest			40																	
Area																				
ICV	20	B	8,570																	
Principal			8,570																	
Interest			428																	
Turnout x4	20	B	9,720																	
Principal			9,720																	
Interest			486																	
Track	20	B	18,720																	
Principal			18,720																	
Interest			936																	
Grading	20	B	140																	
Principal			140																	
Interest			7																	
Paved Road	20	B	1,700																	
Principal			1,700																	
Interest			85																	
PHASE I - TOTAL CAPITAL COSTS																				
YE O/S																				
Principal			46,530																	
Interest			2,480																	
			3,022																	



Interest also has a simple calculation (as noted, rate was assumed at 8%). $\text{Interest} = (\text{previous years loan balance} (v_{t-1}) - \frac{1}{2} \text{ of the annual payment amount (gives you average outstanding for that year)}) \times \text{Interest rate}$

**Assets and Capital Expenditures -
Phitsanulok CT**

Terminal Operator Perspective - Phitsanulok CT		Year																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Volumes (TEUs)		1,417	1,458	1,500	2,250	3,000	3,750	4,500	5,250	6,200	7,150	8,100	9,050	10,000	11,100	12,200	13,300	14,400	15,500	16,880	18,382																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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Avg Rev/TEU		B	2,200	B	2,200	B	2,310	B	2,310	B	2,310	B	2,426	B	2,426	B	2,426	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547	B	2,547

to the owner – the term equities to the period the terminal operator would use the equipment for after which it would be worth the residual value devoted

to the owner – the term equities to the period the terminal operator would use the equipment for after which it would be worth the residual value devoted

**Assets and Capital Expenditures -
Phitsanulok CT**

Capital Schedule - in 000s									
Interest Rate:	8%								
PHASE I (<8,000 teu)									
	Year	1	2	3	4	5	6	7	8
Land	Payback (Yr) Current Cost								
Acquisition	20 B 1,260 YE OS	B 1,197	B 1,134	B 1,071	B 1,008	B 945	B 882	B 819	B 756
Interest		B 63	B 63	B 63	B 63	B 63	B 63	B 63	B 63
		B 98	B 93	B 88	B 83	B 78	B 73	B 68	B 63
Improvement	20 B 5,880 YE OS	B 5,586	B 5,292	B 4,998	B 4,704	B 4,410	B 4,116	B 3,822	B 3,528
Interest		B 294	B 294	B 294	B 294	B 294	B 294	B 294	B 294
		B 459	B 435	B 412	B 388	B 365	B 341	B 318	B 294
Buildings	15 B 960 YE OS	B 896	B 832	B 768	B 704	B 640	B 576	B 512	B 448
CFS		B 64	B 64	B 64	B 64	B 64	B 64	B 64	B 64
		B 74	B 69	B 64	B 59	B 54	B 49	B 44	B 38
Office/Club	15 B 800 YE OS	B 747	B 693	B 640	B 587	B 533	B 480	B 427	B 373
Interest		B 53	B 53	B 53	B 53	B 53	B 53	B 53	B 53
		B 62	B 58	B 53	B 49	B 45	B 41	B 36	B 32
Area									
ICV	20 B 8,570 YE OS	B 8,142	B 7,713	B 7,285	B 6,856	B 6,428	B 5,999	B 5,571	B 5,142
Interest		B 429	B 429	B 429	B 429	B 429	B 429	B 429	B 429
		B 668	B 634	B 600	B 566	B 531	B 497	B 463	B 429
Rail									
Turnout xtd	20 B 9,720 YE OS	B 9,234	B 8,748	B 8,262	B 7,776	B 7,290	B 6,804	B 6,318	B 5,832
Interest		B 486	B 486	B 486	B 486	B 486	B 486	B 486	B 486
		B 758	B 719	B 680	B 642	B 603	B 564	B 525	B 486
Track	20 B 18,720 YE OS	B 17,784	B 16,848	B 15,912	B 14,976	B 14,040	B 13,104	B 12,168	B 11,232
Interest		B 936	B 936	B 936	B 936	B 936	B 936	B 936	B 936
		B 1,460	B 1,385	B 1,310	B 1,236	B 1,161	B 1,086	B 1,011	B 936
Grading	20 B 140 YE OS	B 133	B 126	B 119	B 112	B 105	B 98	B 91	B 84
Interest		B 7	B 7	B 7	B 7	B 7	B 7	B 7	B 7
		B 11	B 10	B 10	B 9	B 9	B 8	B 8	B 7
Paved Road	20 B 1,700 YE OS	B 1,615	B 1,530	B 1,445	B 1,360	B 1,275	B 1,190	B 1,105	B 1,020
Interest		B 85	B 85	B 85	B 85	B 85	B 85	B 85	B 85
		B 133	B 128	B 119	B 112	B 105	B 99	B 92	B 85
PHASE I - TOTAL CAPITAL COSTS		B 45,333	B 42,916	B 40,500	B 38,083	B 35,666	B 33,249	B 30,832	B 28,415
Principal		B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417
Interest		B 3,723	B 3,530	B 3,337	B 3,143	B 2,950	B 2,757	B 2,563	B 2,370

Assets and Capital Expenditures -
Phitsanulok CT

PHASE III (16,000 - 80,000 TEU)										Year																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
	Land	Payback	Cost			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
	Acquisition	20	B	7,290	YE OS																			B	9,190																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
					Principal																			B	484																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
	Improvement	20	B	45,780	YE OS																			B	57,710																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
					Principal																				B	3,037																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
Buildings	CPS	15	B	37,020	YE OS																				B	4,738																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
					Principal																					B	46,963																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
	Office	15	B	13,370	YE OS																				B	3,355																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
					Principal																					B	3,891																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
Gate		15	B	3,310	YE OS																				B	16,559																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
					Principal																					B	1,183																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
	Shop	15	B	6,000	YE OS																				B	1,372																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
					Principal																					B	4,347																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
Area	CY	20	B	103,400	YE OS																				B	311																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
					Principal																					B	360																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
	Washing	20	B	210	YE OS																				B	7,431																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
					Principal																					B	531																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
CarPark/Misc		20	B	15,600	YE OS																				B	616																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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Note: YE OS means Year End Outstanding (principal remaining at the end of the year). This is calculated by dividing the total loan amount by the number term of the loan (which gives the annual payment amount) and subtracting the result each year until the OS equals 0 (the loan is repaid).
Interest also has a simple calculation (as noted). Interest = (previous years loan balance (OS) - 1/2 of the annual payment amount (gives you average outstanding for that year)) x Interest rate

