State Railway of Thailand

SRT Master Development Plan Study

Final Report

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PREFACE

This volume is the final report of the SRT Master Development Plan Study. The study was commissioned by the State Railway of Thailand to the Thailand Development Research Institute (TDRI). The study team consisted of:

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TABLE OF CONTENTS

Chapter 1
Railways: The World Experience

Chapter 2
The State Railway of Thailand: Past and Present

Chapter 3
Future Transport Demand

Chapter 4
Future Role of the State Railway of Thailand

Page

Chapter 5
Bangkok Commuter Needs: A Special Focus

Chapter 6
Adapting the Railway to Meet Its Future Role

Chapter 7
Action Plans

Executive Summary
SRT MASTER DEVELOPMENT PLAN

1. Railways: The World Experience

Like most of the World's great railways, the State Railway of Thailand (SRT) has entered its second century of operation. Throughout its history, the SRT has made a significant contribution to Thai society. But in current times of rapid economic expansion and increased transportation competition, does the SRT continue to make such a contribution? If it does not, should it be discontinued, or is there a different role that it should play?

By world standards, the productivity of the SRT remains high, even today. Yet the SRT is entering a state of crisis. Its financial position is poor and deteriorating. Its infrastructure is also deteriorating. Public confidence in its abilities are low, as is employee morale. The Government is becoming increasingly concerned with the SRT's net annual operating loss, which it must subsidize if the SRT is to remain operational.

To understand how the SRT reached this crisis state, we should recognize that this railway problem is not unique to Thailand. Over the past 15-20 years, railways throughout the world have experienced (or are experiencing) similar problems and challenges. This includes railways in both developed and developing countries. A brief look at these problems on a world scale will assist in understanding the Thai dilemma, and indeed will indicate what some of the solutions might be. Quoting from a World Bank study.[1]

"The World Bank's reviews of railway crises show very clearly that they do not come about suddenly, nor do they happen by accident. Although the points of emphasis may differ, this conclusion is just as true of railways in the developed as in the developing world. As a broad generalization, railway crises occur because railways have not been encouraged, or allowed, to respond to changes in the economies they serve. Long after major segments of railway traffic have been captured by competitors which are often privately owned and operated, railways continue to offer services which are not in demand, at prices which are often far below cost, and with a quality of service which is inferior to the customer's needs. Typically also, as the railway becomes a fiscal drain on an economy already short of resources, longer range maintenance and capital needs are neglected, further diminishing the railway's capabilities as the years pass. The longer the problem continues, the more difficult and expensive it is to resolve, and the more likely it is to be "put off until next year".

Across all economies and cultures, this situation is the result of some or all of the following forces:

(1) The railway is generally one of the nation's oldest institutions, and its years of history have endowed it with perceived roles -- such as a "public service obligation" -- and an associated engineering and production-oriented management culture which are uniquely resistant to change.

(2) The railway often has the largest single unionized work force in the nation, giving its workers a great deal of political power which is used to protect the size of the labor force, even when there is little productive work to be done.

(3) Over the years, various classes of passengers (typically commuters and third class intercity passengers) and shippers (often agricultural interests and major government-owned mining or

1. Huff and Thompson (1990); see also Thompson (1992).

industrial enterprises) have been able to persuade the regulatory authorities of the government to distort the rate structure in their favor. The stated rationale for the intervention in freight rates is as predictable ("the nation needs to control freight rates in order to promote exports, or to control inflation") as the result: nothing positive is achieved because the resulting deficits are merely shifted from one agency budget to the other, and the management incentives of both railway and shipper are badly distorted. Regional interests also believe that the existence of rail service (but not, necessarily, its use) is important either to maintain the local economy, or to protect the possibility of a desired future development program. Eventually, the beneficiaries of the system of cross subsidies come to believe that their favored status is not only important to them, but is also important to the health of the nation, and they defend their positions tenaciously.

(4) The people at large may believe that a railway is "needed", whether or not it is economically justifiable, either because they believe that rail service is a basic "right" (like education or health), or because they consider the presence of a railway to be one of the status symbols of nationhood.

(5) The ministry which owns and operates the railway may be as interested in protecting its organizational domain, budget, and political influence as it is in serving the needs of shippers or tackling the difficult task of restructuring the railway.

(6) Finally, many of the important actual or potential customers eventually switch to other modes because the service may have become sufficiently slow and unreliable that it is no longer economical to use rail. These former users are no longer advocates for change and improvement. Of course, the other beneficiaries of poor rail service, the competing (non-rail) transport modes, are often committed advocates of the status quo as well."

From examining the world experience, there is no ready-made list of proven remedies that could directly be applied to the current problems of the SRT. However, just as the problem symptoms are similar country by country, we might expect to find the concepts for positive change to be similar in nature. Some of the more important concepts for positive change are the followings.

<u>Political Leadership</u>: Successful reform has occurred in those countries where the railway problems are perceived as national problems, requiring political leadership to resolve them, rather than a problem of the railway to be resolved by the railway's management. The highest levels of political leadership must fully understand and support any comprehensive restructuring plan, where this has not occurred, the plan usually fails.

<u>Planning</u>: There is no simple "overnight" cure to the railway's problems. Implementing the reforms is a staged process over time, with a fair degree of "trial and error" required. It requires long range planning. The plans must be well thought out, and must remain dynamic over their time frame. Global experiences demonstrate that this planning process must to the extent practical start at "square one". The primary planning emphasis should not be on the railway of today and how to change it, but rather on the basic question of what future role (if any) should the railway be serving in the economy. The important planning consideration is what are the needs of tomorrow.

<u>Public Service Obligations</u>: Governments have social responsibilities, railways do not. Not recognizing this simple truth has paralyzed many of the world's railways in the past. Where the public good requires railways to offer services at less than cost, it should clearly be the responsibility of the Government to shoulder these losses. These services may include specific train runs, track branch lines, or stations. Governments in the past have made up the railways' losses by global annual subsidies. This does not afford the Government the opportunity to evaluate what good it is receiving for its money, does not lead to incentives for railway management

efficiency, nor do the subsidies normally include enough funds for future railway investment.

A very successful solution to this problem, on a world scale, is the implementation of a system of Public Service Obligations (PSO) for railways. As a part of this system, governments reimburse the railway for specific services it requires, but which cannot earn enough income to cover costs. It is simple for the Government to delete (or add) such services when the costs are fully known. There should be no other subsidies paid to the railway other than the PSO, which requires the railway management to become more concerned with operating efficiencies and cost control. Moreover, the railway must be able to demonstrate to the Government that the PSO services are being operated as efficiently as possible.

Railway Organization (External): An important issue to be resolved is how should the railway relate to the Government and its various agencies. Included in this issue is the degree of railway privatization (if any) desirable. For this issue, there is no standard resolution on a world scale. Virtually every country that has effected railway restructuring has taken a different approach to this issue. It can correctly be assumed that this is because there is no "perfect" plan, but rather any number of alternatives will work well if implemented effectively. It becomes not so important as to what the plan is, but to have a plan in the first place.

Railway Organization (Internal): Developing an effective internal management organization is an important ingredient in the restructuring plan. The key factor to consider is that the organization be responsive to the needs of its chosen market niche.

All of the above factors, and many more, have to be taken into account in developing a conceptual design of a country's ideal future railway. It can readily be seen that the analysis is complex, the solutions are not simple, and the process is very lengthy. The potential dividends are high, though, in terms of the future contribution the railway may make to the economy. The complexity of the process should not divert us from tackling it. In the words of Mr. Louis S. Thompson, Railways Advisor to the World Bank, at the January 30, 1992 symposium which "kicked off" this current study (Thompson, 1992):

"The problem is not unsolvable. There is no reason for despair. Many other countries have attacked exactly this problem with success....In all cases, although the outcome differed considerably, and in many cases is still developing, the process was based on several simple steps.

First, the Government and the Railway together stepped back and asked: 'Why do we have a railway? What is the function of this railway?' It is no longer enough to say we need a railway for national pride or we need a railway because someone thinks we need a railway. What purpose, or market, or function, or social objective does it serve, and is this the most efficient way to serve that objective?

Second, the role of the railway and the government were clearly distinguished and separated. The government took the responsibility for defining social needs. The railway assumed the posture of a paid supplier of social requirements....Except for these (PSO's) the railway assumes the role of a commercial competitor to serve market needs and then, finally, the railway was reshaped or reorganized to meet the market and social functions defined in this process. It was not allowed to remain a traditional government agency."

2. The State Railway of Thailand: Past and Present

The SRT, the largest state enterprise in Thailand, has a total of 3,861 route kilometers open to traffic (excluding the isolated Mae Klong line). General policy formulation and supervision is carried out by the SRT Board of Commissioners, consisting of a Chairman and 4 to 6 members, all appointed by the Cabinet. The SRT tracks is laid at meter gauge with approximately 80% of the track having wooden sleepers, the remainder concrete. There are currently in service 7 steam, 206 diesel electric, and 73 diesel hydraulic locomotives. Also, 140 diesel railcars are in service, along with some 1,037 passenger cars and 8,148 freight cars. In 1990, the number of passengers carried was about 85.3 million, at an average distance of 136.1 kms. per passenger. During the same year, the SRT also transported 7.9 million tons of freight, at an average haul of 418.7 kms.

Prior to 1974, the SRT generally generated adequate revenues to cover expenses and normal investment requirements. During 1974, at the height of a worldwide economic recession, the SRT suffered a significant decline in its financial position. From 1973 to 1974, the SRT's operating ratio (expenses to revenues) rose from 88.6% to 106.1%. Subsequently the SRT has continued in a loss position, requiring government subsidies to remain in operation.

The SRT is heavily regulated by the Government, especially in the setting of tariffs. As the result, the SRT is required to charge unusually low rates for some services. For example, while transportation of 3rd class passengers represents a large majority of SRT business, current 3rd class passenger fares are much lower in real terms (after adjusting for inflation) than what they were in 1970. The same is true for SRT freight tariffs.

Despite the financial difficulties, the SRT managed to double its number of 3rd class passengers and increase the freight tonnage by approximately 60% between 1970-1990. Furthermore, under constant pressure to improve passenger services, the SRT managed to achieve a significant increase in average passenger train speeds over the same period. This was a significant accomplishment - to effect large increases in volume throughput, at ever-increasing speeds, over a prolonged period of unprofitability.

Unfortunately, as is the case with most businesses in financial turmoil, the SRT has been forced to concentrate on immediate financial returns. This oftentimes precludes adequate investments in the asset base to ensure long-range returns. While the SRT managed to reduce the number of employees between 1975 and 1990, which contributed to cost savings, the staff savings realized were almost entirely in the area of the Civil Engineering Department, responsible for the maintenance of track, bridges and buildings. This indicates that track and bridge maintenance is being deferred. Such a policy may be wise over very short periods of financial difficulty. Continued deferred maintenance, however, is a blueprint for financial disaster.

Another common result of poor financial performance is inadequate levels of continued investment in the business. Since it commenced operating at a loss, the average age of the SRT's locomotive fleet has doubled. Also, there has been a significant increase in the average age of its fleet of freight wagons.

Growth in the SRT's revenue has been averaging less than that registered by GDP, suggesting that the SRT has not been able to keep up with the economy. The SRT's revenue position might not be as bad as it appears to be if its operating cost has been kept low. Despite the staff reduction, the wage bill which represents over half of the SRT's operating cost has increased very rapidly due to increased wage rates. And this is beyond the direct control of the SRT. The recent increase (April 1, 1992) is expected to increase the SRT wage bill by over 400 million baht for the 1992 fiscal year. This obviously will aggravate the SRT's financial situation further.

The SRT's expenditure exceeds the operating revenue in every year since 1980. The average rate is over 10%. The situation implies that if the SRT cannot dramatically change this situation, either with considerable increases in operating revenues, or sizable reduction in its operating expenditures, the SRT is heading for total bankruptcy.

The balance sheet of the SRT indicates that the SRT's annual debt outstanding has risen very rapidly. Since 1980, the SRT's debt has grown from 1,394.3 million baht to over 7,899.6 million baht, a jump of over 5.6 times. Moreover, the total debt/total asset ratio over the years keep rising steadily; the annual value for the last 5 years is well over 50%. In short, the SRT's financial health has not been very strong. Without new strategies, both in the area of operating and in the area of government assistance, the SRT cannot survive financially as a commercial entity.

In this report, we shall not dwell upon the mistakes of the past. Of importance is what role the SRT can best play in Thailand in the future to assist in fulfilling the aspirations of the Thai people, and how to restructure the SRT to successfully serve in this role.

3. Future Transport Demand

To determine the SRT's future role in the transport sector, it is important to analyze the future transport demand. The transport sector, as an essential sector in the economy, has grown in line with the overall economy. Over the last two decades from 1970 to 1990, the transport sector has grown by an average of 6.8% per annum in real terms, while Thailand's real GDP has increased at an average rate of 7.25% per annum. The share of the transport sector in real GDP has remained in the range 5.5-6.0% over this period with no clear increasing or declining trend. Within the transport sector, however, the growth of the public transportation sector has been much more rapid than that of the private transportation sector. It indicated that, as the economy develops, the role of the public transportation sector becomes more and more important. This obviously has important implications for public transportation agencies such as the SRT, as demand for the types of transportation services currently provided through public agencies will likely increase rapidly as the economy develops.

Currently, the major domestic modes of transportation in Thailand consist of road, railway, coast, inland waterway, and air transport. It is estimated that the Thai economy will achieve satisfactorily high rates of growth over the next two decades (about 6-8% per annum). As the major support sector, the transport sector will inevitably grow in line with the growth in the economy.

In this study, the future transport demand is projected at two levels. At the macro level, inter-provincial person and freight movements are projected based on inter-provincial transport matrices for 1990. To simplify the analysis, the inter-provincial (73*73) matrices for person and freight movements were aggregated to inter-regional matrices (16*16). Transport demand was assumed to depend on provincial GDP and population, with the elasticities computed through regression analyses. The macro-level demands for person and freight movements were then projected from 1990 to 2011. In addition to the macro analyses, detailed studies of the SRT's major freight markets were also carried out. Four main freight commodity groups were singled out; rice, petroleum products, cement, and containers. These currently account for about 74% of the SRT's freight revenue, so detailed analyses of these markets are important for future SRT strategy.

3.1 Macro Demand

At the macro level, total inter-provincial person movement for the country comes to about

2.32 million persons per day.[2] Of these, about 35% have their origin or destination in the BMR. The main reason is the transportation network configuration which mostly radiates from the BMR, and therefore most of these trips have to pass through the BMR. Another reason is that the BMR is the economic and social center of the whole country. 17.2% of total inter-provincial movements are among the provinces making up the BMR. Most of the movements to/from the BMR have their origin-destinations in the Upper Central provinces and the Eastern Seaboard corridor provinces (ESB). Movements within a region (outside of the BMR) are also fairly large in the southern-most provinces, and the Eastern Seaboard corridor provinces (Chachoengsao, Chon Buri and Rayong).

For freight, total inter-provincial freight movement comes to about 1.4 million tons per day. Similar to the situation for person movement, about 30% of all freight movements have their O-D in the BMR. However, only about 7% of the freight movement is account for by inter-provincial movement within the provinces of the BMR. Freight movements into/out of the BMR has similar patterns to person movements, with major O-D in the Upper Central and ESB provinces.

In 1990 the SRT accounted for about 16.7% of the person movements, and only about 2.5% of the freight movements. For person movements, the largest share of the SRT among the O-D regions was for travel along the Nakhon Ratchasima-Buriram-Surin line. Here the SRT accounted for about forty percent of the person movements. For freight, the SRT was a relatively minor player in total freight movement. Only for freight with destinations in the Upper Central provinces and some southern provinces was the share of the SRT greater than 5%. For the ESB provinces, which was the second largest O-D for freight after the BMR, the SRT's share was tiny.

Demand for person trips is expected to increase quite rapidly over the next 20 years. Between 1990 and 2011, the total number of person trips is expected to increase 4.28 times, totaling about 9.96 million daily person trips in 2011 compared to about 2.32 million daily person trips in 1990. The most important O-D region will obviously still be the BMR, where in 2011 the person trips origination or ending in the BMR is expected to be more than 4.3 million person trips per day, which is close to twice the total number of person trips for the whole country in 1990.[3] However, the most rapid growth occurs in the ESB region. By 2011, the total person trip originating from or arriving in this region is expected to increase spectacularly to about 1.7 million person trips per day, which is over 74% of the total inter-provincial person trips for the whole kingdom in 1990. Other regions that have high total person trips in 2011 include the regions surrounding the BMR and the Southern part of the country.

The overall growth in freight tonnage traffic is not expected to be as high as the growth in person trips. However, the increase will still be large. By 2011 the volume of inter-provincial freight movement is expected to be 3.08 times the level in 1990. The pattern of freight movement is similar to that for person movement. The BMR is still the main O-D region. By 2011, the volume of freight with origin or destination in the BMR is expected to be greater than the total volume of freight traffic for the whole kingdom in 1990. The share of total freight with O-D in the BMR to that for the whole country goes up from about 30% in 1990 to 36% 2011. However, as with person movement, the growth in the ESB region is expected to be the most rapid, and the relative gap between the volumes in ESB and the BMR

2. With the convention of 220 days per year for passenger movement, and 225 days per year for freight movement.

3. Remember than this excludes travel with each provinces of the BMR.

declines over time. By 2011, total volume of freight with O-D in the ESB is expected to be about one million tons per day. This is certainly very substantial, and is more than 60% of the volume with O-D in the BMR. The volume of freight traffic between the BMR and ESB reaches about 700,000 tons per day in 2011. Other areas near to the BMR also show large increases in freight volume, as was the case in person movement. However, in the case of freight, the Southern region is not as important as was the case with person movement.

It is to be expected that transportation demand will inevitably increase a great deal in the future as the Thai economy expands. The above macro projections of transportation demand indicate this well. To meet these demand, huge investment in transportation infrastructure will be needed over the next two decades. As for the SRT, the opportunities are clearly there for much expansion to meet part of the transportation needs in the future. How much of the future increase in transportation demand could the SRT or should the SRT try to cater for will be examined in the next section.

3.2 Micro Demand

Petroleum products are being distributed widely in all geographical regions of the country. The total oil demand in Thailand is expected to grow from 22,524 million litres in 1991 to 50,522 litres in 2001, and expected to reach 94,524 million litres in 2011. While the LPG demand in the country will grow from 0.996 million tons in 1991 to 2.2 million tons in 2001, and to 4.3 million tons by 2011. The future potential for rail transportation is from Saraburi to the North and Northeastern where the demand for oil in these regions will reach 6,069 and 5,371 million litres, respectively, in 2011. Part of these oil volume could be transported by rail. Long range oil transportation from refineries to other regions will be done by barges or pipelines, which will be difficult for rail to compete against. Similarly, LPG could be supplied directly to the North and Northeast by rail from the central terminals in Sriracha.

Rice trading is a complex business as the products change hand several times from farmers to final consumers. Each step of paddy/rice trading requires a particular form of transportation. Major central markets are in the lower North in Phitsanulok, Nakhon Sawan and Chinat. There are also central markets in the Central and Western regions such as in Singburi and Suphanburi. Most of these markets are accessible both by rivers and by roads. None are accessible by rail. Trucks are being used as the main mode for paddy/rice transportation while the use of river barges have been gradually decreasing. On the other hand, rail continues to have small share of rice transportation and is being used only on specific routes. For examples, the rail freight service in the North and Northeast is to transport rice from local mills to rice traders in Bangkok and in the South. Total demand for inter-regional transportation of rice in Thailand is expected to reach about 11.5 million tons and 13.5 million tons in 2001 and 2011, respectively, compared to about 8.5 million tons in 1991. In 1991, the share of rail in rice transportation was only 4.1%.

Cement has been one of Thailand is leading industries for a number of years. Domestic production capacity has been continuously expanded to meet growing demand for construction. The total demand for cement in Thailand was 22.67 million tons in 1991, mainly from the Central area (45 %) and Bangkok (20 %). The major cement producing center is located in Saraburi where both bulk and bagged cement are transported by rail and truck. There are also other cement plants in the North and South where cement are being distributed to consumers by various modes of transportation including barge. Cement demand in the country is expected to grow substantially, and cement transportation will continue to be dominated by truck and rail. Barge will probably play a decreasing role as the future production will occur in inland locations not accessible by barges. Total demand for cement transportation is expected to increase to 53.6 million tons in 2001, compared to 22.7 million tons in 1991. By 2011, the demand is expected to increase further to 111 million tons. This indicates great future potential for rail transport of cement, particularly bulk cement.

Containerization speeds up cargo handling at ports and during shipments, minimize cargo damages from contamination and losses, and simplify customs procedures. Cargo shipments in Thailand have also caught on with the above development trend as the country's international trade volume has been growing steadily during the past fifteen years. Most containerized cargoes have been handled at the Bangkok Port (Klong Toey), under the operatorship of the Port Authority of Thailand (PAT). Because of the congestion in cargo handling at Klong Toey, Laem Chabang Port was designed as the country's future import and export cargo handling facility, and the related Inland Container Depot (ICD) is being constructed in Lad Krabang by SRT. In the mean time, SRT is also building a temporary ICD at Bang Sue in order to service containerized cargoes between Bangkok and Laem Chabang. The overall containerized cargo movements in Thailand in 1987 was 6.2 million tons. The total share of rail transportation of containerized cargoes was only 2.4 %. The combined import and export volume in containers are expected to increase rapidly in line with the increase in export and import volumes. By 2001, total container movement through the various ports is expected to be 32 million tons, and the volume is expected to increase further to 67.8 million tons by 2011. Therefore, there will be a great demand for the transportation of containerized cargoes in the future, and the SRT should be able to play a significant role in container shipments.

4. Future Role of the State Railway of Thailand

Rail transport does have many advantages over road transport. The key point is that road transport generates relatively high negative externalities. First, in terms of fuel efficiency, rail transport is much more superior to road transport. In an economy-wide context, fuel efficiency is important as it will lower production and distribution costs, household transportation-related consumption, and will also help improve Thailand's external trade position. Second, environmental considerations also favor rail over road transport. Given more fuel efficiency of rail transport, emissions of harmful gases from fuel usage will obviously by less per unit of output for rail compared to road transport. In Sweden, a valuation of the emission costs from harmful gases showed that the emission cost for road transport was more than 270 times that from rail. Third, there are now serious congestion on the road, particularly within and around the BMR. Nation-wide, the average road density has also increased rapidly, for example the average density on national highways has increased by over 4 times between 1984 and 1990. More use of rail transport can help reduce the congestion on the road system. Fourth, in term of safety, rail transport also has advantage over road transport. The statistics show that road accidents in 1990 accounted for about 94.5-97.5 percent of all accidents, deaths and injuries, while rail accounted for about 2.5-4.8 percent.

In spite of all the advantages for rail transport indicated above, the railway remains a relatively minor player in the Thai transportation picture compared to road transport. To a large extent, this depends on the relative competitive position of rail versus road transport, which in turns depends on many factors; such as the geographic nature of the country, the human settlement and urbanization patterns, overall government policy concerning the transport sector through infrastructure investment, pricing, fare controls, etc., and also the operational efficiencies of the various transport providers. A principle disadvantage of rail transport is its inefficiency in door-to-door operations, especially the SRT's freight services which cannot connect directly with the origin or destination required by customers, thus requiring double or triple handling costs. Another consideration is the government transportation policy which tends to subsidize the heavy trucks through low road user charges.

The above externalities have not been taken into account in the nation's overall transportation policy. Without such considerations, the railway is likely to continue to play a relatively minor role in the nation's future transportation policy. This suggests that in looking at the role of the railway for the future, a strategic approach is necessary. Analyses based on the past trends or past behaviors implicitly assume the current status quo in transportation policy, and is likely to lead to an expected scenario of declining role of the railway over time. Such an approach is unlikely to be very useful when looking at the very long horizon that is being done in this study. What will be done instead is a strategic approach based on simple targets for rail transport. This presumes that the negative externalities associated with road transport are considered important, and need to be corrected over time.

In the analyses of the future role of the railway for passenger and freight, simple targets are suggested. At a minimum, the rail shares in future transport should not be allowed to decline below the share in the base period of the analysis (1990). While this will mean that the negative externalities associated with road transport will continue to increase along with the trend increase in overall transportation sector of the country, the target is still not easily achieved without efforts and new investment, given the past trend. Apart from the fixed share approach, we shall also suggest targets involving much larger roles for the railway in the future, which implicitly assumes more active government actions to alleviate the harmful externalities associated with road transport.

4.1 Passenger

For passenger movement, with assumed fixed shares in land transport, total rail person trips are expected to increase by 3.87 times by 2011 compared to 1990. In terms of the number of person trips, this is expected to increase from about 388,000 person trips per day in 1990 to about 1.5 million person trips per day in 2011. Much of this growth occurs in inter-provincial travel within the BMR, which is expected to increase from about 97,800 person trips per day in 1990 to about 581,700 person trips per day by 2011 (which is about 1.5 times the total person trips per day on the whole of the present day rail system). Ignoring inter-BMR movements, much of which should be served by various Mass Transits systems by 2011, rail person trips elsewhere are expected to increase from about 290,000 person trips per day in 1990 to about 920,000 person trips per day by 2011, or an increase of about 3.17 times.

While the increase in rail person trips in this fixed share case may appear large if current state of rail operations are taken into account, it seems to be within the capability of the SRT. If one assumes, roughly, that 2/3 of the inter-BMR travel in 2011 will be served by various mass transit systems, then SRT passenger traffic is expected to increase by almost exactly 5 percent per annum between 1990 and 2011. This seems to be within the feasible range. For example, between 1970 and 1980, rail passenger growth was on average 4.4% per annum. It is between 1980 and 1990 that the growth rates fell tremendously to only 1.4% per annum. With recommended "re-positioning" of the SRT along a number of dimensions (to be discussed in section 6), it seems realistically possible that growth in rail passenger service can revert back to at least the level in the 1970s, which would correspond roughly to this fixed share case.

Some feature of this fixed shares case does not appear to be very satisfactory. It implies that road person trips will increase at very high rates. Within the BMR, inter-provincial person trip by road is projected to increase 5.9 times by 2011, from about 302,000 person trips per day in 1990 to a huge 1.8 million person trips per day in 2011. BMR-ESB travel growth is expected to be about 12-13% per annum between 1990 and 2001, and about 8% per annum between 2001 and 2011. The number of person trips for BMR-ESB travel is expected to increase from about 100,000 person trips per day in 1990 to around 710-750,000 person trips per day in 2011. This would be about 2.4 times the inter-provincial person trips within the BMR in 1990. The amount of congestion that this would lead to, even with all the planned new road infrastructure, is difficult to contemplate, even not taking into account other negative effects such as pollution, fuel consumption, and road accidents.

As an alternative to the fixed share case, some rough targets for non-rail land transport growth are imposed. The maximum increases in road transport assumed include: inter-regional road network trips increase at most 5% per annum (2.78 times between 1990 and 2011); inter-regional road network trips BMR-surrounding Central regions at most 7% per annum (4.14 times); BMR-ESB at 9.5% per annum (6.72 times); and, intra-ESB at 11% per annum (8.95 times). These non-rail targets are in fact quite generous concerning the ability of the road system to absorb. For routes which are already highly congested, such as the BMR-ESB routes, it would imply new road constructions at a rate nearly equal to the target rates to prevent unrealistic congestion scenarios.

Given these non-rail targets, the role of rail in person movement for areas surrounding the BMR goes up significantly compared to the fixed share case. For the BMR-ESB trips, rail contribution reaches over 100,000 person trips per day in either direction, a level of volume that may make some form of High Speed Rail economically viable, particularly as demand for inter-provincial travel within the ESB region also increases to about 87,000 person trips per day. For the Central region excluding ESB, rail contribution increases to about 194,000 person trips per day, implying much needed improvement and capacity expansion of the commuter lines extending out from Bangkok. Rail travel between ESB and other Central provinces also increases tremendously, to about 76-100,000 person trips per day. This would require substantial new investment in the integration of the rail system surrounding the BMR area so that rail trips can be made within in the area without all having to come to Bangkok as the center. Finally, with this scenario, the implied share of rail in land person trips increases by about 50% in 2011, to 24.04% compared to 16.78% in 1990.

It seem clear that an adequate person transport system for the future should involve an increase in the role of the railway. The future spatial development pattern in Thailand, as all available indicators point to, suggests an extension of the BMR conglomerates further out to the neighboring provinces, with the ESB corridor and some upper central provinces as the main growth pole. With this development, comes the need for an integrated and expanded transportation system. With current congestion in the BMR area, there is a real need for expanded role for the railway in this integrated transportation system for the area. Without such an expanded role, the negative externalities associated with road transport are likely to grow to almost unacceptable proportions, and may, in fact, significantly affect the productive efficiency of the economy. The study suggests that a strategy to at least maintain the railway's overall share at the 1990 level should be regarded as essential, and at the same time serious efforts should be made to significantly increase the railway's share, particularly for areas in and around the BMR and ESB regions. This will, of course, involve much needed adjustment within the SRT itself and in its relationship with the government. However, it will also need clear ideas on the part of the government about the desired direction of overall transportation patterns in the country, and appropriate measures on road transportation which may need real political courage to implement.

4.2 Freight

It is clear that the demand for freight transportation in the country will be growing at rapid rates in the future. This is particularly true for commodities like containers, cement and oil products where the demand in term of tonnage will grow at about 10.5%, 15.5% and 5.4% per year between 1991 to 2011, respectively. On the other hand, the growth in transport demand for rice will be less strong, but the volume of rice to be transported in the future will continue to be significant.

Oil: For oil, judging from the oil transportation system which are being built including the pipelines, the role of SRT in transporting oil will probably be limited to the locations between Saraburi and Bang Pa In terminals and depots in the North and Northeast regions. This is due to the relative costs between oil pipelines and rail where pipelines are expected to have lower transportation costs than rail. It will also not be economical to transport oil to the south by rail since barge will continue to have strong cost advantage over rail in the future. However, rail will continue to have some business in delivering fuel oil in the Central region, as the pipelines under construction are not designed to carry fuel oil. Fuel oil will be transported by conventional means, that is by barge from refineries to terminals in Bangkok, and then by rail or truck to factories in the Central area.

By 2011, if the SRT can maintain its 37% share of oil transport to depots in the North and Northeast and to direct customers in the Central region, then the volume of oil that could potentially be transported by rail are 5,455 million litres. This is a conservative estimate as the number of rail trips will be increased by only 3-4 times from the existing number of trips, given that the volume of shipment per trip remains unchanged. With more aggressive strategies, the SRT may be able to increase its share. For example, with a 50% share, rail oil transportation will rise to 7,614 million litres per year by 2011. In terms of the number of trips, the number of shipment will be increased from 4-5 per day at present to 20 per day by 2011.

Thus, it is quite clear that even with the conservative estimate, the rail oil transportation volume in the future will be significant. By keeping the existing share, the rail volume will increase to several times today's volume. On the other hand, if SRT decides to go for more aggressive service strategies, rail oil shipment could potentially be close to or even exceed 10 billions litres per year by 2011.

Rice: Total rice shipment by rail in 1991 was only about 0.34 million tons, or only 4% of the total rice being transported. The rest of the shipments, which was about 8.2 million tons, was transported by truck, including a small amount by barge. If the SRT can maintain its share in the rice transportation market, then by 2011 total rice shipment by rail is expected to increase to 0.68 million tons.

Cement: Unlike rice, the potential for shipment of cement by rail is very large. Being a bulk commodity by nature, rail shipment of cement is most suitable both over the short and long distances. Furthermore, most cement plants in Thailand have already had direct rail access at the plants, and the markets for cement are well defined. With improvement in rail transportation efficiency, the potential for gaining cement shipment business is very strong. This is particularly true for bulk or powder cement, most of which will be used in large construction projects in Bangkok and the Central region.

In 1991, 2.4 million tons of cement were shipped by rail. Rail transportation accounted for 11% of the total cement demanded in Thailand which was 22.7 million tons. The rest was supplied by truck, with only a small quantity of 0.29 million tons of barge shipment. Assuming fixed rail share, total cement shipment by rail in 2011 will be 13.7 million tons, or increasing by 5.6 times. There appears to be even more potential than this. Most cement demand in Bangkok are in the form of bulk cement, which makes it most suitable for shipment by rail from the supplying plants in Saraburi. Most cement companies already have silos for bulk cement at Bang Sue railway junction, thus the facilities for bulk cement shipment are already in place. If various constraints can be removed, there is no reason why the SRT cannot increase its current 23% share of bulk cement shipment from Saraburi to Bangkok. For example, if it can increase the share of bulk cement shipment between Saraburi and Bangkok to 80%, then the total volume of cement shipment by rail in 2011 would be 33.1 million tons.

Containers: Although rail shipment of containers is relatively small at present, the future growth potential for rail shipment of containers is enormous. The future volume of container movements between Bangkok and Laem Chabang, where most of the future growth will be, will reach 3 million tons by 2001 and 15 million tons by 2011. This is equal to 300,000 TEU in 2001 and 1.5 million TEU in 2011. Like oil and cement, containers are suitable for rail shipment because of their bulkiness, high volume and fixed schedule nature. In this regard, the study believes rail should take a leading role in container shipment, particularly between Bangkok and Laem Chabang port. We think the target of 50% share of rail for container transport to and from Laem Chabang port by 2001 and 75% share by 2011 are not unrealistic, given that rail operating system be streamlined. Given these assumptions, there would be 7.5 million tons of container shipment by rail in 2001, accounting for 24% of the total market. By 2011, there could be 37.9 million tons of container shipment by rail, or 56% of the market. This would appear to be a highly profitable future freight market for the SRT.

Apart from the above 4 commodity groups, the development of the regional economy over the years has resulted in higher consumer and business incomes, and, consequently, higher purchasing power for household items and motor vehicles. It is estimated that the demand for these commodities will continue to grow in the long term. Therefore, new business opportunities in freight transportation arising from increasing use of household appliances and motor vehicles in upcountry provinces should be considered.

There are also opportunities in the demand for bulk commodities, such as imported coal and lignite from Laem Chabang to be used in cement plants at Saraburi or power plants at Lampang. These commodities could potentially be transported by rail as the new railway line linking Laem Chabang with the North and Northeast junction via Kang Koy junction will make rail service competitive with truck.

In addition, there are many new ideas being proposed to expand rail freight services; for example, to transport heavy construction materials like crushed rock, or gravel, to be used in major construction projects in Bangkok.

For non-rail businesses, the SRT should take advantage of a recent Government decision allowing it to joint venture with other companies in other lines of business. Priority should be given to the development of SRT properties, or business that complement railway services; such as hotel in a major passenger center; trucking, ship, container, and bussing operations to serve the railway system; and telecommunication services.

5. Bangkok Commuter Needs: A Special Focus

Urban development and population are major indicators of transport demand. Urban people tend to travel more frequently and at a longer distance than those who live in rural areas. The BMR agglomerates a large portion of urban population (43%). Other growing urban centers are Chiang Mai and Phisanulok in the North; Chon Buri and Rayong in the East; Nakhon Ratchasima, Udon Thani, Khon Kaen, and Ubon Ratchathani in the Northeast; and Songkla, Phuket, and Surat Thani in the South. All these regional centers except Phuket are served by the SRT.

It is projected that the BMR will continue to be the nation's most important socioeconomic development center over the next two decades. The regional economic growth of the area is expected to be a little faster than that of the national economy. The population of the BMR will also increase faster than the national average. The demand for transportation, therefore, will increase substantially. Considering the existing inadequacy of road transportation, there is a strong tendency that mass rapid transportation, including the commuter trains, will become more and more important in the process of urban development in the BMR and ESB regions in the future.