Assets and Capital Expenditures - Ban Pachi CT

Terminal Operator Perspective - Ban Pachi CT																					
	Year																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Volumes (TEU)	927	950	1113	1590	2234	3088	3677	4445	5773	7178	8942	10076	11620	13508	14840	18097	19589	21735	24584	27937	30626
Tariffs																					
Avg Rev/TEU	B 2,200	B 2,200	B 2,200	B 2,200	B 2,200	B 2,310	B 2,310	B 2,310	B 2,310	B 2,310	B 2,426	B 2,426	B 2,426	B 2,426	B 2,426	B 2,547	B 2,547	B 2,547	B 2,547	B 2,547	B 2,547
Price Increase																					
Inflation																					
50% every 5 years																					
1.5%																					
NUMBERS IN 000s of Baht																					
Revenues																					
Use	B 2,039	B 2,089	B 2,448	B 3,498	B 4,915	B 7,133	B 8,493	B 10,268	B 13,334	B 16,581	B 21,689	B 24,439	B 28,184	B 32,762	B 35,994	B 46,089	B 49,888	B 55,354	B 62,610	B 71,150	
Fixed																					
Rentals																					
TOTAL	B 2,039	B 2,089	B 2,448	B 3,498	B 4,915	B 7,133	B 8,493	B 10,268	B 13,334	B 16,581	B 21,689	B 24,439	B 28,184	B 32,762	B 35,994	B 46,089	B 49,888	B 55,354	B 62,610	B 71,150	
Operating Costs																					
Labor																					
Mgmt	B 240	B 244	B 247	B 251	B 255	B 259	B 262	B 266	B 270	B 274	B 279	B 283	B 287	B 291	B 296	B 300	B 305	B 309	B 314	B 318	
Non-Mgmt	B 480	B 487	B 495	B 502	B 509	B 517	B 525	B 533	B 541	B 549	B 557	B 565	B 574	B 583	B 591	B 599	B 607	B 615	B 623	B 631	
Facility	B 180	B 183	B 185	B 188	B 191	B 194	B 197	B 200	B 203	B 206	B 209	B 212	B 215	B 218	B 222	B 225	B 228	B 232	B 235	B 239	
	B 20	B 20	B 21	B 21	B 21	B 22	B 22	B 22	B 23	B 23	B 23	B 24	B 24	B 24	B 25	B 25	B 26	B 27	B 28	B 29	
Equipment																					
Roach Stocker	B 1,080	B 1,096	B 1,113	B 1,129	B 1,146	B 1,163	B 1,181	B 1,199	B 1,217	B 1,235	B 1,253	B 1,271	B 1,289	B 1,307	B 1,325	B 1,343	B 1,361	B 1,379	B 1,397	B 1,415	
Siderrick	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	
Yard Tractor	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	
Yard Chassis	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	
TOTAL	B 2,000	B 2,030	B 2,060	B 2,091	B 2,123	B 2,155	B 2,187	B 2,220	B 2,253	B 2,287	B 2,321	B 2,354	B 2,388	B 2,421	B 2,454	B 2,487	B 2,520	B 2,553	B 2,586	B 2,619	
Operating Margin	B 39	B 59	B 387	B 1,407	B 2,792	B 4,979	B 6,306	B 8,048	B 11,081	B 14,294	B 18,114	B 20,811	B 24,502	B 29,025	B 32,201	B 34,669	B 37,106	B 41,530	B 47,434	B 54,378	
Lease Costs																					
Equipment																					
Roach Stockers	B 2,138	B 2,173	B 2,408	B 2,445	B 2,481	B 2,518	B 2,556	B 2,595	B 2,633	B 2,673	B 2,713	B 2,753	B 2,793	B 2,833	B 2,873	B 2,913	B 2,953	B 2,993	B 3,033	B 3,073	
Siderricks	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	
Yard Tractors	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	
Yard Chassis	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	
TOTAL LEASE COSTS	B 2,138	B 2,173	B 2,408	B 2,445	B 2,481	B 2,518	B 2,556	B 2,595	B 2,633	B 2,673	B 2,713	B 2,753	B 2,793	B 2,833	B 2,873	B 2,913	B 2,953	B 2,993	B 3,033	B 3,073	
Capital Costs																					
Principal	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	B 2,417	
Interest	B 3,723	B 3,530	B 3,337	B 3,143	B 2,950	B 2,757	B 2,563	B 2,370	B 2,177	B 1,983	B 1,789	B 1,596	B 1,404	B 1,211	B 1,018	B 799	B 580	B 361	B 142	B -	
Taxes	B -	B -	B -	B -	B -	B -	B -	B 219	B 1,75	B 2,185	B 1,488	B 2,365	B 3,539	B 4,963	B 5,983	B -	B -	B -	B -	B -	
Net Cash Flow	(8,439)	(8,261)	(7,775)	(6,598)	(5,056)	(2,713)	(1,240)	(448)	B 2,679	B 5,036	B 3,335	B 5,381	B 8,122	B 11,445	B 13,824	(28,004)	(23,602)	(17,854)	(10,676)	(2,496)	
NPV																					
15%																					

12

Note: Operating lease payments are payments to the equipment owner which roughly equate to principal and interest costs – you only pay for a portion of the equipment, however, after which it reverts back to the owner – the term equates to the period the terminal operator would use the equipment for after which it would be worth the residual value debited.

Assets and Capital Expend

[illegible]

Assets and Capital Expenditures - Ban Pachi CT

PHASE II (6,000 - 16,000 tca)																										
	Payback	Cost	Year																							
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
Land																										
Acquisition	20	B	1,260																							
Improvement	20	B	5,880																							
Area																										
CV	20	B	8,570																							
Rail																										
Turnout x 2	20	B	4,860																							

Assets and Capital Expenditures - Ban Paehi CT

PHASE III (16,000 - 80,000 TEU)																						
			Year																			
	Payback	Cost	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Land																						
	Acquisition	20 B	7,290	YE OS																		
	Principal																					
Interest																						
Improvement																						
		20 B	45,780	YE OS																		
	Principal																					
Interest																						
Buildings																						
	G/S	15 B	37,520	YE OS																		
	Principal																					
Interest																						
Office																						
		15 B	13,370	YE OS																		
	Principal																					
Interest																						
Gate																						
		15 B	3,510	YE OS																		
	Principal																					
Interest																						
Shop																						
		15 B	6,000	YE OS																		
	Principal																					
Interest																						
Area																						
	CY	20 B	103,400	YE OS																		
	Principal																					
Interest																						
Washing																						
		20 B	230	YE OS																		
	Principal																					
Interest																						
Curb/Air/Misc																						
		20 B	15,600	YE OS																		
	Principal																					
Interest																						
Rail																						
	Railhead Op Area	20 B	19,800	YE OS																		
	Principal																					
Interest																						
PHASE III - TOTAL CAPITAL COSTS																						
Note: YE OS means Year-End Outstanding (principal remaining at the end of the year). This is calculated by dividing the total loan amount by the number term of the loan (which gives the annual payment amount) and subtracting the result each year until the OS equals 0 (the loan is repaid).																						
Interest also has a simple calculation (as noted, rate was assumed at 8%). Interest = (previous years loan balance (x) % of the annual payment amount (gives you average outstanding for that year)) x Interest rate																						

9.3

[illegible]

5

[illegible]

Assets and Capital Expenditures - Korat CT

[illegible]

6
Assets and Capital Expenditures - Korat CT

PHASE II (8,000 - 16,000 test)				Year																			
	Payback	Cost		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Land																							
Acquisition	20	B	8,400																				
Improvement	20	B	5,880																				
Area																							
CY	20	B	8,570																				
Rail																							
Turnout x 2	20	B	4,860																				
Track	20	B	4,060																				
PHASE II - TOTAL CAPITAL COSTS																							

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Assets and Capital Expenditures - Korat CT

PHASE III (16,000 - 80,000 TEU)			Year																				
	Payback	Cost		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Land																							
Acquisition	20 B	48,600	YE OS																				
			Principal																				
			Interest																				
Improvement	20 B	45,780	YE OS																				
			Principal																				
			Interest																				
Buildings																							
CFS	15 B	37,920	YE OS																				
			Principal																				
			Interest																				
Office	15 B	13,370	YE OS																				
			Principal																				
			Interest																				
Gate	15 B	3,510	YE OS																				
			Principal																				
			Interest																				
Shop	15 B	6,000	YE OS																				
			Principal																				
			Interest																				
Area																							
CY	20 B	103,400	YE OS																				
			Principal																				
			Interest																				
Washing	20 B	230	YE OS																				
			Principal																				
			Interest																				
CurPark/Misc	20 B	15,600	YE OS																				
			Principal																				
			Interest																				
Rail																							
Railroad Op Area	20 B	19,800	YE OS																				
			Principal																				
			Interest																				
PHASE III - TOTAL CAPITAL COSTS			YE OS																				
			Principal																				
			Interest																				
Note: YE OS means Year End Outstanding (principal remaining at the end of the year). This is calculated by dividing the total loan amount by the number term of the loan (which gives the annual payment amount) and subtracting the result each year until the OS equals 0 (the loan is repaid). Interest also has a simple calculation (as noted, rate was assumed at 8%). Interest = (previous years loan balance (x) 1/2 of the annual payment amount (gives you average outstanding for that year)) x Interest rate																							

Note: YE OS means Year End Outstanding (principal remaining at the end of the year). This is calculated by dividing the total loan amount by the number term of the loan (which gives the annual payment amount) and subtracting the result each year until the OS equals 0 (the loan is repaid). Interest also has a simple calculation (see note). Interest = (previous year's loan balance (x) 0.08) - 1/2 of the annual payment amount (gives you average outstanding for that year) x interest rate