The Government's urban development policies have concentrated on infrastructure development in the BMR and Extended BMR[4] aimed at solving transportation problems. The major projects which will also stimulate the urbanization are the expressway project, the Don Muang toll-way project, all mass rapid transit projects, Nong Ngu Hao airport, and seven new highway projects. Development of new industrial estates in the BMR and Extended BMR has been increasingly popular because of the government's tax incentives, and well developed infrastructure. Therefore, a large number of industrial workers in industrial complexes commute between Bangkok and the factories. Currently, many factories provide shuttle buses for workers since there is no appropriate mass transportation system linking the capital and its surrounding region. An effective mass transportation system will be needed to serve commuter passengers who work in industrial zones and service centers around Bangkok.

In the next twenty years, development in the BMA and BMR is expected to be more intense, and growth will spread more beyond the BMR in all directions. Ribbon development along major roads will still exist, especially the ones leading to the ESB region. The BMR is expected to become a megalopolis that accommodates about 1/5 of the nation's population. Because of high land prices, the inner city will be transformed from residential and small-scale shop-houses and office buildings to high-rise office buildings, high-income condominiums, and commercial and service centers. In the outer city districts, the intensity of urban development is also expected to increase. There will be more and more residential complexes, factories, shopping centers, and food gardens. Many of them are combined as large-scale real-estate projects. The high land prices will continue to push the urban fringe outward. Low-income housing, therefore, would be located further away from downtown while people will have to commute a longer distance to work in the city center.

At present, the SRT has been commissioned to operated 75 commuter trains and 12 airport express trains a day. In 1991, the SRT's Information System Department reported that there were 30,636,550 commuter passengers. During the rush hours, the passenger-volume between inner city and suburb stations is very high in all four major lines -- the Northern line (Hua Lum Phong and Don Muang stations), the Eastern line (Makkasan and Hua Maak stations), the

4. BMR plus Eastern Seaboard and parts of the Upper Central region.

Southern line (Bangkok Noi and Sala Thammasop stations), and the Mae Klong line (Wong Wien Yai and Wat Sing stations). From a survey of several commuter train services, the data indicate that the supply of Northern Line commuter trains between Hua Lam Phong and Don Muang is lower than the demand. The situation is the same for the Eastern Line commuter train between Hua Lam Phong and Hua Maak. For the Southern Line, only the morning arrival trains had a problem of insufficient supply. It is clear that the role of the commuter train is concentrated mostly within the BMR.

There are other mass transportation systems serving people in BMR, such as local bus service by the Bangkok Mass Transit Authority, bus boat (long tailed and express boats), and inter-city bus service by the Transport Company Ltd. However, all the systems combined will not be sufficient to meet the future commuter demands. The accelerating population growth and urban development in the BMR have resulted in a substantial demand for transportation. Traffic volumes have reached the existing road capacity. Moreover, road transportation does create many negative externalities, including traffic congestion, high road accidents, noise pollution, vibration, air pollution, and wasteful energy consumption. Thus, it is essential that mass rapid transportation be introduced.

Mass rapid transportation, including the railway, have several advantages over the private cars, regular buses, and taxies. The system can transport a large number of passengers, while the per passenger unit construction and operation cost of a rapid mass transit system is nearly the same as that of a bus system. Mass rapid transportation has four national economic and social benefits over road transportation: time saving, energy saving, safety, and environmental protection. However, the major disadvantages of mass rapid transportation systems are their requirements for large investment and a long period to recover the investment. Thus, building a mass rapid transit system requires careful planning and integration among various systems.

Currently, there are three mass rapid transit systems planned in Bangkok: the Hopewell project by the Hopewell (Thailand) Ltd. consisting of 60.1 kms. of elevated railway with mass transit services, 57 kms. of expressway, and the development of over 500 rai of SRT land at 5 sites; the Metropolitan Rapid Transit System project by the Metropolitan Rapid Transit Authority consisting of a semi-looped line totaling about 20 kms.; and the BMA Mass Rapid Transit project built and operated by the Tanayong Consortium consisting of two lines -- the Sukhumvit Line (8.5 kms.) and the Victory Monument-Silom Line (6 kms.). The three systems all have some problems. For example, the Hopewell project still has four construction conflict points with the other two systems, and wasteful duplication of services appears in both the East-West and the North-South corridor, also the various new expressways in the mass transit projects would bring about an additional 40,000 vehicles an hour to the inner city area. The arterial roads and expressways together would grossly overload the ordinary surface roads because these roads are already overloaded and there are no plans to reconstruct them.

To reduce the problems, it is recommended that all systems be integrated, with joint-station at the point they meet. If possible, one of the systems cutting across should be placed underground. A joint ticketing system would also be required. The SRT should reconsider the Makkasan-Maenum Line of the Hopewell project, because the areas are already served by other systems. However, to facilitate the implementation of the overall system, the mass transportation should have higher priority over private cars, taxies, trucks, and motor-cycles. The government should use the mass transit systems to lead and control urban development. The mass transit systems should be treated as a single network when they are planned, in order to share common stations, ticket fare, and areas served. Finally, all mass transit system should be planned and designed to have the smallest impact on the environment.

The major role of the SRT commuter train is to bring passengers from the suburbs and other outer cities into the inner areas of Bangkok and to distribute passengers around the outer areas of Bangkok. This study proposes two alternatives for the SRT commuter train system. The first alternative is based on the Hopewell System with recommended extensions of three lines (from Taling Chan Junction to Salaya, from Po Nimit to Wat Sing, and from Sri Nakarin to Nong Ngu Hao Airport). The western portion of future extensions proposed by the investor are kept intact, while the eastern portion of such extensions can be removed from the scheme since its alignment is too close to the MRTS. The second alternative is more desirable. The recommended extensions of the community train from the original Hopewell System to Salaya, Wat Sing, and Nong Ngu Hao Airport are the same as in the first alternative. The future extensions proposed by the investor, however, are replaced by a new looped mass rapid transit line. This looped line is the combination of the Hopewell extensions, from Bang Sue to Taling Chan Junction and from Taling Chan Junction to Po Nimit, and the MRTS. The MRTS portion of the looped line starts at Lad Phrao Road, running along Sri Nakarin, Tae Pharak, and Poo Chao Saming Pri Roads, crossing the Chao Phraya River to Suk Sawat Road and ends at Po Nimit. This looped mass rapid transit line would help collect and distribute passengers in the outer city areas more effectively and would help reduce the use of private cars in these areas. In both alternatives, the Makkasan-Maenum Line is excluded since the areas it intends to serve are already served by the other two mass transit systems.

In addition to the BMR mass rapid transit systems, we recommend that the SRT consider the potential express train extension from Don Muang Airport, passing Min Buri to Nong Ngu Hao Airport. It could be connected to the so-called "high-speed train" that may in the future link Nong Ngu Hao Airport with the Eastern Seaboard Region. It would help reduce the SRT traffic in the inner areas of Bangkok since the trains from Rangsit and Ayutthaya to Chachoengsao and vice versa no longer have to pass through the city center.

With the implementation of the Hopewell Project, train parking spaces at Hau Lam Phong will be reduced since most of the land will be developed for commercial purposes. We recommend that the SRT utilize Hua Lam Phong as the central station for mass rapid transit systems, and prepare the new central railway station at Bang Sue where more spaces are available. We also recommend that accesses for regular and freight trains be limited to the new central station. Only commuter and express trains should be allowed to pass through to Hau Lam Phong Central Station and crossing the Chao Phraya River to Bangkok Noi and to Wong Wien Yai.

Car parking spaces would also be required at major stations where private car owners can park their cars and take the community train to work. We recommend that the SRT prepare adequate parking spaces at Bang Sue, Rangsit, Don Muang, Taling Chan, Po Nimit, and Bangkok Noi.

Finally, we recommend that the SRT pay attention to the design of the elevated portion of the Hopewell System, especially when it passes through the inner city areas where its visual impact will be apparent. The scale of the system, especially the height and the width of the expressway portion, should be reduced wherever possible. The alignment of the line should conform the existing road pattern.

For community trains outside the BMR, we recommend double-tracking the lines to Ban Phachi Junction, Nakon Pathom, Samut Sakhon, and Chachoengsao. Some of these lines are already double-tracked, but others are not. This would allow commuter passengers from these areas to travel to Bangkok quickly. Combined with the mass rapid transit systems mentioned earlier, people can live outside the metropolitan area and come to work in the inner areas of Bangkok conveniently. This, in turn, would help raise their quality of living and reduce environmental pollution within the BMA.

6. Adapting the Railway to Meet its Future Role

An expansion of the SRT's role is only recommended contingent on certain key changes being carried out. Given the SRT's current financial position, these changes are designed to ensure that the SRT will be able to provide future services more efficiently and remain financially viable on long-term sustainable basis. Adapting the railway to meet the future role, the follow six key areas should be considered.

6.1 Public Service Obligations (PSO)

One dilemma of railway is the expectation they can offer services for the public good at low prices, while they are criticized for poor financial performance. Public Service Obligations (PSO) are designed to resolving the above problem, to enhance the performance of a public enterprise, and to increase the degree of accountability on the part of the management. Such system recognizes that it is the Government who requires the services for public good, and therefore the Government should make any relevant decisions concerning the continuance of these services, and it is the Government who rightfully should pay for any loses in providing these services. This requires that each service be considered on its own, which in turn requires that each service be fully costed so that its individual loss be known. If the Government wishes to continue the service, it rightfully should reimburse the SRT for any losses in providing that service. In turn, this means that the SRT no longer can claim losses due to providing such services, and as such must show a profit at year-end.

At present, the Thai Government has already decided to implement the PSO system through a cabinet resolution. The next step is to ensure that the system is effectively formulated and implemented.

Since 1974, the SRT has received government assistance in one form or another. The first type of assistance is that the government agreed to help finance the actual loses as stipulated by the Railway of Thailand Act B.E. 2494. The second form of financial contribution is the yearly appropriation for tariff discounts granted to certain groups of passengers. The third item is the capital investment in rail infrastructure of specific lines as well as all auxiliary investment related to the lines which have been prompted by government development policy such as the ESB railway line. The fourth form of government contribution is the cost of the rail police operation. An annual budget is appropriated for this particular service which was initially financed by the SRT budget.

Although some of the above financial contributions are targeted-oriented such as the capital investment for construction of certain lines and the annual budgeted expenditure via relevant agencies for price discounts and free travel of certain target passenger groups, these contributions cannot be channeled to the services to which it should contribute. Not being service oriented, financial performance cannot be appraised for affected services. Moreover, the major contributions through the budget to cover annual operating losses are neither target- nor service-oriented. Hence, it is impossible to isolate individual services which account for the losses and the magnitude of losses each service sustains. Another problem is the government contribution has not been paid on time, causing an additional interest cost to the SRT financial burden.

Many types of SRT services fall into the PSO category. In general, government directive for the provision of a service which goes against the SRT's commercial principles -- such as local train service linking smaller towns in rural areas, commuter train service, and train service at below-cost fare -- will make such service a PSO, and hence implies government financial assistance.

Approaching government financial contribution via identification of PSO's is the most efficient way to enhance the performance of a public enterprise and to increase the degree of accountability on the part of the management. Each PSO is viewed and justified separately. The scope (quantity as well as quality) of each PSO can be specified for delivery at an agreed upon financial contribution and conditions for contribution. The PSO arrangement makes it possible for the arrangement to focus on planning for the efficient delivery of such services. This transparency, both with respect to its obligation to the government (via PSO's) and to the profitability of its commercial ventures, would enhance the overall operational efficiency and the financial performance of the enterprise. As a consequence, performance accountability can be separately assigned, and evaluation made.

With the recently introduced new Transmark accounting system, it has been possible to more accurately estimate the PSO costs, although the system will need to be improved over a number of years. The services related to PSO's comprise altogether 14 profit centers, regrouped as 3 broad types of PSO's namely, (1) Bangkok commuter service, (2) rural commuter service, and (3) mixed train service. Each broad group of services consists of several lines; 85 lines for Bangkok commuter service (including 34 lines Mae Klong-Bangkok commuter service), 63 lines for rural commuter service (including 8 Mae Klong rural commuter service), and 24 mixed train service.

The PSO cost was projected to 2011. This assumes that the passenger growth on PSO services is as in the fixed share case of section 4. It is also assumed that fares on PSO lines will remain constant in real terms. On the unit cost side, it is assumed that the SRT becomes more efficient over time. Per person unit cost of providing PSO services is assumed to decline by 1.5 percent in real terms annually. With the assumed 5 percent inflation rate, unit cost of PSO services is assumed to increase by 3.5 percent per annum in nominal terms. It is found that PSO payments are expected to increase from about 820 million baht in 1991 to about 3,750 million baht in 2011, representing an average increase of about 7.9 percent per annum. Given the growth in PSO traffic and inflation, these figures depend crucially on the fare growth and productivity increases. If fares can increase in real terms, and productivity gains are larger, then the PSO payments will not increase so rapidly. On the other hand, if the government is not willing to put up fares, then the PSO payments will have to be much greater than the above figures unless some of the current PSO services are terminated.

As noted earlier, one can always question the perfect accuracy of the PSO costing, especially for the base year upon which the PSO costs of other years are estimated. The costing of these PSO lines cannot be individualized in all aspects, and there are unsettled issues such as the treatment of joint costs. However, the above calculations are the best and the most accurate figures to date. It should also be noted that implementing the PSO system is a process requiring monitoring and improvement over time. Some currently agreed upon PSO services may be terminated in the future, if the government finds that it may be more cost effective to provide the service through other modes of transport. Further, unit cost reductions on PSO services should be encouraged. Target reduction in unit cost could be part of the PSO conditions. If the SRT cannot achieve the agreed upon target, penalties could be imposed. On the other hand, if the SRT can do better, then possibly the additional gain can be split equally between the SRT and the government.

6.2 Organizational Requirement

Currently, the SRT's organization structure is departmentalized along the line of its prime objective designated de jure by putting greater emphasis on the operation of daily services with delivery of passengers and freight. The market function necessary for the growth in revenue is not emphasized in the organizational status. Similar to general Thai bureaucratic organizations, the SRT's hierarchical chain of command is top-down. The power of decision-making and command is centralized around the General Manager, who delegates tasks and responsibilities to the three Deputy General Managers. Although the organization puts greater emphasis on centralization, tasks and responsibilities are also decentralized from the top to the lowest levels, and to regional branches all over the country. Regional offices carry out the tasks and responsibilities with bounded autonomy.

Within this huge organization, coordination of work in the SRT, especially under the operation functions, must be strictly achieved because of the necessity to operate trains in a safe manner, therefore the SRT has to apply mixed methods of standardization of work processes and standardization of work output together. However, the SRT has not been able to sufficiently meet the market demand due to the so-called "Engineering or Railway Culture" which exerts greater importance on only running trains on the basis of designated schedule and available resources.

Analyzing the SRT's personnel management, the study found both problems and potential. (1) Imbalance division of labor and manpower causing insufficient manpower to cope with the work load in some departments, especially the operating core in the regional offices. (2) Recruiting qualified manpower with certain educational background and experience such as business administration has been quite difficult, while the organization is facing a problem of brain drain. (3) Personnel management and promotion in the SRT are still under the influence of patron-client culture and political pressure. (4) There is no formal evaluation of work performance for the SRT's officials as well as efficient methods of work motivation.

Despite these problems, the SRT has good job descriptions for its officials down to the level of section heads and a clear salary structure.

The SRT has carried out its functions under the governance of the State Railway of Thailand Act of B.E. 2494 along with the Railway and Highway Provision Act of B.E. 2464. Moreover, the SRT has to operate under or subject to control and coordination with other government agencies by other laws such as the Budget Act of B.E. 2502, the National Economic and Social Development Act of B.E. 2521, etc. Under these laws, it is difficult for the SRT to manage and adjust itself into a business-like organization in order to survive in the changing transport market environment in Thailand.

Analyzing both organization and management, three major areas are recommended for immediate consideration: operation and maintenance; marketing; and personnel.

Operation and Maintenance. The study demonstrated that the SRT has been relatively effective in its ability to operate trains and maintain property. As a result, the study finds that major changes of the SRT organization for operations and maintenance are not necessary. Only a couple of philosophical points need to be considered. First, the decision-making capability on daily operations should be at the local level, with exceptions of the assignment of diesel locomotives, and locomotive schedule maintenance periods, the SRT should consider centralizing these functions. Second, to effectively decentralize the decision-making to the local level, there is a need to develop better information systems related to budgeting and expenditure control. The current system of accounts is not conductive to effective management control, and the current reporting is not timely enough. Lastly, the three main operating departments -- Traffic, Civil Engineering, and Mechanical Engineering -- should be more coordinated in order to reduce overlapping and organizational conflicts. In cases where the Departments themselves cannot resolve conflicts, a "management referee" is needed. Therefore, it will become more and more important that these three Departments in the future report to a common position, not too highly placed within the organization.

Marketing. In order to become a commercially oriented enterprise, the SRT will have to increase the size and importance of its marketing organization. This marketing organization should be dynamic and decentralized, managed by skilled managers and consisting of a good analyst team who are able to work with customers in developing transportation solutions, rather than simply acting as a sales agency for services developed internally by the SRT itself. This organization should have reliable information and should participate in the railway planning processes.

Personnel. Although the SRT labor salary levels are competitive, management salary levels are not. It is important that the SRT reconsider the salary levels of these positions in order to retain good management staff. Failure to pay management staff competitive salaries will ensure that many of the benefits that might otherwise be achieved by restructuring cannot be realized. Motivation is not provided by salaries alone, however. The management of human resources is a very specialized field, involving organizational and individual career planning, clear definitions of authorities and responsibilities, a system of performance appraisal (including merit increases in salaries), and management skills training. The SRT should review and improve its human resources development and management system.

In order to restructure the SRT for its role in the future, two management functions should be enlarged and put into positions of prominence in the organization. These are Marketing and Personnel. In making organizational changes, the SRT should study similar organizations in other railways. It is further recommended that the SRT seeks technical assistance for this work, to assist in defining the organization in detail, and to develope the various systems that will be required.