2-7

2-7

2-7

Operating lease payments to the equipment owner which roughly equate to principal and interest costs – you only pay for a portion of the equipment, however after which it reverts back to the owner – the term equates to the period the terminal operator would use the equipment for after which it would be worth the residual value (about 10% of the portion of the equipment cost the owner never saw) –

[illegible]



Assets and Capital Expenditures - Khon Kaen CT

PHASE II (\$,000 - \$6,000 rev)																						
	Payback	Cost	Year																			
Land			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Acquisition	20 B	15,120	YE O/S Principal Interest									B 16,670	B 15,293	B 14,915	B 14,038	B 13,161	B 12,283	B 11,406	B 10,528	B 9,651	B 8,774	
Improvement	20 B	5,880	YE O/S Principal Interest									B 6,483	B 6,142	B 5,800	B 5,459	B 5,118	B 4,777	B 4,436	B 4,094	B 3,753	B 3,412	
Area CY	20 B	8,570	YE O/S Principal Interest									B 9,449	B 8,951	B 8,454	B 7,957	B 7,459	B 6,962	B 6,465	B 5,968	B 5,470	B 4,973	
Rail Turnout x 2	20 B	4,860	YE O/S Principal Interest									B 5,338	B 5,076	B 4,794	B 4,512	B 4,230	B 3,948	B 3,666	B 3,384	B 3,102	B 2,820	
Track	20 B	4,060	YE O/S Principal Interest									B 4,436	B 4,241	B 4,005	B 3,769	B 3,534	B 3,298	B 3,063	B 2,827	B 2,591	B 2,356	
PHASE II - TOTAL CAPITAL COSTS			YE O/S Principal Interest									B 42,436	B 40,203	B 37,969	B 35,735	B 33,502	B 31,268	B 29,035	B 26,802	B 24,568	B 22,335	
												B 2,333	B 2,233	B 2,233	B 2,233	B 2,233	B 2,233	B 2,233	B 2,233	B 2,233	B 2,233	
												B 3,084	B 3,066	B 3,127	B 2,998	B 2,969	B 2,940	B 2,911	B 2,882	B 2,853	B 2,824	

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Note: YE: O/S means Year-End Outstanding (principal remaining at the end of the year). This is calculated by dividing the total loan amount by the number term of the loan (which gives the annual payment amount) and subtracting the result each year until the O/S equals 0 (the loan is repaid).



Note: Operating lease payments are payments to the equipment owner which roughly equate to principal and interest costs – you only pay for a portion of the equipment, however, after which it reverts back to the owner – the term equates to the period the terminal operator would use the equipment for after which it would be worth the residual value deposited

(30% - the portion of the equipment cost the user never pays for).

Implicit interest rate for calculations was 8%

**Assets and Capital Expenditures -
Ubon Ratchathani CT**

Capital Schedule - in 000s									
Item	Year	1	2	3	4	5	6	7	8
Interest Rate:									
8%									
PHASE I (<\$1,000 ea)									
Land	Payback (Yrs)	Current Cost							
Acquisition	20	B	1,890	B	1,885	B	1,880	B	1,875
YE O/S									
Principal									
Interest									
Improvement	20	B	5,880	B	5,892	B	5,904	B	5,916
YE O/S									
Principal									
Interest									
Buildings	15	B	960	B	960	B	960	B	960
O/S									
YE O/S									
Principal									
Interest									
Office/Garage	15	B	800	B	800	B	800	B	800
YE O/S									
Principal									
Interest									
Area									
CY	20	B	8,570	B	8,570	B	8,570	B	8,570
YE O/S									
Principal									
Interest									
Rail									
Turnout x4	20	B	9,720	B	9,720	B	9,720	B	9,720
YE O/S									
Principal									
Interest									
Truck	20	B	18,720	B	18,720	B	18,720	B	18,720
YE O/S									
Principal									
Interest									
Grading	20	B	140	B	140	B	140	B	140
YE O/S									
Principal									
Interest									
Paved Road	20	B	1,700	B	1,700	B	1,700	B	1,700
YE O/S									
Principal									
Interest									
PHASE I - TOTAL CAPITAL COSTS									
YE O/S									
Principal									
Interest									

**Assets and Capital Expenditures -
Ubun Ratchathani CT**

PHASE II (8,000 - 16,000 test)											
	Payback	Cost	Year								
Land			1	2	3	4	5	6	7	8	9
Acquisition	20 B	2,100	YE O/S								
Principal											
Interest											
Improvement	20 B	5,880	YE O/S								
Principal											
Interest											
Area											
CY	20 B	8,570	YE O/S								
Principal											
Interest											
Ball											
Turnout x 2	20 B	4,860	YE O/S								
Principal											
Interest											
Track	20 B	4,060	YE O/S								
Principal											
Interest											
PHASE II - TOTAL CAPITAL COSTS			YE O/S								
Principal											
Interest											

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Assets and Capital Expenditures -
Ubon Ratchathani CT

PHASE III (16,000 - 80,000 TEU)			Year																			
	Payback	Cost	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Land																						
Acquisition	20 B	12,225	YE OS																			
			Principal																			
			Interest																			
Improvement	20 B	45,780	YE OS																			
			Principal																			
			Interest																			
Buildings																						
CFS	15 B	37,920	YE OS																			
			Principal																			
			Interest																			
Office	15 B	13,370	YE OS																			
			Principal																			
			Interest																			
Gate	15 B	3,510	YE OS																			
			Principal																			
			Interest																			
Shop	15 B	6,000	YE OS																			
			Principal																			
			Interest																			
Area																						
CV	20 B	103,400	YE OS																			
			Principal																			
			Interest																			
Washing	20 B	230	YE OS																			
			Principal																			
			Interest																			
CarPark/Misc	20 B	15,600	YE OS																			
			Principal																			
			Interest																			
Rail																						
Railhead Op Area	20 B	19,800	YE OS																			
			Principal																			
			Interest																			
PHASE III - TOTAL CAPITAL COSTS			YE OS																			
			Principal																			
			Interest																			

Note: YE OS means Year-End Outstanding (principal remaining at the end of the year). This is calculated by dividing the total loan amount by the number (n) of the loan which gives the annual payment amount) and subtracting the result each year until the OS equals 0 (the loan is repaid).

Interest also has a simple calculation (as noted, rate was assumed at 8%). Interest = (previous years loan balance (n-1) - 1/2 of the annual payment amount) gives you average outstanding (for this year) x Interest rate

Notes: YE O/S means Year End Outstanding (principal remaining at the end of the year). This is calculated by dividing the total loan amount by the number term of the loan (which gives the annual payment amount) and subtracting the result each year until the O/S equals 0 (the loan is repaid).