6.3 Technology Considerations

Technology is generally defined as the know-how which enables the transformation from the inputs to outputs in a manufacturing process. A railway organization is a service organization which sells the services of transportation as its product. The image of a railway as a technology-based organization was well-entrenched in the early days where civil engineers built tracks and mechanical engineers drove the locomotives to explore uncultivated part of the country. Today, the railway organization has developed into a complex business entity which becomes more and more market and demand driven like other business undertakings.

Reviewing technological capabilities of the SRT, the study found that the SRT has reasonable acquisitive and operative capabilities, some adaptive capability and very little innovative capability. There is no reasons to be alarm over the deficiency of adaptive and innovative capabilities at present, because the SRT as a service organization only needs acquisitive and operative capabilities to operate well and provide good service, if all the technologies are available in the market with reasonably low prices. This situation is true for the SRT which can choose a large variety of technologies from more advanced countries to satisfy its development needs.

However, the problem here is not the assessment of individual technology under consideration but rather the ability to foresee the impact of such technology introduction into the total system a few years from now. In other words, the SRT needs a more systematic method of technology acquisition guided by an indigenous operative philosophy to ensure a more effective operative capability improvement. Once a technology is fully operated, any further improvement will require adaptation which has inherent advantages of shorter lead-time, more enhancement of indigenous capacity and better compatibility of existing systems.

New technology is introduced into an organization to increase profit. If the SRT is to become commercially viable, that rule will also apply to it. The increased profits may be due to new lines of business, higher productivity, cost savings, etc. The key to the introduction of any new technology on the SRT is therefore a full feasibility study showing adequate financial returns to the railway for investing in the technology. Some of the new technologies that the SRT is implementing include Seat Ticketing and Reservation System (STARS), Centralized Traffic Control (CTC), and Operation Control System (OCS). In the future, it has the possibility of using some form of computer-aided dispatching and computer programs for train scheduling. Furthermore, in the course of the study, a number of issues perceived to be technological ones did arise, namely, double tracking, electrification, standard rail gauge, and high speed train services.

Double tracking is expensive, therefore it probably makes sense to double track stretch by stretch starting from the most congested routes. The SRT should carefully analyze the data such as train frequency over the time of the day, train speeds, distance between trains, location of the congestion in order to find the best remedy for the train delay and train traffic congestion. However, to facilitate the decision making process for double tracking, some agreed upon formula based on SRT's experience should be developed. The formula should not be much more complicated than that of the Japanese National Railway which takes 80 trains a day as the capacity of a single track.

Electric train have the advantage of less pollution, greater starting tractive effort and faster acceleration. One locomotive can haul a lot more weight. But it also represents a very high initial investment on the infrastructure which must be justified by the frequency of usage. This means that electric trains are more easily justifiable as suburban commuters in areas surrounding Bangkok and on main routes between big cities.

Standard gauge rail (1.435 meter) may allow a more comfortable ride, faster speed on curves, and possible connection with China. However, to make such a decision, calculations on capital investments required for all new infrastructure and motive power and rolling stock must be made to see how the SRT can finance them. Lost service during construction and conversion also needs to be considered as a financial loss. Sufficient benefits, both tangible and intangible, must be derived from such conversion to justify the investment. If a future situation calls for true high speed train services (200-300 kph.), track of standard gauge would be appropriate. On the other hand, unless the SRT was willing to discontinue slower services (e.g. freight or 3rd Class passenger), a dedicated track for high speed services would be required. This is because it is normally not effective to operate slower speed trains on the same line as very high speed trains. Unless a decision were made to have the only train services in Thailand as very high speed passenger, we can foresee no condition that would justify conversion of gauge on existing lines.

High Speed Train Services should have separate rails which may well be Standard Gauge. The cost justification of high speed service must therefore include the full cost of the dedicated infrastructure. On the question of whether the SRT has the technological capability to run high speed trains, the answer is "yes" given adequate time and resources in planning and training. In any case, the SRT is certainly better qualified than any other public agencies which have never had any experience with rail transport.

Information technology (IT) is as important for the SRT as other engineering technology. IT is the integration of computer technology to gather and disseminate information. The SRT can bring about many more improvements for promotion of IT. However, carefully planned implementation steps must be laid out. First, it is essential to have the active support and participation from the top management as well as workers to lessen resistance to change and to avoid IT being negatively portrayed as "labor saving". Second, planning must ensure "interconnectivity" and "interoperability" of all systems throughout the SRT. IT should be able to "do better with less" by improving existing work and services like inventory control or maintenance scheduling. It can significantly improve productivity and generate new services; for examples, OCS to make optimum utilization of rolling stock, and STARS to provide convenience to passengers as well as increase revenue for SRT. Bigger pay-off, however, is possible when all the information is integrated, manipulated and presented in various forms for strategic management. When top managers are supported by such a wealth of information at appropriate levels of aggregation, they can give quick response to opportunities in the marketplace, avert incoming threats, and plan strategically. There is a clear case that to ensure long-run success, the SRT must pay close attention to the development of IT in the short-run. The MIS Department already possesses the core of a professional IT development team, but this must be expanded. Of perhaps greater importance is the need to develop IT know-how within the various SRT Departments.

6.4 Business strategies

Business strategies based on goals which are realistically achievable within the short-run must be develop as a continuing requirement for carrying out business on the SRT. These strategies will include:

a) Implementation of full PSO system,
b) Abandonment of services not covering costs (after PSO services are defines),
c) Implementation of an investment strategy fully related to positive return on all investment, and
d) Timely and accurate assessment of results.

The main lines of business for the SRT are:

Freight services, with a priority on bulk commodities in car-loads over medium to long distance (including container services), must operate under commercially sound tariffs which recover full costs. At present, there are complaints by the customers such as not enough freight cars and locomotive for freight services, slow turn around times of freight services, low capacity freight trains causing high unit costs of freight transportation, and twin locomotives are needed to pull freight trains in some mountainous area. To correct these problems, some restructuring of the overall rail operation system will be required. The SRT must emphasize reliability of service provisions to all customers.

Inter-city passenger services should concentrated on express services with stops a major population centers, for example between Bangkok and Chiang Mai. The double tracking program and improved track conditions for the most profitable routes will allow for reduced travel times by rail. Also, the SRT should embark on a major program to improve the appearance, cleanliness, and comfort of passenger coaches. In doing so, a greater emphasis in differentiation between service classes should be introduced in order to encourage the public to pay the premium fares.

Passenger services with frequent stops normally operate at a loss, and they should be operated under the PSO program. In the future, the SRT should generally discourage some of these services unless they are imposed upon the SRT by the government. The Government should carefully analyze whether trains or buses are economically best suited to carry out such services.

Real estate development will enhance SRT's revenue. The SRT should study all SRT properties to determine status and investment opportunity. In developing the strategy, preference should be given to land usage that would enhance SRT railway revenues. For example, development of an industrial estate along-side the SRT line would be preferred over a golf course development. In any case, it is imperative that, if real estate development and concessions are carried out, then they should be done along fully commercial lines to maximize the returns to the SRT. It must be stressed, however, that revenues from land development should not be allowed to cloud the true financial position of railway operations. The efficiencies aimed at through such policies as PSO's could easily be lost, with land revenues in fact providing a hidden subsidy to railway operations. Land revenues can be incorporated at the annual corporate accounting level, but never integrated within the railway operation. In order to help achieve this, and to prevent diversion of railway management attention to non-railway business, the land development organization should be run by real estate professionals, reporting to the highest levels within the SRT (i.e. General Manager or Board of Commissioners Chairman).

Each of these above businesses must be operated as a separate, commercial enterprise. Specific requirements must be developed for each service types (and sub-division of these service types). Services which can cover their variable costs plus an appropriate level of financial and overhead costs (including PSO services) should be targeted.

6.5 Investment requirements

The 20-year investment plan for the SRT has been developed in two phases. Phase I is concerned with developing a plan based on the status quo, where status quo is defined as the existing SRT structure and general business policies. The plan thus developed forms the basis for Phases II, where the plan is modified to reflect the new directions recommended for the SRT.

In the future, if rail operations are to continue on a competitive basis, there are certain elements requiring increased investment over time. Of immediate concern is the condition of rail. The majority of main line trackage is 70 lb./yd. rail, which is in excess of 20 years old and in poor condition. The incidence of rail failures (broken rails) is high. As a matter of urgent safety, this rail should be replaced as soon as possible. This involves some 1,100 kms. of track. As a very general rule for the future, to maintain track conditions, rail should be replaced at the rate of 3% per year. Over the 20-year Plan time frame, it is estimated that 30% of the SRT shops and depots, and 50% of the present employee housing, will also require replacement. For signaling and telecommunications systems, major investments have been made over the past 5 years. In the future, the past high level of investment can be reduced.

The average age of the SRT diesel locomotive fleet is 20.4 years. Investments in new locomotives over the past 5 years has been almost negligible. As a result, the average age of the fleet is relatively high and continues to grow. Not only are the maintenance costs high, the SRT is also experiencing an abnormal number of locomotive breakdowns. As a result, the SRT is seeking approval to purchase 76 new locomotives in the 7th Development Plan, along with some additional locomotives already contracted for. Beyond this period, in order to maintain an average fleet age of less than 20 years, it will be necessary to invest in approximately 10 new locomotives per year (status quo case). For wagons and coaches, however, the recent level of investment appears appropriate, and should continue in the future.

In twenty years' time, the land transport demand will increase 4 folds. With the organizational changes we recommended earlier, the SRT should be able to achieve a 50% greater share of the land transport demand (passenger and freight) compared to the current situation. This results in increased business of 6 folds. We feel that approximately 66.6% of this increase can be absorbed under the status quo investment plan. This can be achieved through increased efficiencies (related to structural changes), utilization of current excess capacities, and increased capability introduced through double tracking. To arrive at the final investment plan, some of the investment requirements related to the mechanical engineering components of investment and new line constructions in the status quo case have been increased by 2 folds. Although individual investment items would vary as to inflation requirements, the result in total is considered to be reasonably accurate. At current prices, and assuming 5% inflation, total investment is expected to increase from about 3,609 million baht in 1992 to 13,730 million baht in 2001 and 22,365 million baht in 2011. It should be noted that more than half of these investments from 1992-2011 is for the nation-wide double tracking project, assuming that the whole project will be carried out.

6.6 Debt Burden

Once the system of PSO has been fully implemented, the Government should no longer be involved with any losses suffered by the SRT as the latter run its business. In fact, if SRT profits in any year are larger than required for re-investment, the surplus should revert back to the Government as the sole share holder. If, however, losses should occur, the management team must be held fully accountable.

An important issue is the present debt which are the result of past loss-ridden operations. It is recommended that with the PSO strategies to be adopted in the very near future, the remaining SRT debt should continue to be borne by the SRT. The SRT should be able to efficiently clear away the debt to be incurred annually. If this burden were to prove too great, however, (as would be the case if it resulted in non-competitive pricing), it is suggested that the SRT offset some of its current debt by sale of land to the Government. And the Government should purchase back land at fair prices.

7. Action Plans

In Thailand, the SRT's past and present experiences exhibit many features of problems that have faced, or still being faced by, railways through out the world. Unclear policy objectives and the failure to separate the railway's responsibility from that of the Government concerning the provision of social services have resulted in a vicious cycle of loss, increasing debt, deferred maintenance, increasing age of rolling stock, and low employee morale. Yet, from this study, it is clear that the railway has an important role to play in serving the nation's future transportation needs. In fact, increasing negative externalities associated with other modes of transport point to the need to increase the railway's role substantially in the future. Because the problem with the SRT is not yet at the critical level, implementing the needed solutions should be much easier that if the problems were already critical. The following paragraphs suggest some courses of action that could be initiated in the process of finding appropriate solutions.

7.1 Getting Political Consensus and Commitment

To bring about effective reform, is necessary that a political consensus be developed on the real nature of the SRT's problems and the need to promote more use of the railway. This will not happen automatically, however. The SRT needs to develop an effective strategy to bring it about. Components of such a strategy may include the followings.

(a) The SRT should actively and continuously disseminate the findings in this and other studies in other countries to generate a better understanding of the railway's problems and potentials, and to develop a consensus on the need to make required changes. The target groups should include politicians, government agencies, technocrats, academicians, and the general public.

(b) In achieving effective dissemination, the SRT may need to utilized professional public relations agencies to develop a public relations plan and implementation.

(c) Some show-case services (passenger and freight) should be developed to demonstrate that the SRT is able to provide such services if given the chance through appropriate reforms. This will help improve the SRT's image.

7.2 Implementation of the PSO System

The PSO system which is a crucial step in the effective reform of the railway should be implemented as soon as possible. It will lead to many benefits such as clear divisions of responsibilities between the Government and the SRT on social services, incentives for full commercial operations on non-PSO services, full accountability of the SRT management for the future financial situation of the SRT, possibility for transforming the SRT into a profitable enterprises and increase employee morale.

A reasonable PSO system which can later be monitored and fine-tuned should be started as soon as possible. Given the importance of the implementation of the PSO, it is suggested that implementation should start without having to wait for all parties to agree that all the details of the system are perfect. Waiting to develop the perfect system is likely to lead to non-action. As long as some reasonable system can be developed, implementation should start. The system will need to be monitored and fine-tuned in any case. For future modifications; (1) a detailed study should be launched within two years of implementing the PSO strategy to determine the possibility of alternative means of providing the same types of transport services presently provided by some branch lines and local train services, (2) the system of cost accounting presently installed can be used in the initial implementation of the PSO system, but it should later be improved to enhance economic decision making, in particular to be able to isolate fixed and variable costs for various services, (3) annual process for PSO negotiation should be established, and (4) the PSO strategy should be subjected to biannual review.

7.3 Government-SRT Contractual Agreements

As the PSO is implemented, the Government and SRT should begin to discuss and reach agreement on the boarder aspects of their relationships. The aim would be to develop commitments that each side will carry out in the process of reform. The process should lead to the development of the "Contract Plan," the "Management Plan," and the "Enabling Actions Plan."

The contract plan is a formal ratification by the SRT and the Government of their respective obligations. It certifies the authority and responsibility of the SRT, stipulates the performance level expected of the railway, specifies the commitments to be undertaken by the Government, and establishes a time period for the duration of the contract.

There are a number of steps involved in the contract planning process:

1) Adoption and affirmation of the mission statement and objectives for the railway enterprises, including that implicit in the PSO implementation;
2) Delineation of the railway's authority to make decision which control the fulfillment of its responsibilities crucial to the successful operation of an efficient provider of PSO services, and a competitive, profit-making enterprise on non-PSO operation;
3) Establishment of the railway performance standards;
4) Proposals of railway commitment in return for its broader and clearer authority such as aggressive and professional efforts to meet the performance standards, effective management of operations, etc.;
5) Consideration of Government's commitments such as on deregulation, changes in government policy toward non-rail modes of transportation, etc.; and
6) Consideration of contingency provision by identifying the procedures to be used in the event of major failures.

The management plan is an internal document prepared by and for the SRT, consisting of the activity plans according to future rail strategy, and the performance commitments by the SRT in the Contract Plan which are converted into detailed operational targets for each of the SRT's departments. The plan will have a three to five years planning horizon, and includes:

1) Establishment of the organizational framework for converting to a commercial mode of operation.
2) Determination of the SRT's pricing and marketing policies for its non-PSO modes of operations taking into account the potential markets in the future.
3) Specification of responsibilities for each department and the managers who direct them, and performance goals.

The enabling action plan takes a comprehensive list of the obligation from the contract plan and develops the program of specific steps which must be taken to enable the Government to make good on each of its promises, and enable the railway to begin operating as a truly commercial enterprise. The enabling action plan contains the identification of necessary new legislations and amendment of existing legislations, and a plan to achieve them, necessary policy and administrative directives for the relevant government departments, the implementation agreement upon changes in the organization of government agencies, and any new funding authority.

7.4 Investment Plan

Given the past deferred maintenance and low investment, the investment plan is a critical component necessary to improve SRT performance and prepare the railway for an increased role in the future. The recommended investment plan shows a level of average investment for the next 20 years much greater than the average for the past 5 years. It should also be noted that almost half of the requirement relates to the double tracking project, on the assumption that the whole project will be carried out. Certain other potential investments for new lines of business, such as high speed train service, are not included. These need to be studied in more depth, and it is anticipated that they could be developed using private capital.

7.5 Financial Projection

An important question in the reform process is whether the SRT will become a financially viable operation once the PSO and various reforms are in place. A rough projection of the SRT's financial position to 2011 is carried out. This shows that, with the PSO in place, the SRT's is expected to become fairly profitable in the future, with the profit rate increasing to about 6.7% of turnover in 2011, or 7.8% of turnover excluding PSO service costs. This is, of course, dependent on the PSO. Without the PSO, the SRT is expected to continue to make large losses.

7.6 Conclusions

This study has indicated the necessity and desirability of reforms so that the SRT can play a more active and commercially oriented role to serve the nation's future transportation need. From all the previous analyses, there appears to be a great potential for rail transport in Thailand. An expanded role for rail would serve the rapidly growing demand for transportation of both passenger and freight in line with the country's development, and also help reduce the worsening trends of negative externalities associated with other modes of transport. To be able to exploit this potential fully, however, the "status quo" approach needs to be changed. Explicit understandings and contractual plans need to be developed between the government and the SRT. Actions will be required on both sides. If such agreements can be implemented and actions seriously carried out to conform to the agreements, along the lines suggested above, then one can optimistically look forward to the day when the SRT will be regarded as an efficient and successful organization by a wide spectrum of the population, and rail transport regarded as a high quality transportation system which is indispensable for the nation.

CHAPTER 1

RAILWAYS: THE WORLD EXPERIENCE

Like most of the World's great railways, the State Railway of Thailand (SRT) has entered its second century of operation. Throughout its history, the SRT has served the people of Thailand well. That it has made a significant contribution to Thai society is unquestionable. But in current times of rapid economic expansion and increased transportation competition, does the SRT continue to make such a contribution? If it does not, should it be discontinued, or is there a different role that it should play?