Interest also has a simple calculation (as noted). Interest = (previous years loan balance x 5.0 - 1/2 of the annual payment amount) (give you average outstanding for that year) x Interest rate

**Assets and Capital Expenditures -
Ongkharak CT (Domestic Freight Only)**

Terminal Operator Perspective - Ongkharak CT (Domestic Freight Only)																						
	Year																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
Volumes (TEUs)	398	409	500	773	1,150	1,649	1,992	2,450	3,000	3,758	4,633	5,137	5,880	6,805	7,410	9,098	9,784	10,840	12,306	14,059		
Tariffs	B 2,200	B 2,200	B 2,200	B 2,200	B 2,200	B 2,310	B 2,310	B 2,310	B 2,310	B 2,310	B 2,426	B 2,426	B 2,426	B 2,426	B 2,426	B 2,547	B 2,547	B 2,547	B 2,547	B 2,547		
Avg Rev/TEU																						
Price Increase																						
Inflation																						
5.0% every 5 years																						
1.5%																						
NUMBERS IN 000s of Baht																						
Revenues																						
Use	B 876	B 900	B 1,100	B 1,700	B 2,530	B 3,809	B 4,602	B 5,660	B 7,115	B 8,680	B 11,237	B 12,459	B 14,262	B 16,506	B 17,973	B 21,171	B 24,918	B 27,607	B 31,340	B 35,805		
Fixed																						
Rentals																						
TOTAL	B 876	B 900	B 1,100	B 1,700	B 2,530	B 3,809	B 4,602	B 5,660	B 7,115	B 8,680	B 11,237	B 12,459	B 14,262	B 16,506	B 17,973	B 21,171	B 24,918	B 27,607	B 31,340	B 35,805		
Operating Costs																						
Labor																						
Mgmt	B 240	B 244	B 247	B 251	B 255	B 259	B 262	B 266	B 270	B 274	B 279	B 283	B 287	B 291	B 296	B 300	B 309	B 318	B 328	B 337		
Non-Mgmt	B 480	B 487	B 495	B 502	B 509	B 517	B 525	B 533	B 541	B 549	B 557	B 565	B 574	B 583	B 591	B 600	B 618	B 636	B 655	B 674		
Rail	B 180	B 183	B 185	B 188	B 191	B 194	B 197	B 200	B 203	B 206	B 209	B 212	B 215	B 218	B 222	B 225	B 231	B 238	B 246	B 254		
Facility	B 20	B 20	B 21	B 21	B 21	B 22	B 22	B 22	B 23	B 23	B 23	B 24	B 24	B 24	B 25	B 25	B 25	B 26	B 26	B 27		
Equipment																						
Reach Stacker	B 1,080	B 1,096	B 1,113	B 1,129	B 1,146	B 1,163	B 1,181	B 1,199	B 1,217	B 1,235	B 1,253	B 1,272	B 1,291	B 1,311	B 1,330	B 1,350	B 1,371	B 1,392	B 1,414	B 1,436		
Sidewalk	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -		
Yard Tractor	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -		
Yard Chassis	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -		
TOTAL	B 2,000	B 2,030	B 2,060	B 2,091	B 2,123	B 2,155	B 2,187	B 2,220	B 2,253	B 2,287	B 2,321	B 2,356	B 2,391	B 2,427	B 2,464	B 2,501	B 2,539	B 2,576	B 2,614	B 2,652		
Operating Margin	(1,124)	(1,130)	(960)	(392)	(407)	(1,655)	(2,415)	(3,440)	(4,862)	(6,393)	(8,916)	(10,103)	(11,871)	(14,078)	(15,509)	(18,195)	(19,867)	(22,481)	(26,137)	(30,524)		
Lease Costs																						
Equipment																						
Reach Stackers	B 2,338	B 2,373	B 2,408	B 2,445	B 2,481	B 2,518	B 2,556	B 2,595	B 2,633	B 2,673	B 2,713	B 2,754	B 2,795	B 2,837	B 2,880	B 2,925	B 2,973	B 3,022	B 3,072	B 3,124		
Sidewalks	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -		
Yard Tractors	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -		
Yard Chassis	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -		
TOTAL LEASE COSTS	B 2,338	B 2,373	B 2,408	B 2,445	B 2,481	B 2,518	B 2,556	B 2,595	B 2,633	B 2,673	B 2,713	B 2,754	B 2,795	B 2,837	B 2,880	B 2,925	B 2,973	B 3,022	B 3,072	B 3,124		
Capital Costs																						
Principal	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616	B 2,616		
Interest	B 4,035	B 3,825	B 3,616	B 3,407	B 3,197	B 2,988	B 2,779	B 2,569	B 2,360	B 2,151	B 1,941	B 1,732	B 1,523	B 1,314	B 1,104	B 889	B 679	B 469	B 260	B 50		
Taxes	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -	B -		
Net Cash Flow	(10,112)	(9,944)	(9,601)	(8,859)	(7,888)	(6,468)	(5,537)	(4,340)	(2,748)	(1,047)	(1,073)	(2,022)	(3,377)	(5,039)	(6,158)	(7,882)	(9,432)	(10,975)	(12,222)	(13,222)		
NPV																						
15%																						

**Assets and Capital Expenditures -
Ongkhark CT (Domestic Freight Only)**

Capital Schedule - in 000s																					
Interest Rate:																					
PIASE I (<8,000 teu)																					
Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Land	Payback (Yr) Current Cost																				
	20 B 5,250																				
Acquisition	YE O/S	4,988	4,725	4,463	4,200	3,938	3,675	3,413	3,150	2,888	2,625	2,363	2,100	1,838	1,575	1,313	1,050	788	525	263	-
	Principal	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263	263
Improvement	Interest	410	389	368	347	326	305	284	263	242	221	200	179	158	137	116	95	74	53	32	11
	20 B 5,580																				
Building	YE O/S	5,586	5,292	4,998	4,704	4,410	4,116	3,822	3,528	3,234	2,940	2,646	2,352	2,058	1,764	1,470	1,176	882	588	294	-
	Principal	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294
GIS	Interest	459	435	412	388	365	341	318	294	270	247	223	200	176	153	129	106	82	59	35	12
	15 B 960																				
Office/Gate	YE O/S	806	832	858	884	910	936	962	988	1,014	1,040	1,066	1,092	1,118	1,144	1,170	1,196	1,222	1,248	1,274	-
	Principal	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
Area	Interest	74	69	64	59	54	49	44	38	33	28	23	18	13	8	3	-	-	-	-	-
	15 B 800																				
CY	YE O/S	747	693	640	587	533	480	427	373	320	267	213	160	107	53	53	53	53	53	53	-
	Principal	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Rail	Interest	62	58	53	49	45	41	36	32	28	23	19	15	11	6	2	-	-	-	-	-
	20 B 8,570																				
Turnout x4	YE O/S	8,142	7,713	7,285	6,856	6,428	5,999	5,571	5,142	4,714	4,285	3,857	3,428	3,000	2,571	2,143	1,714	1,286	857	429	-
	Principal	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429
Track	Interest	658	634	600	566	531	497	463	429	394	360	326	291	257	223	189	154	120	86	51	17
	20 B 9,720																				
Gravel	YE O/S	9,234	8,748	8,262	7,776	7,290	6,804	6,318	5,832	5,346	4,860	4,374	3,888	3,402	2,916	2,430	1,944	1,458	972	486	-
	Principal	486	486	486	486	486	486	486	486	486	486	486	486	486	486	486	486	486	486	486	486
Paved Road	Interest	758	719	680	642	603	564	525	486	447	408	369	330	292	253	214	175	136	97	58	19
	20 B 18,720																				
TOTAL CAPITAL COSTS	YE O/S	17,784	16,848	15,912	14,976	14,040	13,104	12,168	11,232	10,296	9,360	8,424	7,488	6,552	5,616	4,680	3,744	2,808	1,872	936	-
	Principal	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936	936
Interest	Interest	1,460	1,385	1,310	1,236	1,161	1,086	1,011	936	861	786	711	636	562	487	412	337	262	187	112	37
	20 B 140																				
Paved Road	YE O/S	133	126	119	112	105	98	91	84	77	70	63	56	49	42	35	28	21	14	7	-
	Principal	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Interest	Interest	11	10	10	9	9	8	8	7	6	6	5	5	4	4	3	3	2	1	1	0
	20 B 1,700																				
TOTAL CAPITAL COSTS	YE O/S	1,615	1,530	1,445	1,360	1,275	1,190	1,105	1,020	935	850	765	680	595	510	425	340	255	170	85	-
	Principal	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Interest	Interest	133	126	119	112	105	99	92	85	78	71	63	58	51	44	37	31	24	17	10	3
	20 B 4,035																				
TOTAL CAPITAL COSTS	YE O/S	49,124	46,507	43,891	41,275	38,658	36,042	33,426	30,809	28,193	25,577	22,960	20,344	17,728	15,111	12,495	9,879	7,263	4,647	2,031	-
	Principal	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616	2,616
Interest	Interest	4,035	3,825	3,616	3,407	3,197	2,988	2,779	2,569	2,360	2,151	1,941	1,732	1,523	1,314	1,104	900	700	500	300	100
	20 B 4,035																				