By world standards, the productivity of the SRT remains high, even today. For example, in terms of Traffic Units per Employee, the SRT ranks second amongst ten Asian railways reported (see Figure 1-1), and eighteenth amongst seventy eight railways reporting worldwide. Yet the SRT is entering a state of crisis. Its financial position is poor and deteriorating. Its infrastructure is also deteriorating, and in some cases quality is below normal safety standards. Public confidence in its abilities are low, as is employee morale. The Government is becoming increasingly concerned with the SRT's net annual operating loss, which it must subsidize if the SRT is to remain operational.

To understand how the SRT reached this crisis state, we should recognize that this railways problem is by far not unique to Thailand. Over the past 15-20 years, railways throughout the world have experienced (or are experiencing) similar problems and challenges. This includes railways in both developed and developing countries. A brief look at these problems on a world scale will assist in understanding the Thai dilemma, and indeed will indicate what some of the solutions might be.

1. THE HISTORIC RAILWAY PROBLEM

During the nineteenth and early part of the twentieth centuries, railways throughout the world represented the vanguard of technology. They virtually had a monopoly on medium to long range overland transportation, both of passengers and goods. In this type of environment, it was a "sellers' market". The railways' monopolistic position allowed them to pick and choose the services they wanted to offer, based on their

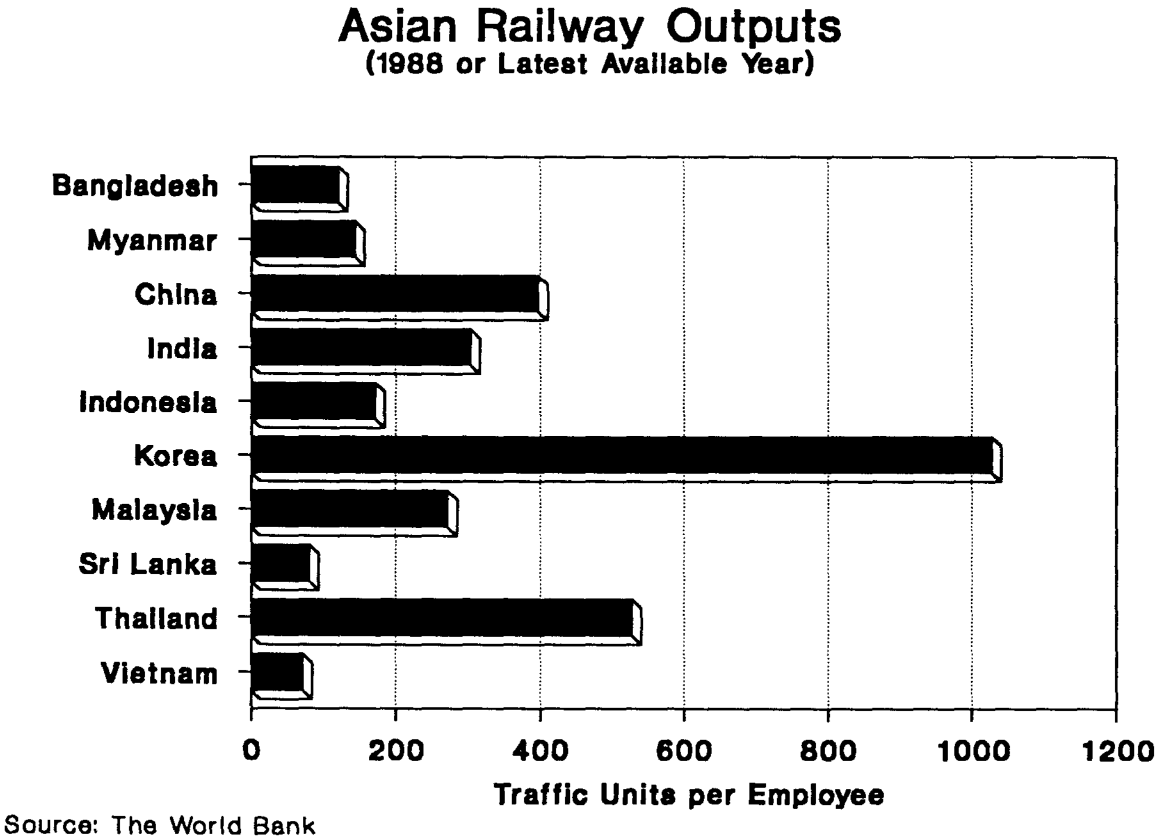

FIGURE 1-1

own preferences rather than those of its customers. In the absence of any real competition, they had a free-hand to charge whatever tariffs were necessary to offset costs and realize profit.

This monopoly status prompted most governments to create regulations to control railway rates, and in the case of government-owned railways to ensure that the general public had access to the railways' services. With the advent of viable trucking and bus operations, the railways' monopoly quickly deteriorated. Governments invested massive amounts of capital into road systems, with little or no regard to direct investment returns. As the road networks grew, and automotive technology improved, the truck and bus operators made ever increasing gains in the transportation market. They had the advantage of being smaller and therefore easier to manage units, and their high motivation towards profit made them efficient and highly responsive to the needs of their customers.

As they continued to see their share of the market being eroded, railways tried to fight back. They were now at a disadvantage, however. Because of their size and their history, they were not as responsive to customers' needs as were their competition. They were also at a competitive disadvantage because of the many regulations that had been put in place, and governments continued to require low tariffs. In Canada, for example, a government-imposed railway tariff for shipping grain, introduced in the early 1900's, remained in existence into the 1970's. In many other countries (including Thailand), governments required the railways to maintain artificially low fares for passenger services offered to the poorer class of society. Railways which were once large money-makers were now put at a distinct competitive disadvantage, by having to offer services at rates less than costs.

Faced with a deteriorating financial status, the railways pondered on how to effect change aimed at reversing the trend. The task was enormous because of all the factors working against them. Oftentimes their attempts to reduce costs by staff reductions were thwarted by government regulations disallowing staff layoffs. Their management teams had been recruited from the ranks of railway operators, and had little experience in aggressive or dynamic business techniques. Although they tried to turn themselves around, the obstacles were too formidable. As a result, they continued in financial decline.

As railways tried to function with ever-decreasing availability of cash, the inevitable happened. They started to defer maintenance activities and capital investments. Little or no funds were put into research and development, resulting in a long period of time where there were negligible advances in railway technology. These "fixes" only went to ensure that the problems became worse with time. In their paper "Strategic Repositioning of Railways", Booz-Allen & Hamilton Inc. refer to this as the "Cycle of Doom", characterized by the following features interacting in cyclical fashion:[1]

- Insufficient Capital & Funds
- Poor Track Conditions
- Old Locomotive Fleet
- High out of Service Levels
- Slow Train Operations

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1. Booz-Allen & Hamilton (1990).

- Excess Equipment Needs
- Excess Locomotive Needs
- Excess Trains, Crews
- Excess Costs
- Slow and Unreliable Service
- Low Fares, Rates & Tariffs
- Declining Traffic Base

One notable "victim" of this cycle, with the resultant financial fiasco, was the Japanese National Railways (JNR). Prior to its restructuring in 1987, the JNR was experiencing annual losses of US$ 10 billion. Their long-term debt was over US$ 210 billion, which if paid at one time would have represented 10% of the Japanese GNP!

In order to summarize the problems experienced by the world's railways, we quote from a World Bank working paper entitled "Techniques for Railway Restructuring". One of the co-authors of this paper, Mr. Louis S. Thompson, has an advisory role on the current SRT study.[2]

"The World Bank's reviews of railway crises show very clearly that they do not come about suddenly, nor do they happen by accident. Although the points of emphasis may differ, this conclusion is just as true of railways in the developed as in the developing world. As a broad generalization, railway crises occur because railways have not been encouraged, or allowed, to respond to changes in the economies they serve. Long after major segments of railway traffic have been captured by competitors which are often privately owned and operated, railways continue to offer services which are not in demand, at prices which are often far below cost, and with a quality of service which is inferior to the customer's needs. Typically also, as the railway becomes a fiscal drain on an economy already short of resources, longer range maintenance and capital needs are neglected, further diminishing the railway's capabilities as the years pass. The longer the problem continues, the more difficult and expensive it is to resolve, and the more likely it is to be "put off until next year".

Across all economies and cultures, this situation is the result of some or all of the following forces:

(1) The railway is generally one of the nation's oldest institutions, and its years of history have endowed it with perceived roles -- such as a "public service obligation" -- and an

2. Huff and Thompson (1990); see also Thompson (1992).

associated engineering and production-oriented management culture which are uniquely resistant to change.

(2) The railway often has the largest single unionized work force in the nation, giving its workers a great deal of political power which is used to protect the size of the labor force, even when there is little productive work to be done.

(3) Over the years, various classes of passengers (typically commuters and third class inter-city passengers) and shippers (often agricultural interests and major government-owned mining or industrial enterprises) have been able to persuade the regulatory authorities of the government to distort the rate structure in their favor. The stated rationale for the intervention in freight rates is as predictable ("the nation needs to control freight rates in order to promote exports, or to control inflation") as the result: nothing positive is achieved because the resulting deficits are merely shifted from one agency budget to the other, and the management incentives of both railway and shipper are badly distorted. Regional interests also believe that the existence of rail service (but not, necessarily, its use) is important either to maintain the local economy, or to protect the possibility of a desired future development program. Eventually, the beneficiaries of the system of cross subsidies come to believe that their favored status is not only important to them, but is also important to the health of the nation, and they defend their positions tenaciously.

(4) The people at large may believe that a railway is "needed", whether or not it is economically justifiable, either because they believe that rail service is a basic "right" (like education or health), or because they consider the presence of a railway to be one of the status symbols of nationhood.

(5) The ministry which owns and operates the railway may be as interested in protecting its organizational domain, budget, and political influence as it is in serving the needs of shippers or tackling the difficult task of restructuring the railway.

(6) Finally, many of the important actual or potential customers eventually switch to other modes because the service may have become sufficiently slow and unreliable that it is no longer economical to use rail. These former users are no longer advocates for change and improvement. Of course, the other beneficiaries of poor rail service, the competing (non-rail) transport modes, are often committed advocates of the status quo as well."

2. THE CONCEPTUAL SOLUTIONS

It would be very helpful if we could list here proven remedies that could directly be applied to the current problems of the SRT. Unfortunately that is not possible, for there is no such list. Different world railways have tried different solutions, achieving different levels of success. Each railway is serving a country with different markets, different business and social cultures, and different governmental objectives. It is therefore reasonable to assume that the ideal structure for one country's railway system should not be a standard for all countries.

Just as the problem symptoms are similar country by country, however, we might expect to find the concepts for positive change to be similar in nature. The discussion which follows will consider, in general terms, some of the more important concepts. This discussion is in a global context, related to the experiences of railways that have successfully effected positive change, and not specifically related to the unique requirements of the SRT.

2.1 Political Leadership

In any attempt to resolve the "ills" of a railway, it is natural to focus on financial and technical considerations only. These of course are important ingredients. Any comprehensive restructuring plan, however, will inevitably lead to some population groups being beneficiaries, and others who will suffer harm. These groups need to be defined. Because of these consequences, the highest levels of political leadership must fully understand and support the plan. Where this has not occurred, the plan usually fails.

In turn, all government agencies who are involved with the reforms and the results must also understand and accept the plan, and exactly what their responsibilities are in effecting the plan. This only occurs when there is strong political leadership. Successful reform has occurred in those countries where the railway problems are perceived as national problems, requiring political leadership to resolve them, rather than a problem of the railway to be resolved by the railway's management.

2.2 Planning

The railway's problems of today are the result of many decades of inefficient policies and objectives. We might therefore expect that there is no simple "overnight" cure, and the experience in other countries supports this premise. In some countries (notably Britain, Japan and the United States) reform has taken many years to effect, and further reforms are still felt to be desirable. Implementing the reforms is a staged process over time, with a fair degree of "trial and error" required. Because it is a process requiring time, it requires long range planning. The plans must be well thought out, and must remain dynamic over their time frame. The first plans will not be perfect, due in part to the long range unpredictability of the environment in which the railway will operate over the planning time frame.

Global experiences further demonstrate that this planning process must to the extent practical start at "square one". The primary planning emphasis should not be on the railway of today and how to change it, but rather on the basic question of what future role (if any) should the railway be serving in the economy. That the railway is not adequately serving the economy today is accepted, and determination of blame for this situation is inconsequential. The important planning consideration is what are the needs of tomorrow. If these needs include operation of a railway with certain business goals, then the transformation of the railway must be planned to meet those goals.

2.3 Public Service Obligations

Governments have social responsibilities - railways do not. Not recognizing this simple truth has paralyzed many of the world's railways in the past. It is only when Governments recognize the effectiveness of market forces in business development in general, and in railways specifically, that real solutions to the ills of the railways can be developed.

This is not to say that the government owners of railways do not have the right to expect their railway to further the public good. Where the public good requires railways to offer services at less than cost, however, it should clearly be the responsibility of the Government to shoulder these losses. These services may include specific train runs, track branch lines, or stations. Governments in the past have made up the railways' losses by global annual subsidies. This does not afford the Government the opportunity to evaluate what good it is receiving for its money, does not lead to incentives for railway management efficiency, nor do the subsidies normally include enough funds for future railway investment.

A very successful solution to this problem, on a world scale, is the implementation of a system of Public Service Obligations (PSO) for railways. As a part of this system, governments reimburse the railway for specific services it requires, but which cannot earn enough income to cover costs. It is simple for the Government to delete (or add) such services when the costs are fully known. There should be no other subsidies paid to the railway other than the PSO, which requires railway management to become more concerned with operating efficiencies and cost control. Moreover, the railway must be able to demonstrate to the Government that the PSO services are being operated as efficiently as possible.

This issue of PSO is covered in detail later in this report. The Thai Cabinet has already taken the important step of adopting a PSO strategy for the SRT. The working details of the strategy are currently being developed, and it is hoped that this report will serve as a major input to this development.

2.4 Railway Organization (External)

An important issue to be resolved is how the railway should relate to the Government and its various agencies. Included in this issue is the degree of railway privatization (if any) desirable. For this issue, there is no standard resolution on a world scale. Virtually every country that has effected railway restructuring has taken a different approach to this issue. It can correctly be assumed that this is because there is no "perfect" plan, but rather any number of alternatives will work well if implemented effectively. It becomes not so important as to what the plan is, but to have a plan in the first place.

In developing this external organization plan, it is of prime importance that the railway be treated fairly in relation to its competition. The degree of regulation must be equal across all transport modes. Safety regulations and policy must also be equally applied (for example over-crowding or over-loading). Direct or indirect subsidies, taxation and duty levies too must all be applied equally. Failure to create such organizational and regulatory equalities (or to use a common expression; "to create a level playing field") will surely lead to the financial collapse of the transport mode in the sector for which it is disadvantaged.

2.5 Railway Organization (Internal)

Developing an effective internal management organization is an important ingredient in the restructuring plan. The key factor to consider is that the organization be responsive to the needs of its chosen market niche. On a world scale, several approaches have been undertaken. British Rail remained a single organization subsequent to reforms effected to date (although additional reforms are being considered). Swedish Rail was split into basically two organizations; one to manage infrastructure and the other to manage a set of operating lines of business. The Japanese National Railways basically adopted both approaches. They are broken into geographical market-oriented companies, then one cross-cutting freight company, and then on an infrastructure basis for the high-speed lines, and on an operating basis for operating the Shinkansen lines.

The choice of the appropriate organizational structure for the SRT will depend upon the mission and objectives to be set for it. In the words of Sir Robert Reid, Board Chairman, British Railways; *"The choice or the trade-off is between a simple, but unfocused and unresponsive monolith, or the increasing complexity in the case of a market-focused organization, and I want to make it very clear that as the complexity of the organization grows in order to deal with different markets, the cost of operating that organization grows. There is a price to be paid between the market sensitivity and focus of the railway and the cost of operating it that way. Those trade-offs are based on a number of different things, but one of them is the relative importance of the markets to be served. If a railway is carrying 99.9 percent of its traffic as freight, and 0.1 as minor traffic, or passenger traffic, it makes no sense to assign equal importance to those two kinds of traffic. If, however, it is equally poised between commuter traffic, inter-city passenger traffic, and freight traffic, a completely different balance needs to be struck".*

2.6 Railway Physical Constraints

There is a common feeling that anything that can move by truck or bus can move on the railway. This may be essentially correct technically, but experience in other countries shows that this premise is not economically sound. This experience shows that the inherent advantage of a railway lies in the mass production of transportation. This advantage cannot be fully realized, however, if there are extraordinary limits on train sizes or numbers of trains.

Train sizes may be limited by :

- drawbar strength
- maximum axle loads
- clearances
- tractive effort
- siding lengths and spacing
- yard trackage lengths
- labor agreements

- dispatching capability
- gradients & curves.

Numbers of Trains may be limited by :

- maximum speeds
- slow orders
- running speeds
- siding lengths and spacing
- yard times
- dispatching capability
- communications effectiveness
- signaling effectiveness.

Each of these constraints needs to be considered in determining new market niches for the railway. Some constraints can be lessened in severity at relatively low cost, others at very high cost. In each case, the potential rate of investment return needs to be taken into account. This includes consideration of new technologies, such as high-speed trains, electrification, or (in the case of a single track railway) double tracking.

These considerations result in the railway of the future being oriented to those market segments for which it is best suited. In the past, railways attempted to enter all land transport markets. It is further true, based on experiences in other countries, that even when market segments are compatible with the railway's capabilities, there may be conflicts between the various segments. The best example is the conflict between fast and slow train services. Experience shows that the two big money-makers for the railways are medium to high speed passenger services and heavy haul freight services. Because of speed differences, however, the two are generally incompatible. This is why the successful railways in the world are normally oriented towards freight or passenger services, but not both.