**Assets and Capital Expenditures -
Ongkharak CT (Domestic Freight Only)**

PHASE III (16,000 - 80,000 TEU)				Year																			
		Payback	Cost	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Land	Acquisition	20	B 30,375	YE OS																			
				Principal Interest																			
Improvement		20	B 45,780	YE OS																			
				Principal Interest																			
Buildings	OS	15	B 37,920	YE OS																			
				Principal Interest																			
Office		15	B 13,370	YE OS																			
				Principal Interest																			
Gate		15	B 3,510	YE OS																			
				Principal Interest																			
Shop		15	B 6,000	YE OS																			
				Principal Interest																			
Area	CY	20	B 103,400	YE OS																			
				Principal Interest																			
Washing		20	B 230	YE OS																			
				Principal Interest																			
Car/Pd/Misc		20	B 15,600	YE OS																			
				Principal Interest																			
Rail	Railhead Op/Ave	20	B 19,800	YE OS																			
				Principal Interest																			
PHASE III - TOTAL CAPITAL COSTS				YE OS																			
				Principal Interest																			
														</									

Note: YE OS means Year End Outstanding (principal remaining at the end of the year). This is calculated by dividing the total loan amount by the number term of the loan (which gives the annual payment amount) and subtracting the result each year until the OS equals 0 (the loan is repaid).

Assets and Capital Expenditures - Hat Yai CT

Terminal Operator Perspective - Huai Yai																					
	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Volumes (TEUs)		2,583	2,667	2,750	4,150	5,550	6,950	8,350	9,750	11,650	13,550	15,450	17,350	19,250	21,300	23,350	25,400	27,450	29,500	32,126	34,985
Tariffs		B	2,200	B	2,200	B	2,200	B	2,310	B	2,310	B	2,426	B	2,426	B	2,426	B	2,547	B	2,547
Avg Rev/TEU																					
Price Increase																					
Inflation																					
every 5 years																					
1.5%																					
NUMBERS IN 000s of Baht																					
Revenues		B	5,683	B	5,867	B	6,050	B	6,050	B	6,050	B	6,050	B	6,050	B	6,050	B	6,050	B	6,050
Use																					
Fixed																					
Remials																					
TOTAL		B	5,683	B	5,867	B	6,050	B	6,050	B	6,050	B	6,050	B	6,050	B	6,050	B	6,050	B	6,050
Operating Costs																					
Labor		B	240	B	244	B	247	B	247	B	247	B	247	B	247	B	247	B	247	B	247
Mgmt		B	480	B	487	B	495	B	495	B	495	B	495	B	495	B	495	B	495	B	495
Non-Mgmt		B	180	B	183	B	185	B	185	B	185	B	185	B	185	B	185	B	185	B	185
Rail		B	20	B	20	B	21	B	21	B	21	B	21	B	21	B	21	B	21	B	21
Facility																					
Equipment		B	1,080	B	1,096	B	1,113	B	1,129	B	1,146	B	1,163	B	1,180	B	1,197	B	1,214	B	1,231
Reach Stacker		B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-
Sidepick		B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-
Yard Tractor		B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-
Yard Chassis		B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-
TOTAL		B	2,000	B	2,030	B	2,060	B	2,091	B	2,123	B	2,155	B	2,187	B	2,219	B	2,251	B	2,283
Operating Margin		B	3,683	B	3,837	B	3,990	B	3,990	B	3,990	B	3,990	B	3,990	B	3,990	B	3,990	B	3,990
Lease Costs																					
Equipment		B	2,338	B	2,373	B	2,408	B	2,445	B	2,481	B	2,518	B	2,555	B	2,592	B	2,629	B	2,666
Stackers		B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-
Sidepicks		B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-
Yard tractors		B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-
Yard Chassis		B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-
TOTAL LEASE COSTS		B	2,338	B	2,373	B	2,408	B	2,445	B	2,481	B	2,518	B	2,555	B	2,592	B	2,629	B	2,666
Capital Costs																					
Principal		B	2,616	B	2,616	B	2,616	B	2,616	B	2,616	B	2,616	B	2,616	B	2,616	B	2,616	B	2,616
Interest		B	4,035	B	3,825	B	3,616	B	3,407	B	3,197	B	2,988	B	2,779	B	2,569	B	2,360	B	2,151
Taxes		B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-	B	-
Net Cash Flow			(5,305)		(4,978)		(4,651)		(4,324)		(4,000)		(3,675)		(3,350)		(3,025)		(2,700)		(2,375)
NPV																					

Note: Operating lease payments are payments to the equipment owner which roughly equate to principal and interest costs – you only pay for a portion of the equipment, however, after which it reverts back to the owner – the term equates to the period the terminal operator would use the equipment for after which it would be worth the residual value deposited.

Capital Schedule - in MWs																					
Interest Rate:																					
8%																					
PHASE I (<8,000 fed)																					
Payback (Yr) Current Cost																					
Land	20	B	5,550	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Acquisition	Principal	4,988	4,725	B	4,463	4,300	B	3,938	B	3,675	B	3,413	B	3,150	B	2,888	B	2,625	B	2,363	
Principal	Interest	263	263	B	263	263	B	263	263	B	263	263	B	263	263	B	263	263	B	263	
410	389	B	368	B	347	B	326	B	305	B	284	B	263	B	242	B	221	B	199	178	
Improvement	Principal	5,586	5,292	B	4,998	4,704	B	4,410	B	4,116	B	3,822	B	3,528	B	3,234	B	2,940	B	2,646	
Principal	Interest	459	459	B	459	459	B	459	459	B	459	459	B	459	459	B	459	459	B	459	
Buildings	Principal	896	832	B	768	B	704	B	640	B	576	B	512	B	448	B	384	B	320	B	256
CFS	Principal	64	64	B	64	B	64	B	64	B	64	B	64	B	64	B	64	B	64	B	64
Principal	Interest	74	69	B	64	B	59	B	54	B	49	B	44	B	38	B	33	B	28	B	23
Office/Gate	Principal	747	693	B	640	B	587	B	533	B	480	B	427	B	373	B	320	B	267	B	213
Principal	Interest	62	58	B	53	B	49	B	45	B	41	B	36	B	32	B	28	B	23	B	19
Area	Principal	8,143	7,713	B	7,285	B	6,856	B	6,428	B	5,999	B	5,571	B	5,142	B	4,714	B	4,285	B	3,857
Principal	Interest	429	429	B	429	429	B	429	429	B	429	429	B	429	429	B	429	429	B	429	429
668	634	B	600	B	566	B	531	B	497	B	463	B	429	B	394	B	360	B	326	B	291
Rail	Principal	8,234	7,878	B	7,522	B	7,166	B	6,810	B	6,454	B	6,098	B	5,742	B	5,386	B	5,030	B	4,674
Principal	Interest	486	486	B	486	486	B	486	486	B	486	486	B	486	486	B	486	486	B	486	486
Turnout x4	Principal	758	719	B	680	B	642	B	603	B	564	B	525	B	486	B	447	B	408	B	369
Truck	Principal	17,784	16,848	B	15,912	B	14,976	B	14,040	B	13,104	B	12,168	B	11,232	B	10,296	B	9,360	B	8,424
Principal	Interest	936	936	B	936	936	B	936	936	B	936	936	B	936	936	B	936	936	B	936	936
1,460	1,385	B	1,310	B	1,236	B	1,161	B	1,086	B	1,011	B	936	B	861	B	786	B	711	B	636
Grading	Principal	133	126	B	119	B	112	B	105	B	98	B	91	B	84	B	77	B	70	B	63
Principal	Interest	7	7	B	7	B	7	B	7	B	7	B	7	B	7	B	7	B	7	B	7
115	110	B	105	B	100	B	95	B	90	B	85	B	80	B	75	B	70	B	65	B	60
Paved Road	Principal	1,615	1,530	B	1,445	B	1,360	B	1,275	B	1,190	B	1,105	B	1,020	B	935	B	850	B	765
Principal	Interest	85	85	B	85	B	85	B	85	B	85	B	85	B	85	B	85	85	B	85	85
133	126	B	119	B	112	B	105	B	98	B	91	B	84	B	77	B	70	B	63	B	56
PHASE I - TOTAL CAPITAL COSTS																					
Principal	Interest	46,507	43,891	B	41,275	B	38,658	B	36,022	B	33,426	B	30,809	B	28,193	B	25,577	B	22,960	B	20,344
Principal	Interest	2,616	2,616	B	2,616	2,616	B	2,616	2,616	B	2,616	2,616	B	2,616	2,616	B	2,616	2,616	B	2,616	2,616
4,035	3,825	B	3,616	B	3,407	B	3,197	B	2,988	B	2,779	B	2,569	B	2,360	B	2,151	B	1,941	B	1,732