3. THE WORLD EXPERIENCE: CONCLUSION

All of the above factors, and many more, have to be taken into account in developing a conceptual design of a country's ideal future railway. It can readily be seen that the analysis is complex, the solutions are not simple, and the process is very lengthy. The potential dividends are high, though, in terms of the contribution the railway of the future may make to the economy. The complexity of the process should not divert us from tackling it. In the words of Mr. Louis S. Thompson, Railways Advisor to the World Bank, at the January 30, 1992 symposium which "kicked off" this current study (Thompson, 1992):

"The problem is not unsolvable. There is no reason for despair. Many other countries have attacked exactly this problem with success. British Rail has made considerable progress over the past 30 years. Rinthe in Spain has made dramatic progress in the last 10 years, (as have) SNCF in France, Finland, Sweden, Japan, New Zealand, Australia, South Africa, the U.S., and Canada. Deutsche Bundesbahn is now in the process of reorganization, which is every bit as thoroughgoing as anything that has been undertaken. These are developed countries. In developing countries, we have been working in Argentina, Chile, Korea, Cameroon, Senegal, Poland, Hungary. Many, many countries have decided to attack this problem. In all cases, although the outcome differed considerably, and in many cases is still developing, the process was based on several simple steps.

First, the Government and the Railway together stepped back and asked: 'Why do we have a railway? What is the function of this railway?' It is no longer enough to say we need a railway for national pride or we need a railway because someone thinks we need a railway. What purpose, or market, or function, or social objective does it serve, and is this the most efficient way to serve that objective?

Second, the role of the railway and the government were clearly distinguished and separated. The government took the responsibility for defining social needs. The railway assumed the posture of a paid supplier of social requirements....Except for these (PSO's) the railway assumes the role of a commercial competitor to serve market needs and then, finally, the railway was reshaped or reorganized to meet the market and social functions defined in this process. It was not allowed to remain a traditional government agency."

CHAPTER 2

THE STATE RAILWAY OF THAILAND: PAST AND PRESENT

1. THE EARLY YEARS

Construction of the first railway line in Thailand (Siam) commenced in 1892 under the reign of King Chulalongkorn (Rama V). Five years later, the first section between Bangkok and Ayutthaya (71 kms.) was opened to traffic. The line was operated by the office of the Royal State Railway of Siam, which was under the control of the Ministry of Public Works.

During the initial years of operation, the Royal State Railway was divided into 2 operating departments - the Northern and Southern Railways. In 1917 these two departments were combined to form the Department of the Royal State Railways of Siam. This new department was directed by Prince Parachatra of Kamphaeng Phet who was appointed its first Commissioner-General. It was largely due to his abilities and hard-work that the Department was significantly improved and modernized. It was he who introduced to Thailand the diesel locomotive (1928).

At the time the new Department was created, there were two different track gauges in Thailand (1.00 and 1.435 meters). This led to inevitable operational inefficiencies, resulting in a Royal Decision to standardize with meter gauge. This conformed to the railway gauge in neighboring countries (i.e. Malaysia, Burma and Cambodia). The meter gauge standard was achieved in Thailand by 1930.

From these initial beginnings, the Royal State Railways of Siam gradually developed and played a major role in the country's development. There was a terrible set-back, however, during World War II, when a large amount of railway assets throughout the country were destroyed by air-raids. At the conclusion of the War, the Government put a high priority on restoring full railway services for the benefit of the public. In 1951, the Royal State Railways became a state enterprise by virtue of the State Railway of Thailand Act B.E. 2494. In terms of manpower, the SRT is the largest state enterprise in Thailand.

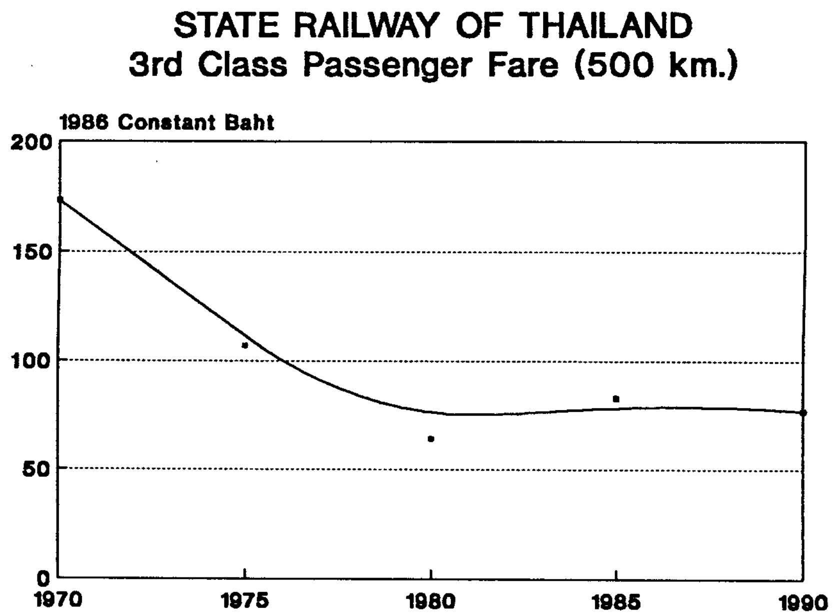

Figure 2-1

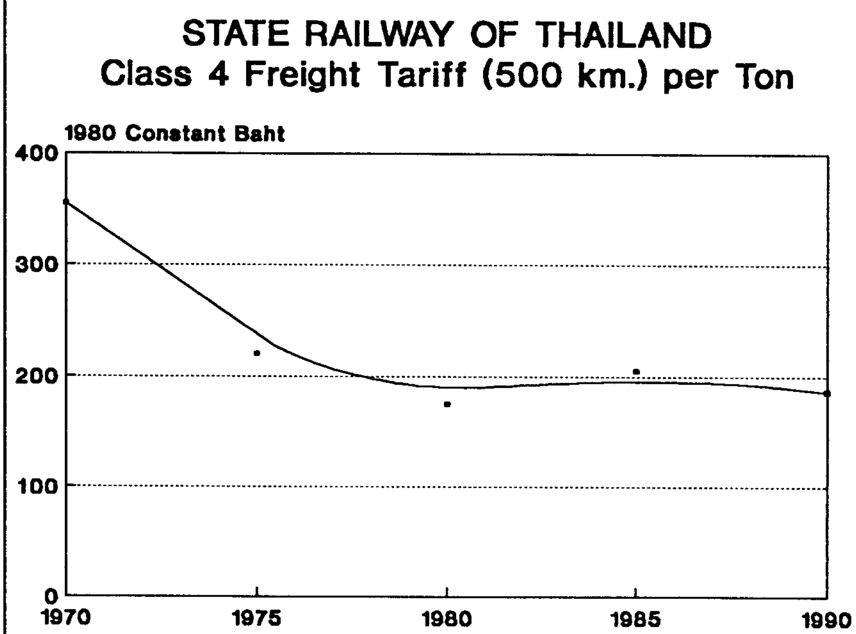

Figure 2-2

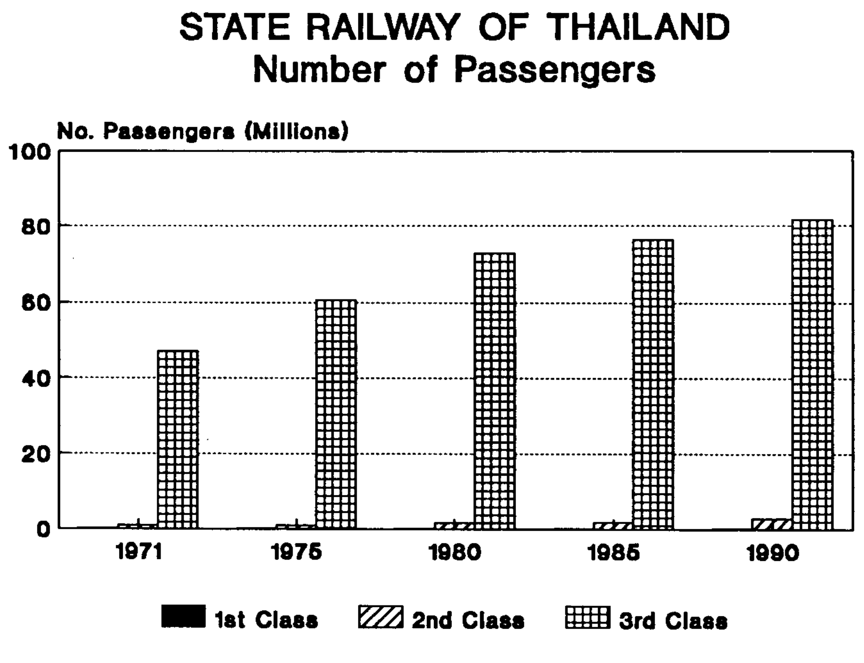

Figure 2-3

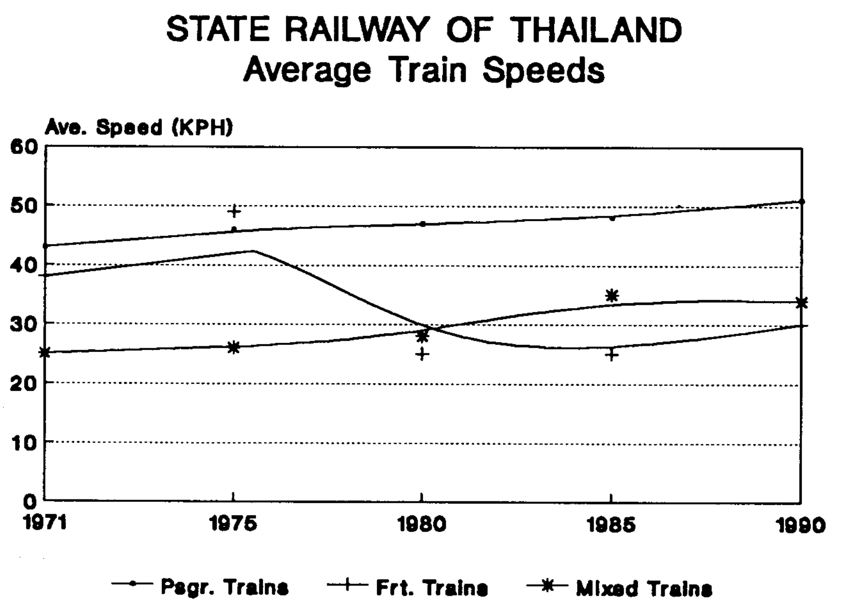

Figure 2-4

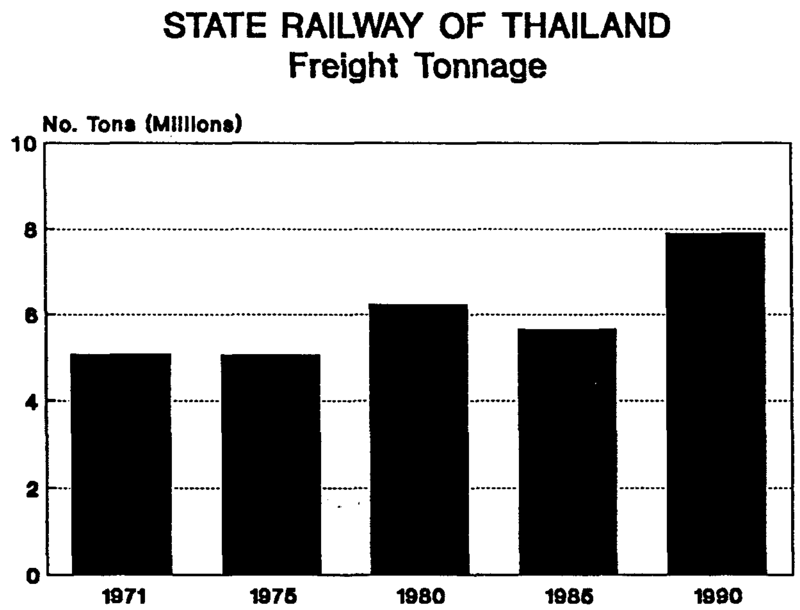

Figure 2-5

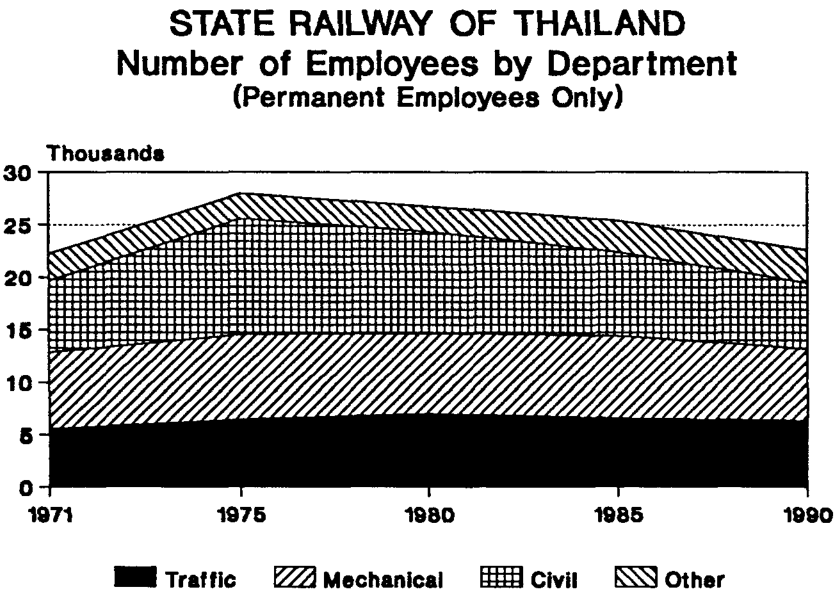

Figure 2-6

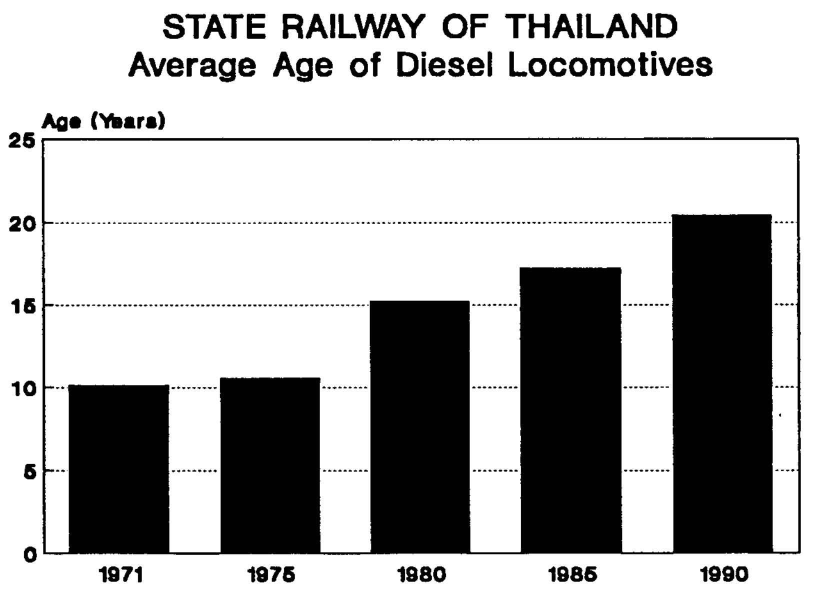

Figure 2-7

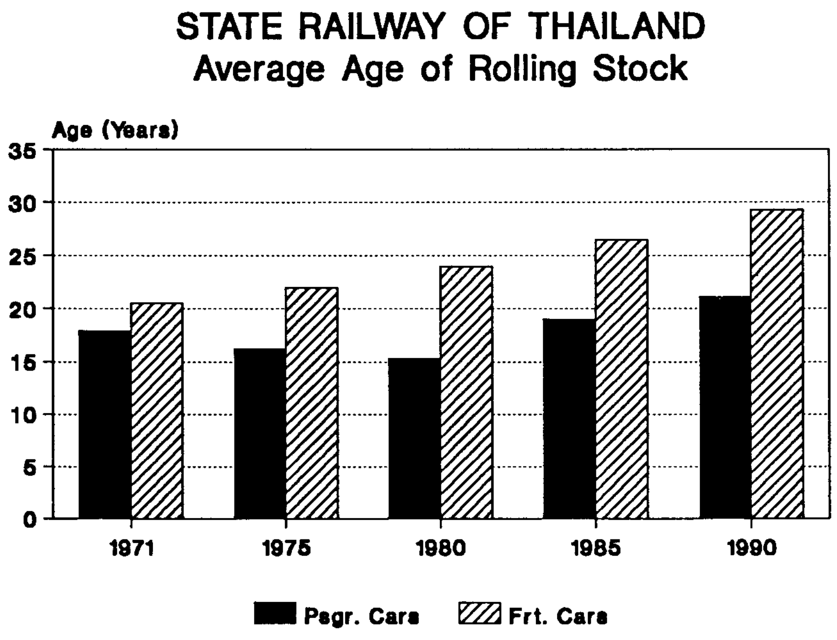

Figure 2-8

2. FROM PROFIT TO LOSS

Prior to 1974, the SRT generally generated adequate revenues to cover expenses and normal investment requirements. During 1974, at the height of a worldwide economic recession, the SRT suffered a significant decline in its financial position. From 1973 to 1974, the SRT's operating ratio (expenses to revenues) rose from 88.6% to 106.1%. Subsequently the SRT has continued in a loss position, requiring government subsidies to remain in operation.

It is not our intention here to fully analyze SRT management and operations in order to isolate the exact causes for the poor financial performance over the past 18 years. The focus of this study is not to effect corrections to the status quo, but instead to determine a logical future role for the SRT in the economic development of the country, and to restructure the SRT over a period of time to satisfy the requirements of this role. We feel that a cursory review of the factors which contributed to the poor financial performance of the past is appropriate, however. We undertake this review with two objectives in mind. Firstly, in an attempt to ensure that the lessons of the past are considered in developing policies for the future. Secondly, we hope to demonstrate that the problems of the past were mainly the result of conflicting objectives, rather than due to any issues related to management ability.

The SRT is heavily regulated by the Government, especially in the setting of tariffs. Democratic governments by their very nature tend largely to the immediate needs of the majority of their citizens. In many countries, including Thailand, this has resulted in railways being required to charge unusually low rates for some services - rates which oftentimes do not cover costs.

As noted above, the SRT entered a financial loss position in the year 1974. Figure 2-1 shows 3rd class passenger fares for a distance of 500 kms. These fares have been adjusted to constant Baht, by using Thai consumer price indices (transportation group) with a base year of 1986. In terms of train kilometers, passenger service represents about 75% of the SRT's train operations, and in terms of number of passengers, 3rd class passengers represent about 96% of the SRT's passenger business. Therefore transportation of 3rd class passengers represents a large majority of SRT business. Note the sharp decline in real 3rd Class passenger fares prior to 1974. This trend continued for the next 4-5 years after 1974, at which point the fares remained relatively constant until the present. Figure 2-2, developed using the same indices, shows a very similar trend associated with SRT freight tariffs.

Many SRT managers perceive their business mission as being to provide train services for the public good. That fares are low is mostly outside their sphere of control. Figures 2-3, 2-4 and 2-5 indicate that the SRT is achieving some degree of success in this mission. Between 1970 and 1990, the SRT managed to almost double its number of 3rd class passengers (Figure 2-3). Freight tonnage increased by approximately 60% during the same period (Figure 2-5). Furthermore, under constant pressure to improve passenger services, the SRT managed to achieve a significant increase in average passenger train speeds over the same period (Figure 2-4). This was a significant accomplishment - to effect large increases in volume throughput, at ever-increasing speeds, over a prolonged period of unprofitability.

It might be argued that the SRT achieved the level of success indicated above by ignoring operating expenses, in the knowledge that any operating loss would be subsidized. For a given volume of business, the major variable in a railway's operating expense is employee wages. Given that employee unit wage rates are also heavily regulated by the Government, this means that the major expenditure variable which can be controlled by the SRT management is the number of employees. Figure 2-6 shows that there has been a steady decrease in the number of SRT employees between the year 1975 and 1990. Again it is no mean feat to effect such savings during a period which saw major increases in the volume of business and levels of services. (Note that in 1971, the SRT retained a large compliment of temporary employees, whereas from 1975 onwards there were insignificant numbers of such employees. If the reduction of temporary employees was considered in Figure 2-6, the result would also be a net decrease in the total number of employees between 1971 and 1975).

Unfortunately, as is the case with most businesses in financial turmoil, the SRT has been forced to concentrate on immediate financial returns. This oftentimes precludes adequate investments in the asset base to ensure long-range returns. Figure 2-6 shows a very disturbing trend. The staff savings realized were almost entirely in the area of the Civil Engineering Department, responsible for the maintenance of track, bridges and buildings. (The picture would be similar if temporary employees were also taken into account.) Under the circumstances this is understandable. Any gains that might be realized in the Traffic Department were offset by the increased volume of business. Similarly, any gains that might have been achieved in the Mechanical Department (responsible for maintaining locomotives and rolling stock) were offset also by increased business. This same increase in business, however, increases the wear on track and bridges. The large reduction in Civil Engineering Department staff levels would indicate that track and bridge maintenance is being deferred. Such a policy may be wise over very short periods of financial difficulty. Continued deferred maintenance, however, is a blueprint for financial disaster. In the case of privately-owned railways in the U.S., such prolonged deferral of maintenance has oftentimes led to bankruptcies resulting from inoperable infrastructure. In most cases there was little or no warning of the impending financial doom.

Another common result of poor financial performance is inadequate levels of continued investment in the business. Since it commenced operating at a loss, the average age of the SRT's locomotive fleet has doubled (Figure 2-7). Also, there has been a significant increase in the average age of its fleet of freight wagons (Figure 2-8). It is interesting to note from Figure 2-8, however, that this trend does not exist for passenger coaches. Again, with the heavy political pressure to provide good services to the majority of the population, the SRT has continued to upgrade its passenger car fleet. The SRT management are no doubt aware that monies invested in passenger equipment could have produced significantly higher financial returns if invested elsewhere in the business, but their present policy is mainly the result of external political pressures.

3. CURRENT RAILWAY OPERATIONS

In this section we shall provide a general overview of current SRT train operations. All of the data are for the fiscal year 1990, except where specified, and are derived mostly from the SRT's annual "Information Booklet".

The SRT has a total of 3,861 route kilometers open to traffic (excluding the isolated Mae Klong line). The trackage radiates from Bangkok and connects with the Malayan and Kampuchean railways.

General policy formulation and supervision is carried out by the SRT Board of Commissioners, consisting of a Chairman and 4 to 6 members, all appointed by the Cabinet. The SRT General Manager is an ex-officio member of the Board. The Minister of Transport and Communications has general supervisory power over the SRT.

The SRT track is laid at meter gauge. The rail is predominantly 70 lbs./yd. weight, with approximately 1000 kms. of 80 lb./yd. rail. New rail on main line planned for the future will be 100 lb./yd. Approximately 80% of the track has wooden sleepers, the remainder concrete. Future planned renewal programs would employ mono-block concrete sleepers. There are 2,470 bridges, representing an aggregate of 53.7 kms. of line.

There are currently in service 7 steam (primarily for ceremonial usage), 206 diesel electric, and 73 diesel hydraulic locomotives. Also, 140 diesel railcars are in service, along with some 1,037 passenger cars and 8,148 freight cars.

During the reporting year, the SRT operated 34,741,000 train kilometers of revenue service (74% passenger, 24% freight, 2% mixed). Average train speeds were 51 kms./hr. for passenger trains, 30 kms./hr. for freight trains, and 34 kms./hr. for mixed trains (corresponding maximum permissible speeds are 90 kms./hr.; 70 kms./hr.; and 55 kms./hr. respectively). For freight service, the average number of wagons per train is 46, average freight car turnaround time was 5.9 days, and empty wagon-kilometers was 30% of total.

The number of passengers carried during the reporting year was 85.3 million, at an average distance of 136.1 kms. per passenger. Both the number of passengers and average distance traveled have been increasing over time. An overwhelming proportion of SRT's passengers are third class (Figure 2-3 and Table 3.1).

Table 3.1
SRT Passenger by Class ('000)

Fiscal Year	1st Class	2nd Class	3rd Class	Special DRC
1986	65	1,775	73,913	949
1987	64	1,943	74,850	1,074
1988	45	2,140	79,433	1,088
1989	32	2,467	80,469	1,028
1990	39	2,798	81,630	836

Source: SRT Information Booklet, 1991.

During the same year, the SRT transported 7.9 million tons of freight, at an average haul of 418.7 kms. Figure 3-1 displays a breakdown of freight commodities transported.

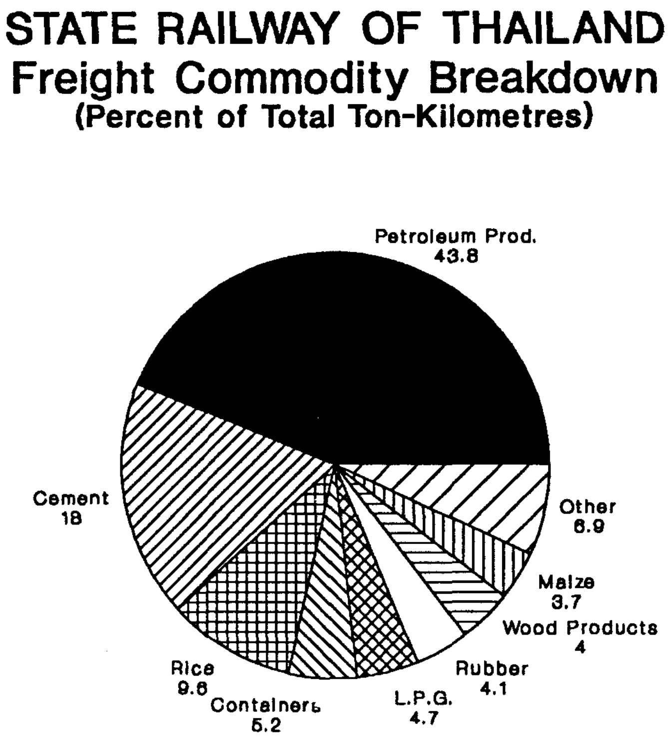

Figure 3-1

4. PRESENT FINANCIAL SITUATION OF THE SRT

The study team has analyzed the current financial position of the SRT, and in a general sense how it came to this position. Included in this analysis is the status of income, expenses, capital investment and debt. These topics are covered in a Working Paper entitled "Government Assistance in Rail Transport: The Case of PSOs and the

Financial Implication."[1] The findings on the SRT's current financial position are summarized below.

4.1 Overall Financial Situation of the SRT

Table 4.1 shows the income standing of the SRT as the result of its passenger and freight service operations for the decade of 1980's. Over this period its revenue for passenger service has increased steadily. Its revenue from the freight service has not been as impressive, however. Growth in the SRT's revenue has been averaging even less than that registered by real GDP, which averaged about 7.7% over the corresponding period. This situation suggests that the SRT has not been able to keep up with the economy.

The revenue position of the SRT might not be as bad as it appears to be if the operating cost of the SRT has been kept low. The fact is that SRT's operating cost has increased very rapidly in the 1970s due to significant increase in fuel cost. Though fuel cost has been more or less stable in the early half of 1980's, it started to increase in the last two years of the 1980's (see Table 4.2). Most importantly, the wage bill of the SRT, which represents over half of the SRT operating cost, has increased very rapidly. In so much as staffing levels have decreased during the same period, this increases in the wage bill is due to increased wage rates. It is one of the major sources of the SRT's operating problems as suggested by the operating figures in Table 4.1.

The operating cost of the SRT has increased at a greater rate than the SRT's revenue generation. No ordinary enterprise can sustain such a financial situation. The longer the SRT experiences such an unenviable financial position the heavier it suffers losses.

This financial implication is clearly shown in Table 4.1. What is so revealing about the loss situation of the SRT is that the size of its annual losses is uniquely correlated with the increase in its wage bill (see Table 4.2). If the SRT can only control the increase in its wage bill, its financial predicament will be less acute than at present.

Unfortunately, the wage rate is one item that is beyond the direct control of the SRT. The standard wage structure has not been set by the SRT in the light of its operational results, but by the negotiated results between the central government and the public enterprise labor union (presently assuming another name) in which the SRT's labor union plays an important role.

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1. Dhiratayakinant (1992).

When the agreement has somehow been finalized, the newly negotiated wage structure is automatically implemented. The recent increase (April 1, 1992), occurred even without the push of the so-called public enterprise labor unions, but with the pressure applied by the then Minister of Interior. The wage bill of the SRT is expected to increase by over 400 million baht for the 1992 fiscal year. This obviously will aggravate the SRT's financial situation further.

The significance of this aspect can be further illustrated in Table 4.3 where the SRT's expenditure is measured in terms of operating revenue. The expenditure exceeds the operating revenue every year since 1980. The average rate is over 10%. The situation implies that if the SRT cannot dramatically change this situation, either with considerable increases in operating revenues, or sizable reduction in its operating expenditures, the SRT is heading for total bankruptcy.

The gravity of the situation is also confirmed by the gross profit margin which obviously is negative for the whole period under review. SRT's losses expressed as a percentage of its assets are also shown in Table 4.3. Although the percentages are still low because the SRT's high valued assets, the situation should not be regarded as healthy insofar as the survivability of an enterprise is concerned. There is an encouraging sign here. Sales/net fixed assets ratios are on the average about a quarter of its net fixed assets, suggesting that operating revenue is not too low. The actual situation is made worse because of the high operating cost, particularly the wage bill.

Of course, the SRT also generates its income from sources other than rail services. These other sources have yet to be significant, though their potential will increasingly be realized in the future. When these other sources of income are taken into account, the nature of the SRT's financial situation does not change noticeably, although the severity of the financial stress is reduced some what. This situation is shown in Table 4.4.

When other costs are also taken into account, for example, fixed charges and other expenses, foreign exchange loss due to the depreciation of the baht against the foreign currencies in which the SRT's loan are paid, the SRT's financial situation aggravates; the absolute values of its losses increase considerably.

Table 4.5 shows the balance sheet of the SRT. As an entity, whose operating income is well over 4,400 million baht in 1990, its cash position is extremely low (see Table 4.6). Such a cash position may possibly reflect an extremely efficient system of cash management on the part of SRT, which keeps its cash as low as possible to minimize foregone interest earnings. Or it may merely reflect a situation of financial stress, manifested in the form of severe shortage of funds. The latter seems to be the case.

The situation is not planned (i.e. managed) as much as the operation forces the SRT to be in such a position. The supporting evidence for this conclusion is that in certain years the cash position was quite good. There were few other years when the cash position was very low. This is also confirmed by frequent short-term financing launched by SRT.

In terms of free cash flow, it has been negative every year since 1980 (Table 4.4). This financial situation also prevails when its net income is reviewed.

4.2 SRT's Debt Situation

The balance sheet in Table 4.5 also shows how heavily the SRT is in debt. Its annual debt outstanding has risen very rapidly. In a period of 20 years, SRT's debt has grown from a mere 617.9 million baht to over 7,899.6 million baht, a jump of over 1200%!

Even though not all debt must be repaid at once, it is still interesting to note that the SRT's debt outstanding in any given year is greater than its revenue for the corresponding year (Table 4.7). It demonstrates that the SRT's ability to generate debt far exceeds its ability to earn income.

Moreover, the total debt/total asset ratio over the years keeps rising steadily; the annual value for the last 5 years is well over 50%. As a self-financing entity, the SRT's ability to sustain more debt is reaching its limit unless it can turn its business around in a spectacular manner.

In short, the SRT's financial health has not been very strong. Without new strategies, both in the area of operation and in the area of government assistance, the SRT cannot survive financially as a commercial entity.

5. CONCLUSIONS

The SRT has served the transportation needs of the people of Thailand well since its inception. This continues to be the case today. However, the SRT has fallen upon bad times financially. There are many reasons for this, and unless some dramatic action is taken, the negative trends of its immediate past will continue. The longer the trends are allowed to continue, the more of a financial burden the SRT will become, and the more expensive the solutions will become.

The problems, however, are not unique to Thailand, nor are they unsolvable. The world experience tells us that solutions are available, but they sometimes are very difficult to implement. Realistically the SRT cannot continue operating indefinitely under the status quo. To an ever increasing extent, the choice will be between difficult solutions or closure of railway operations in Thailand. If no attempt is made to resolve its present difficulties, however, then the time may eventually come when there is no other logical solution but to severely reduce the scope of rail services in Thailand.

Almost without fail, however, other Governments when faced with these difficult decisions have opted to continue railway services, and have effected necessary solutions to turn around their ailing railways. It takes strong political will on the part of the Government, and hard work on the part of the railway. Success is not immediate, nor are all the original solutions necessarily the "correct" ones.

In the remainder of this report, we shall not dwell upon the mistakes of the past. Of importance is what role the SRT can best play in Thailand in the future to assist in fulfilling the aspirations of the Thai people, and how to restructure the SRT to successfully serve in this role. With a concerted effort on the part of all parties, the SRT can once again become a proud and successful organization.

TABLE 4.1: SRT Operating Income 1980-1990

(million baht)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Operating Revenues:											
passenger	1,286.6	1,545.5	1,826.1	1,964.4	2,054.6	1,983.6	2,064.5	2,123.8	2,309.5	2,532.5	2,791.7
freight	813.1	881.2	1,048.4	968.9	1,016.8	1,062.8	996.3	990.9	1,005.7	1,106.8	1,230.2
others	135.9	161.2	196.6	221.0	253.6	208.9	203.6	211.0	308.4	339.6	398.5
Total	2,235.6	2,587.9	3,071.1	3,154.3	3,325.0	3,255.3	3,264.4	3,325.7	3,623.6	3,978.9	4,420.4
Operating Expenses											
personnel	1,224.0	1,378.2	1,593.0	1,769.7	1,832.1	1,916.7	2,068.2	2,051.1	2,062.8	2,272.8	2,769.6
material and supply	511.9	699.6	828.8	784.0	783.9	748.9	688.7	717.9	692.3	818.3	886.6
fuel	605.2	703.0	711.5	705.7	703.1	658.2	642.8	638.6	657.3	691.0	723.7
depreciation	169.0	198.9	211.1	211.4	266.4	297.4	440.9	486.3	377.2	404.2	446.1
other	17.0	20.7	27.4	32.8	29.2	29.0	38.6	27.5	25.9	30.7	37.3
Total	2,527.0	3,000.3	3,371.8	3,503.6	3,614.6	3,650.2	3,879.3	3,921.4	3,815.5	4,217.1	4,863.4
Operating Income (Loss)	(291.4)	(412.4)	(300.7)	(349.3)	(289.6)	(394.9)	(614.9)	(595.7)	(191.9)	(238.2)	(443.0)
Net Operating Income (Loss)	(122.4)	(213.5)	(89.6)	(137.9)	(23.2)	(97.5)	(174)	(109.4)	185.3	166.0	2.1

Source : SRT

TABLE 4.2: Increase In Operating Cost and Operating Income Over the Preceding Year

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Operating Expenses												
personnel	156.3	122.0	-1.2	21.8	-0.1	241.5	217.4	154.2	214.8	176.7	62.4	84.6
material and supply	18.7	81.0	91.6	-83.7	17.9	103.4	84.4	187.7	129.2	-44.8	-0.1	-35.0
fuel	91.5	36.3	-25.8	24.4	12.9	51.5	316.7	97.8	8.5	-5.8	-2.6	-44.9
depreciation	0.4	12.3	23.7	6.3	6.7	2.0	0.3	29.9	12.2	0.3	55.0	31.0
other	0.5	0.6	-0.1	-2.5	-1.1	1.0	3.3	3.7	6.7	5.4	3.6	-0.2
Total												
Employees	32,954	31,878	31,041	29,918	29,855	29,378	29,398	30,094	30,541	29,586	27,821	27,161
Personnel expenditure per employee	18,892	23,359	23,949	25,578	25,627	34,264	41,635	45,796	52,160	59,815	65,852	70,568