0

PHASE II (8,000 - 16,000 tpy)

Assets and Capital Expenditures - Hat Yai CT

PHASE III (16,000 - 80,000 TEU)			Year																			
	Payback	Cost	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Land	Acquisition	20 B 30,375	YE O/S																			
			Principal																			
Improvement	20 B 45,780	YE O/S																				
			Principal																			
Buildings	15 B 37,920	YE O/S																				
			Principal																			
Office	15 B 13,370	YE O/S																				
			Principal																			
Gate	15 B 3,510	YE O/S																				
			Principal																			
Shop	15 B 6,000	YE O/S																				
			Principal																			
Area	20 B 103,400	YE O/S																				
			Principal																			
Washing	20 B 240	YE O/S																				
			Principal																			
CarPark/Misc	20 B 15,600	YE O/S																				
			Principal																			
Rail	20 B 19,800	YE O/S																				
			Principal																			
PHASE III - TOTAL CAPITAL COSTS			YE O/S																			
			Principal																			
			Interest																			
Note: YE O/S means Year End Outstanding (principal remaining at the end of the year). This is calculated by dividing the total loan amount by the number yrs of the loan (which gives the annual payment amount) and subtracting the result each year until the loan is repaid.																						
Interest also has a simple calculation (as noted, rate was assumed at 5%). Interest = (previous year's loan balance (o.s.) x the annual payment amount (given your average outstanding for that year)) x Interest rate.																						

Note: YE O/S means Year-End Outstanding (principal remaining at the end of the year). This is calculated by dividing the total loan amount by the number term of the loan (which gives the annual payment amount) and subtracting the result each year until the O/S equals 0 (the loan is repaid).

Interest also has a simple calculation (as noted, rate was assumed at 8%). Interest = (previous year loan balance (0.5) - 1/2 of the annual payment amount (gives you average outstanding for that year)) x Interest rate



Appendix G

Details of Economic Benefit-Cost Analysis

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Economic Cost Analysis

Costs (000s, 1997 Baht)	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Present Value																
ADDITIONAL BANGKOK ICD CAPACITY																
LK expansion																
Capital	5,531,652															
Capital Equipment	2,170,168															
O & M	571,575															
SRT Rail O&M Cost	1,666,651															
SRT Rail Equipment Cost	467,970															
	655,288															
New ICD (Ongharak)																
Capital	6,412,777															
Capital Equipment	1,443,463															
O & M	758,135															
SRT Rail O&M Cost	2,291,770															
SRT Rail Equipment Cost	1,213,051															
	706,358															
TOTAL PV COST, Bangkok/L. Chab																
	11,944,430															
HINTERLAND CT FACILITIES																
NORTH																
Lamphun																
Phase I Capital	689,350															
Phase I Capital Equipment	44,555															
Phase I O & M	18,182															
Phase II Capital	7,582															
Phase II Capital Equipment	21,388															
Phase II O & M	18,182															
Phase III Capital	15,087															
Phase III Capital Equipment	236,527															
Phase III O & M	68,455															
	298,392															
Phitsanulok																
Phase I Capital	644,735															
Phase I Capital Equipment	43,409															
Phase I O & M	18,182															
Phase II Capital	11,518															
Phase II Capital Equipment	22,382															
Phase II O & M	18,182															
Phase III Capital	21,233															
Phase III Capital Equipment	229,900															
Phase III O & M	69,455															
	210,475															
Ban Phachi																
Phase I Capital	689,683															
Phase I Capital Equipment	43,409															
Phase I O & M	18,182															
Phase II Capital	4,974															
Phase II Capital Equipment	252,500															
Phase II O & M	87,636															
Phase III Capital	282,982															
Phase III Capital Equipment	0															
Phase III O & M	0															
TOTAL, NORTH REGION ICD SYSTEM																
	2,023,767															

Economic Cost Analysis

Costs (000s, 1997 Baht)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ADDITIONAL BANGKOK ICD CAPACITY																
LK expansion	5,531,552															
Capital	2,170,168	0	0	0	0	Phase II 1655500	0	0	0	0	0	0	0	0	0	0
Capital Equipment	571,575	349200	0	0	0	349200	0	0	0	0	0	0	0	0	0	0
O & M	1,666,651	151100	151100	151100	151100	302200	302200	302200	302200	302200	302200	302200	302200	302200	302200	302200
SRT Rail O&M Cost	467,970	69651	69651	69651	69651	69651	69651	69651	69651	69651	69651	69651	69651	69651	69651	69651
SRT Rail Equipment Cost	655,288	436736	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New ICD (Ongharak)	6,412,777															
Capital	1,443,463	889500	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital Equipment	758,135	349200	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O & M	2,291,770	302200	302200	302200	302200	302200	302200	302200	302200	302200	302200	302200	302200	302200	302200	302200
SRT Rail O&M Cost	1,213,051	105024.8	149710.1	174187.4	184433.8	184433.8	184433.8	184433.8	184433.8	184433.8	184433.8	184433.8	184433.8	184433.8	184433.8	184433.8
SRT Rail Equipment Cost	706,358	187500	0	0	0	436618	0	0	0	0	0	0	0	0	0	0
TOTAL PV COST, Bangkok/L. Chab	11,944,430															
HINTERLAND CT FACILITIES																
NORTH																
Lamphun	689,350															
Phase I Capital	44,555															
Phase I Capital Equipment	18,182															
Phase I O & M	7,582															
Phase II Capital	21,388															
Phase II Capital Equipment	18,182															
Phase II O & M	15,087															
Phase III Capital	236,527															
Phase III Capital Equipment	69,455															
Phase III O & M	258,392	30890	30890	30890	30890	30890	30890	30890	30890	30890	30890	30890	30890	30890	30890	30890
Phitsanulok	644,735															
Phase I Capital	43,409															
Phase I Capital Equipment	18,182															
Phase I O & M	11,518															
Phase II Capital	22,382															
Phase II Capital Equipment	18,182															
Phase II O & M	21,233															
Phase III Capital	229,900															
Phase III Capital Equipment	69,455															
Phase III O & M	210,475	3980	3980	3980	3980	3980	3980	3980	3980	3980	3980	3980	3980	3980	3980	3980
Ban Phachi	689,683															
Phase I Capital	43,409															
Phase I Capital Equipment	18,182															
Phase I O & M	4,974															
Phase II Capital	252,500															
Phase II Capital Equipment	87,636															
Phase II O & M	282,982															
Phase III Capital	0															
Phase III Capital Equipment	0															
Phase III O & M	0															
TOTAL, NORTH REGION ICD SYSTEM	2,023,767															

Economic Cost Analysis

Costs (000s, 1997 Baht)	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Present Value																
NORTHEAST																
Khon Kaen																
Phase I Capital			61610	0												
Phase I Capital Equipment			20000													
Phase I O & M			2000	2000	2000	2000	2000	2000	2000	2000	2000	38480				
Phase II Capital												20000				
Phase II Capital Equipment												3980				
Phase II O & M																
Phase III Capital																
Phase III Capital Equipment																
Phase III O & M																
Ubon Ratchathani																
Phase I Capital			48590	0												
Phase I Capital Equipment			20000													
Phase I O & M			2000	2000	2000	2000	2000	2000	2000	2000	2000					
Phase II Capital																
Phase II Capital Equipment																
Phase II O & M																
Phase III Capital																
Phase III Capital Equipment																
Phase III O & M																
Korat																
Phase I Capital			54890	0												
Phase I Capital Equipment			20000													
Phase I O & M			2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Phase II Capital																
Phase II Capital Equipment																
Phase II O & M																
Phase III Capital																
Phase III Capital Equipment																
Phase III O & M																
ONGKHARAK CT (northeast region)																
Ongharakak CT																
Phase I Capital			46490	0												
Phase I Capital Equipment			20000													
Phase I O & M			2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Phase II & III Capital																
Phase II & III Capital Equipment																
Phase II & III O & M																
Phase III Capital																
Phase III Capital Equipment																
Phase III O & M																
SOUTH																
Hat Yai																
Phase I Capital			51740	0												
Phase I Capital Equipment			20000													
Phase I O & M			2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Phase II Capital																
Phase II Capital Equipment																
Phase II O & M																
Phase III Capital																
Phase III Capital Equipment																
Phase III O & M																
TOTAL, SOUTH REGION ICD SYSTEM																

Economic Cost Analysis

Costs (000s, 1997 Baht)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NORTHEAST																
Khon Kaen																
Phase I Capital																
Phase I Capital Equipment																
Phase I O & M																
Phase II Capital																
Phase II Capital Equipment																
Phase II O & M																
Phase III Capital																
Phase III Capital Equipment																
Phase III O & M																
Ubon Ratchathani																
Phase I Capital																
Phase I Capital Equipment																
Phase I O & M																
Phase II Capital																
Phase II Capital Equipment																
Phase II O & M																
Phase III Capital																
Phase III Capital Equipment																
Phase III O & M																
Korat																
Phase I Capital																
Phase I Capital Equipment																
Phase I O & M																
Phase II Capital																
Phase II Capital Equipment																
Phase II O & M																
Phase III Capital																
Phase III Capital Equipment																
Phase III O & M																
ONGKHARAK CT (northeast region)																
Ongharak CT																
Phase I Capital																
Phase I Capital Equipment																
Phase I O & M																
Phase II & III Capital																
Phase II & III Capital Equipment																
Phase II & III O & M																
Phase III Capital																
Phase III Capital Equipment																
Phase III O & M																
SOUTH																
Hat Yai																
Phase I Capital																
Phase I Capital Equipment																
Phase I O & M																
Phase II Capital																
Phase II Capital Equipment																
Phase II O & M																
Phase III Capital																
Phase III Capital Equipment																
Phase III O & M																
TOTAL, SOUTH REGION ICD SYSTEM																

Economic Cost Analysis

Costs (000s, 1997 Baht)	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Present Value																
SRT RAILROAD OPERATING COSTS (Hinterland Transport)																
NORTH																
Lamphun			10647	10991	11334	17723	24111	30499	36888	43276	50283	57290	64296	71303	78309	87171
NORTHEAST																
Khon Kaen			2703	2782	2862	4388	5915	7441	8967	10494	12115	13737	15359	16980	18602	20415
Ubon Ratchathani			4811	4915	5020	8032	11044	14056	17068	20080	23092	26104	29116	32128	35140	38528
SOUTH																
Hat Yai			8915	9203	9490	14322	19153	23984	28816	33647	40204	46761	53318	59875	66431	73506
SRT RAILROAD EQUIPMENT COSTS (Hinterland Transport)																
NORTH																
Lamphun			175,118	0	0	0	104,559	0	0	0	0	320,177	0	0	0	0
NORTHEAST																
Khon Kaen			320,236	0	0	0	27,000	0	0	0	0	79,000	0	0	0	0
Ubon Ratchathani																
SOUTH																
Hat Yai			161,118	0	0	0	14,500	0	0	0	0	36,500	0	0	0	0

ICD and CT capital costs include land acquisition. Costs are introduced in phases, based on increases in container volumes.

Economic Cost Analysis

Costs (000s, 1997 Baht)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Present Value																
SRT RAILROAD OPERATING COSTS (Hinterland Transport)																
NORTH																
Lamphun	96032	104893	113765	122616	133529	145413	158355	172448	187796	204510	222712	242533	264118	287625	313223	341100
NORTHEAST																
Khon Kaen	22227	24040	25852	27665	30127	32808	35728	38908	42371	46142	50248	54720	59590	64894	70670	76959
Ubon Ratchathani	41916	45305	48693	52082	56717	61765	67262	73248	79768	86867	94598	103017	112186	122170	133043	144884
SOUTH																
Hat Yai	80580	87655	94729	101804	110864	120731	131476	143178	155921	169798	184910	201367	219288	238805	260059	283204
SRT RAILROAD EQUIPMENT COSTS (Hinterland Transport)																
NORTH																
Lamphun	360,177	0	0	0	0	518,736	0	0	0	0	0	0	0	0	0	0
NORTHEAST																
Khon Kaen	410,236	0	0	0	0	296,118	0	0	0	0	0	0	0	0	0	0
Ubon Ratchathani																
SOUTH																
Hat Yai	200,618	0	0	0	0	149,059	0	0	0	0	0	0	0	0	0	0

Economic Benefits Analysis

Unit Values Look-Up Table									
1. Cost savings from reduced mid/long haul truck operations (baht/truck ton kilometer)									Baht
2. Cost savings from reduced mid/long haul truck operations (baht/truck TEU kilometer @ 12 tons/TEU)									1.53
3. Time/Congestion cost savings add-on factor, BKK region only, rail TEU only									18.36
4. Residual benefit of using ICD, versus non-ICD distribution, net of transport cost savings, baht/TEU km									1.2
									1.82

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Benefits (000s, 1997 Baht)														
NPV														
Additional Bangkok ICD Capacity														
Benefits for Rail Transported TEU¹														
- LK expansion														
- New ICD (Ongkarak)														
Benefits for Truck Transported TEU²														
- LK expansion														
- New ICD (Ongkarak)														
Total LK Expansion														
Total Ongkarak														
Hinterland CT Facilities³														
North														
Lamphun														
Phitsanulok														
Ban Pachi														
Northeast														
Khon Kaen														
Ubon Ratchathani														
Korat														
South														
Hat Yai														

- Benefits due to trucks removed from the highway system, and diverted to rail: calculated as estimated annual TEU diverted from truck to rail x average truck distance from ICD to LC Port (TEU truck kilometer) x product of items 2 and 3 in look up table.
- Residual truck benefits associated with trucks utilizing ICDs: estimated annual truck TEU at each ICD x distance from ICD to LC Port x item 4 in lookup table.
- Benefits due to trucks removed from the highway system, and diverted to rail: estimated annual CT TEU x average truck distance from hinterland CT to central Bangkok x item 2 in look up table

Economic Benefits Analysis

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Benefits (000s, 1997 Baht)														
NPV														
(from 1st year of operation)														
Additional Bangkok ICD Capacity														
Benefits for Rail Transported TEU¹														
- LK expansion	791863	791863	791863	791863	791863	791863	791863	791863	791863	791863	791863	791863	791863	791863
- New ICD (Ongkarak)	740767	959777	1188449	1433224	1694103	1971086	2069640	2087032	2087032	2087032	2087032	2087032	2087032	2087032
Benefits for Truck Transported TEU²														
- LK expansion	382	506	557	652	753	863	951	1017	1081	1149	1274	1274	1274	1274
- New ICD (Ongkarak)	0	0	0	0	0	0	0	0	0	0	-7238	2663	13059	23976
Total LK Expansion	792245	792369	792420	792515	792617	792726	792815	792880	792944	793012	793137	793137	793137	793137
Total Ongkarak	740767	959777	1188449	1433224	1694103	1971086	2069640	2087032	2087032	2087032	2079793	2089695	2100091	2111008
Hinterland CT Facilities³														
North														
Lamphun	222909	248133	273357	298580	323804	349028	380092	413920	450759	490876	534564	582140	633951	690373
Phitsanulok	54896	60935	66974	73012	79051	85089	92662	100909	109890	119670	130321	141920	154551	168306
Ban Pachi	2121	2333	2545	2757	2969	3181	3464	3772	4108	4474	4872	5305	5778	6292
Northeast														
Khon Kaen	69277	76027	82777	89527	96277	103027	112197	122182	133056	144898	157794	171838	187131	203786
Ubon Ratchathani	129291	141758	154226	166693	179161	191628	208683	227256	247481	269507	293493	319614	348060	379037
Korat	16854	18441	20027	21613	23200	24786	26992	29394	32010	34859	37962	41340	45020	49026
South														
Hat Yai	360852	399280	437709	476137	514566	552994	602210	655807	714174	777736	846954	922333	1004421	1093814

Economic Benefits Analysis

Benefits (000s, 1997 Baht)	NPV	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Additional Bangkok ICD Capacity														
Benefits for Rail Transported TEU ¹														
- LK expansion	5,772,083	791863	791863	791863	791863	791863	791863	791863	2087032	2087032	2087032	2087032	2087032	2087032
- New ICD (Ongkarak)	12,634,864	2087032	2087032	2087032	2087032	2087032	2087032	2087032	2087032	2087032	2087032	2087032	2087032	2087032
Benefits for Truck Transported TEU ²														
- LK expansion	3,619	1274	1274	1274	1274	1274	1274	1274	85205	85205	85205	85205	85205	85205
- New ICD (Ongkarak)	105,612	35438	47473	60110	73379	85205	85205	85205	85205	85205	85205	85205	85205	85205
Total LK Expansion	5,775,702	793137	793137	793137	793137	793137	793137	793137	2172237	2172237	2172237	2172237	2172237	2172237
Total Ongkarak	12,740,476	2122470	2134505	2147142	2160411	2172237	2172237	2172237	2172237	2172237	2172237	2172237	2172237	2172237
Hinterland CT Facilities³														
North	2,079,468													
Lamphun	1,660,731	751816	818727	891594	970946									
Phitsanulok	404,213	183285	199597	217361	236706									
Ban Pachi	14,524	6852	7461	8126	8849									
Northeast	1,564,962													
Khon Kaen	506,018	221923	241674	263183	286607									
Ubon Ratchathani	940,048	412771	449508	489514	533081									
Korat	118,895	53390	58141	63316	68951									
South														
Hat Yai	2,614,677	1191163	1297177	1412626	1538349									

Net Present Value, Internal Rate of Return Results

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bangkok/Laem Chabang													
LK Expansion													
Present Value, Benefit Stream					100303	256036	372176	498874	633509	778753	792023	792093	792169
Present Value, Cost Stream)					2536022	680856	183836	194980	208821	219590	336931	196141	203106
IRR					-2435720	-424821	188340	303894	426688	559163	455092	595952	589063
New ICD 1 (Ongkarak)													
Present Value, Benefit Stream											173919	347839	541082
Present Value, Cost Stream)											2081260	212009	220547
IRR											-1907341	135830	320535
Combined LK Expansion & Ongkarak													
IRR					-2435720	-424821	188340	303894	426688	559163	-1452249	731781	909598
Hinterland CT Facilities													
North System													
Present Value, Benefit Stream		38438	39645	40851	63224	85596	107969	130341	152714	178156	203599	229041	254483
Present Value, Cost Stream)		396275	16991	17334	426763	163560	113249	73758	80146	87153	460937	466636	137063
IRR		-357837	22654	23517	-363539	-77964	-5281	56583	72568	91003	-257338	-237595	117421
Northeast System													
Present Value, Benefit Stream		29749	30430	31111	49265	67420	85574	103728	121883	140591	159299	178007	196715
Present Value, Cost Stream)		627330	15698	15882	20420	51958	74837	83455	42533	47167	191261	58414	63048
IRR		-597580	14732	15229	28845	15461	10737	20274	79350	93424	-31962	119592	133667
South System													
Present Value, Benefit Stream		48426	49988	51550	77794	104038	130282	156525	182769	218386	254002	289619	325235
Present Value, Cost Stream)		243773	11203	11490	16322	35653	76574	32796	37627	44184	87241	413498	90765
IRR		-195347	38786	40060	61473	68385	53707	123730	145142	174202	166762	-123879	234471

Present values computed using 10% real discount rate.

Internal Rate of Return represents that discount rate at which the NPV exactly equals 0.

Net Present Value, Internal Rate of Return Results

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Bangkok/Laem Chabang													
LK Expansion													
Present Value, Benefit Stream	792245	792369	792420	792515	792617	792726	792815	792880	792944	793012	793137	793137	793137
Present Value, Cost Stream)	210303	218197	657487	569951	220751	220751	220751	2376551	371851	371851	371851	371851	371851
IRR	581942	574172	134933	222564	571866	571975	572064	-1583671	421093	421161	421286	421286	421286
New ICD 1 (Ongkarak)													
Present Value, Benefit Stream	740767	959777	1188449	1433224	1694103	1971086	2069640	2087032	2087032	2087032	2089695	2100091	2100091
Present Value, Cost Stream)	229371	239048	1833425	428856	451910	476387	486634	923252	835834	486634	486634	486634	486634
IRR	511397	720729	-644976	1004368	1242193	1494698	1583006	1163780	1251198	1600398	1593160	1603051	1613457
Combined LK Expansion & Ongkarak													
IRR	1093339	1294901	-510043	1226932	1814058	2066673	2155070	-419891	1672291	2021559	2014446	2024347	2034744
Hinterland CT Facilities													
North System													
Present Value, Benefit Stream	279926	311400	342875	374349	405824	437298	476218	518601	564757	615020	669757	729366	794279
Present Value, Cost Stream)	144069	152931	521969	170653	179515	544576	226199	756819	251025	265118	280466	297180	315382
IRR	135856	158470	-179094	203696	226309	-107278	250019	-238218	313732	349902	389291	432185	478898
Northeast System													
Present Value, Benefit Stream	215422	236226	257030	277834	298637	319441	347871	378832	412548	449255	489249	532792	580211
Present Value, Cost Stream)	67682	434018	515230	110195	115396	120597	564084	512191	172730	181896	191878	202748	214586
IRR	147741	-197791	-258200	167639	183242	198844	-216213	-133359	239818	267368	297371	330044	365625
South System													
Present Value, Benefit Stream	360852	399280	437709	476137	514566	552994	602210	655807	714174	777736	846954	922333	1004421
Present Value, Cost Stream)	97321	104396	312088	118545	125619	132694	141754	300680	162366	174068	188811	200688	215800
IRR	263531	294885	125620	357592	388946	420300	460456	355127	551808	603668	660143	721645	788621

Net Present Value, Internal Rate of Return Results

Year	2026	2027	2028	2029	2030
Bangkok/Laem Chabang					
LK Expansion					
Present Value, Benefit Stream	793137	793137	793137	793137	793137
Present Value, Cost Stream)	371851	721051	371851	371851	371851
IRR	421286	72086	421286	421286	421286
	11.3%				
New ICD 1 (Ongkarak)					
Present Value, Benefit Stream	12,853,646	2122470	2134505	2147142	2160411
Present Value, Cost Stream)	6,412,777	486634	486634	486634	486634
IRR	1275174	1635836	1647871	1660508	1673777
	28.9%				
Combined LK Expansion & Ongkarak					
IRR	1696460	1707922	2069157	2081794	2095063
	17.3%				
Hinterland CT Facilities					
North System					
Present Value, Benefit Stream	864970	941952	1025786	1117081	1216501
Present Value, Cost Stream)	335203	356788	380295	405893	405893
IRR	529767	585164	645491	711188	810608
	9.3%				
Northeast System					
Present Value, Benefit Stream	1,564,962	688084	749324	816014	888639
Present Value, Cost Stream)	1,598,108	241516	256804	670963	318493
IRR	404372	446568	492520	145051	570146
	9.6%				
South System					
Present Value, Benefit Stream	1093814	1191163	1297177	1412626	1538349
Present Value, Cost Stream)	232257	250178	269695	290949	290949
IRR	861557	940985	1027482	1121677	1247401
	36.6%				