	1986	1987	1988	1989	1990
Operating Expenses					
personnel	151.5	-17.1	11.7	210.0	496.8
material and supply	-60.2	29.2	-25.6	126.0	68.3
fuel	-15.4	-4.2	18.7	33.7	32.7
depreciation	143.5	45.4	-109.1	27.0	41.9
other	9.6	-11.1	-1.6	4.8	6.6
Total					
Employees	27,068	25,546	24,926	25,133	26,499
Personnel expenditure per employee	76,407	80,291	82,756	90,432	104,519

TABLE 4.3: SRT's Profitability

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Average 1980-1990
Operating Expenditure/Revenue	1.13	1.16	1.10	1.11	1.09	1.12	1.19	1.18	1.05	1.06	1.10	1.12
Operating Income/Revenue	-0.13	-0.16	-0.10	-0.11	-0.09	-0.12	-0.19	-0.18	-0.05	-0.06	-0.10	-0.12
Sales/Net Fixed Assets	0.31	0.32	0.36	0.33	0.33	0.28	0.26	0.26	0.27	0.29	0.31	0.3
Profit/Assets (%)	-2.7	-3.4	-2.0	-3.0	-2.6	-6.9	-5.7	-5.3	-2.7	-2.9	-3.7	-3.7
Net income/Capital	-0.04	-0.06	-0.03	-0.05	-0.05	-0.16	-0.14	-0.13	-0.07	-0.07	-0.10	-0.08

Soruce : Table 4.1

TABLE 4.4: SRT's Income Statement 1980-1990

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Operating revenues	2,235.6	2,587.9	3,071.1	3,154.3	3,325.0	3,255.3	3,264.4	3,325.7	3,623.6	3,978.9	4,420.4
Operating expenses	2,527.0	3,000.3	3,371.8	3,503.6	3,614.6	3,650.2	3,879.3	3,921.4	3,815.5	4,217.1	4,863.4
Operating income (loss)	(291.4)	(412.4)	(300.7)	(349.3)	(289.6)	(394.9)	(614.9)	(595.7)	(191.9)	(238.2)	(443.0)
Net rent	18.1	13.6	13.5	20.8	20.3	23.1	19.0	27.1	22.4	20.3	28.8
Net Operating income (loss)	(273.3)	(398.8)	(287.2)	(328.5)	(269.3)	(371.8)	(595.9)	(568.6)	(169.5)	(217.9)	(414.2)
Other income	72.7	1.9	0.7	0.7	2.5	14.4	37.1	2.9	2.3	26.5	56.4
Total income (loss)	(200.6)	(396.8)	(286.5)	(327.8)	(266.8)	(357.4)	(558.8)	(565.7)	(167.2)	(191.4)	(357.8)
Fixed charges and other expenses	79.9	83.9	95.5	111.8	201.3	317.5	435.2	374.7	378.6	359.2	359.5
Net income (loss) before profit from sales of property and exchange adjustment	(280.5)	(480.7)	(382.0)	(439.6)	(468.1)	(674.9)	(994.0)	(940.4)	(545.8)	(550.6)	(717.3)
Net profit (loss) from sale of property, etc.	4.5	(0.3)	12.6	11.9	2.6	38.5	10.6	11.9	52.3	10.3	37.0
Foreign exchange adjustments	17.2	136.0	147.6	45.3	134.2	(437.8)	(51.5)	(57.2)	(56.5)	(51.7)	(115.0)
Net income (net loss)	(258.7)	(345.0)	(221.8)	(382.4)	(331.3)	(1074.2)	(1034.9)	(985.7)	(550.0)	(592.0)	(795.3)
Free cosh flow (net income + depreciation)	(89.8)	(146.1)	(10.7)	(171.0)	(64.9)	(776.8)	(594.0)	(459.4)	(172.8)	(187.8)	(349.2)

TABLE 4.5: SRT's Balanced Sheet, 1980-1990 (Year ending September 30)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Balance Sheet (Baht million)											
(Year ending September 30)											
ASSETS											
Current Assets:											
Cash	90.6	17.4	18.6	433.1	25.3	24.8	427.0	26.7	220.5	296.3	116.6
Special deposits	76.5	38.6	21.9	20.4	5.0	4.7	1.6	4.3	0.3	0.2	1.2
Material and supplies	691.1	877.5	1,008.1	929.0	923.7	888.5	1,160.1	1,273.4	1,296.1	1,388.9	1,420.6
Other current assets	201.1	209.1	230.8	211.6	218.1	210.3	184.1	220.2	383.1	554.5	864.6
Total	1,059.3	1,142.7	1,279.4	1,594.1	1,172.1	1,128.3	1,772.8	1,524.6	1,900.0	2,239.9	2,403.0
Special Funds	979.3	1,012.5	1,135.0	1,192.5	1,218.1	1,331.9	1,481.2	1,431.2	1,515.1	1,607.1	1,754.0
Government Bonds								--	1.0	1.0	1.5
Road & Equipment Property	9,757.7	10,707.1	11,540.7	12,761.1	13,416.9	15,443.5	16,864.0	17,383.9	18,445.8	19,099.6	20,517.3
Less: Donations and grants	(265.1)	(302.7)	(323.6)	(385.2)	(408.3)	(482.0)	(542.4)	(539.8)	(534.5)	(667.1)	(1165.5)
Accrued depreciation	(2252.6)	(2431.7)	(2610.5)	(2799.4)	(3061.2)	(3319.3)	(3706.5)	(4140.5)	(4500.2)	(4886.0)	(5313.7)
	7,240.0	7,972.7	8,606.6	9,576.5	9,947.4	11,642.2	12,615.1	12,703.6	13,411.1	13,546.5	14,038.1
Other Assets & Deferred Charges	388.6	133.9	136.1	291.9	528.1	1,407.2	2,432.9	2,939.7	3,239.0	3,367.9	3,252.4
Total Assets	9,667.2	10,261.7	11,157.0	12,655.0	12,865.7	15,509.6	18,302.0	18,599.1	20,066.2	20,762.4	21,449.0
LIABILITIES AND CAPITAL											
Current Liabilities:											
Loans payable	151.1	92.9	80.9	96.5	73.2	127.9	159.8	456.3	453.3	213.6	260.5
Audited accouts & wages payable	210.7	465.7	746.7	595.3	955.9	1,141.3	685.4	280.4	296.1	311.5	426.3
Accrued accounts payable											
Other current liabilities	33.5	191.7	297.8	383.8	468.8	120.6	375.8	140.0	320.4	123.4	136.7
	395.3	750.3	1,125.3	1,075.6	1,497.9	1,389.8	1,221.0	876.7	1,069.8	648.5	823.5
Funded Debt Unmatured	1,394.3	1,458.5	1,237.3	1,253.4	1,893.3	3,993.9	6,191.8	6,444.4	7,114.5	7,208.4	7,899.6
Pension & Welfare Reserves and other	1,287.9	1,359.4	1,554.7	1,543.0	1,610.0	1,796.9	1,485.2	1,435.2	1,519.1	1,611.1	1,758.0
Other Liabilities & Deferred Credits	454.0	437.6	552.1	1,605.1	860.5	1,552.7	2,715.5	3,217.6	3,467.2	3,819.4	3,864.6
Capital:											
Capital	6,051.9	6,377.2	6,933.4	7,547.4	7,704.8	8,206.3	8,396.2	8,484.8	8,509.3	8,555.9	8,579.7
Retained Income	83.9	(121.2)	(245.8)	(369.5)	(700.8)	1,430.0	(1116.7)	(1074.0)	(750.1)	(253.1)	(376.8)
	6,135.8	6,256.0	6,687.6	7,177.9	7,004.0	6,776.3	7,279.5	7,410.8	7,759.2	8,302.8	8,202.9
Unamortized Foreign Exchange Adjust						--	(591.0)	(785.6)	(863.6)	(827.8)	(1099.6)
Total Liabilities and Capital	9,667.2	10,261.7	11,157.0	12,655.0	12,865.7	15,509.6	18,302.0	18,599.1	20,066.2	20,762.4	21,449.0
Total debt & Total liabilities	3,531.4	4,005.7	4,469.4	5,477.1	5,861.7	8,733.3	11,022.5	11,188.3	12,307.0	12,459.6	13,246.1

TABLE 4.6: SRT's Financial Management 1980-1990

	1980	1981	1982	1983	1984	1985	1986	1987	1989	1989	1990
Operating Revenue	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cash as % of OR	4.1	0.7	0.6	13.7	0.8	0.8	13.1	0.8	6.1	7.4	4.2
Material and Supply as % of OR	30.9	33.9	32.8	29.5	27.8	27.3	35.5	38.3	35.8	34.9	32.1
Loan payable as % of OR	6.8	3.6	2.6	3.1	2.2	3.9	4.9	13.7	12.5	5.4	5.9
Funded debt unmatures as % of OR	62.4	56.4	40.3	39.7	56.9	122.7	189.7	193.8	196.3	181.2	178.7
Audited accounts and wage payable as % of OR	9.4	18.0	24.4	18.9	28.7	35.1	21.0	8.4	8.2	7.8	9.6

TABLE 4.7: SRT's Leverage Situation 1980-1990

	1980	1981	1982	1983	1984	1985	1986	1987	1989	1989	1990
Total debt/Total assets	0.37	0.39	0.40	0.43	0.46	0.56	0.63	0.64	0.66	0.64	0.67
Total debt/Net worth	0.58	0.64	0.67	0.76	0.84	1.29	1.60	1.62	1.70	1.60	1.75
Total debt/Total operating revenue	1.58	1.55	1.46	1.74	1.76	2.68	3.38	3.36	3.40	3.13	3.00

CHAPTER 3

FUTURE TRANSPORT DEMAND

This chapter analyzes the future transportation demand in Thailand from the present up to 2011, the last year of the 10th Five-Year Plan. This will provide the input into the analysis of the SRT's future role in the transport sector in the next chapter. This chapter analyzes the future transportation demand at two levels:-

- Macro level; analyses of the inter-provincial person and freight movement,
- Micro level; analyses of the future development in the transportation of the four major revenue generating freight commodities of the SRT; namely, petroleum products, rice, cement and containers.

The chapter has 6 sections. Section 1 gives a brief overview of the transport sector in Thailand. Section 2 presents an overview the traffic and freight movements in the country, and also puts together base year (1990) inter-provincial transport matrices (73*73) of person and freight movement in the country, which are then aggregated into inter-regional movements (16*16). The macro transport demand projection are carried out on these inter-regional matrices to the year 2011, by relating inter-provincial transportation demand to provincial GDP's and populations. Section 3 presents the socio-economic outlook for the country over the next two decades. Provincial GDP and population projects, which are used in the macro demand projections, are presented. Section 4 presents the macro transport demand projections for person and freight movements. Section 5 analyzes the micro demand for the four major freight items indicated above. For each commodity, detailed analyses are presented on the current production-consumption and distribution system, and likely future transportation demand up to the year 2011. Finally section 6 concludes.

1. OVERVIEW OF THE TRANSPORT SECTOR

1.1 Introduction

As an essentially sector in the economy, the transport sector has grown in line with the overall economy. Over the last two decades from 1970 to 1990, the transport sector has grown by an average of 6.84% per annum in real terms (see Table 1.1), while Thailand's real GDP has increased at an average rate of 7.25% per annum. The share of the transport sector in real GDP has remained in the range of 5.5-6.0% over this period with no clear increasing or decreasing trend. Within the transport sector, however, the growth of the public transportation sector has been much more rapid than that of the private transportation sector. The public transportation sector has grown by an average rate of 11.84% per annum between 1970 and 1990, while the average growth rate of the private transportation sector has been only 5.15% per annum. This has meant that the share of public transportation in GDP has been increasing, from 0.92% of GDP in 1970 to 2.13% of GDP in 1990. On the other hand, the share of private transportation in GDP has been continually falling; declining from 5.07% of GDP in 1970 to 3.41% of GDP in 1990. This trend seems to indicate that, as the economy develops, the role of the public transportation sector becomes more and more important. This obviously has important implications for public transportation agencies such as the SRT, as demand for the types of transportation services currently provided through public agencies will likely increase rapidly as the economy develops.[1]

Currently, the major domestic modes of transport in Thailand in order of their importance consist of road, railway, coast, inland waterway, air and pipeline transport. The following sub-sections briefly describe the major elements of these subsectors in terms of network coverage with the exception of coastal transport which is not relevant in terms of the present study.

1.2 Road Transport Network

Road transport is administered by a number of agencies and no combined statistics are collected. The national and provincial roads are both administered by the Department of Highways (DOH) under the Ministry of Communications. Rural roads

1. However, the share of the public transportation sector may not go on increasing as in the past if some of the services currently provided through public agencies are privatized in the future. Nevertheless, the demand for the types of services currently provided through public agencies are likely to increase rapidly.

Table 1.1
Gross Domestic Product At 1972 Prices

GROWTH	1970-75	1975-80	1980-85	1985-90	1970-90
Transportation (Total)	3.74%	9.03%	5.89%	8.78%	6.84%
- Public	8.21%	15.26%	13.84%	10.20%	11.84%
- Private	2.84%	7.34%	2.60%	7.95%	5.15%
Gross domestic product, (GDP)	5.60%	7.94%	5.65%	9.89%	7.25%
Per capita GDP (1972 Baht)	2.90%	5.35%	3.53%	8.01%	4.93%
Population	2.62%	2.45%	2.04%	1.74%	2.21%

SHARE	1970	1975	1980	1985	1990
Transportation (Total)	5.99%	5.48%	5.76%	5.83%	5.54%
- Public	0.92%	1.04%	1.44%	2.10%	2.13%
- Private	5.07%	4.44%	4.32%	3.73%	3.41%

Table 1.2
Length of all Roads (1985-1989)

Administered by	Road Type	Length of Roads ('000 km)				
		1985	1986	1987	1988	1989
DOH	National Highways	15.70	16.52	16.57	16.70	16.80
	Provincial Highways	29.46	30.03	32.03	33.17	34.30
ARD	Rural	18.55	19.07	19.51	19.51	20.30
PWD	Rural	3.64	3.93	4.43	6.17	2.50
RID	Rural	4.87	5.17	5.17	5.17	15.00
BMA	Municipal	1.16	2.79	2.79	2.79	2.79
Local	Municipal	7.39	7.39	11.92	11.92	11.92
Others	Rural	81.65	81.65	81.65	81.07	82.40
ETA	Bangkok Expressway	0.02	0.02	0.03	0.03	0.03
Total		162.44	166.57	174.10	176.53	186.04

Notes: DOH - Department of Highways
ARD - The Office of Accelerated Rural Development
PWD - Public Works Department
RID - The Royal Irrigation Department
BMA - Bangkok Metropolitan Administration
ETA - Expressway and Rapid Transit Authority of Thailand

are mainly administered by agencies within the Ministry of the Interior. The lengths of all roads for the years 1985 to 1989 are shown in Table 1.2.

The national road system connects the principal towns and regional centers throughout the country whilst the provincial road system connects the provincial centers and other major towns with the national roads and also interconnects the rural roads. The rural roads are defined as all those roads outside of cities and municipalities.

1.3 The State Railway of Thailand (SRT)

The State Railway of Thailand was made an autonomous organization on July 1, 1951 by the State Railway of Thailand Act. The rail network in 1990 consisted of approximately 3,861 route-kms. of meter gauge track. The main lines, of which there are three, radiate from Bangkok: the Northern line to Chiang Mai; the Northeastern line to Nong Khai and to Ubon Ratchathani; and the Southern line to the Malaysian border at Padang Basar and at Sungai Kolok. In addition, there are several branch lines, including the Eastern line to Aranyaprathet on the border of Kampuchea. One branch line, the Mae Klong line serves an area to the west of Bangkok, and is separated from the main network. In the Central Region a new railway line from Chachoengsao to Sattahip has recently been constructed. It is planned to extend the Sattahip line to Rayong. Within the Eastern Seaboard Development Program it is also planned to build a link between Sriracha and Laem Chabang and to construct a line from Klong Sip Kao to Kaeng Khoi on the Northern line to provide a shorter connection between the Eastern Seaboard and the Northeast.

SRT's fleet of locomotives and wagons consists (as of 1990) of 279 diesel locomotives (206 electric and 73 hydraulic), 7 steam locomotives, 181 diesel railcars, 1155 passenger cars and 8751 freight cars.

1.4 Inland Waterways

Thailand has a well developed inland waterways system which covers approximately one-third of the country's area and comprises of about 1,600 kms. of navigable waterways. The main rivers utilized for transport are Chao Phraya, Thachin and Mae Klong rivers along with their tributaries. The network of navigable waterways consist mainly of the following:

a) The Chao Phraya river from the Gulf of Thailand to Nakhon Sawan (365 km) and its tributaries, the Nan river from Nakhon Sawan to Uttaradit (370 km) and the Ping river to Kamphaeng Phet (136 km);

b) The Suphan Tha Chin river from the Gulf of Thailand up to Wat Sing (318 km) and the Noi river (167 km). Chao Phraya, Nan and Suphan Tha Chin rivers are connected by a system of canals;

c) The Pasak river from Ayutthaya to the Rama VI Dam (45 km). Navigation further upstream is only possible with smaller vessels due to the small width of the locks at the dam;

d) The Mae Klong river system connects the lower parts of the Chao Phraya river, the Suphan Tha Chin and the Mae Klong river to the west. On the Mae Klong river, the navigable section is from the Gulf of Thailand up to Kanchanaburi (136 km);

e) The Bang Pakong river from the Gulf of Thailand to Chachoengsao (135 km). This river is of minor importance for inland water traffic except for lighterage operation at the estuary. The Bang Pakong river is connected to the Chao Phraya river by a system of canals.

1.5 Air

The Department of Aviation (DOA) was established by the provision of the Thai Air Navigation Act, 1954. The Department is in charge of controlling and administering both domestic and international civil aviation activities. There are two carriers engaging in domestic traffic, namely Thai Airways Company Ltd. and Bangkok Airways Company. The predominant carrier however is Thai Airways Company.

Thai Airways Company (TAC) operates on five main routes, with Bangkok as the starting point, and several feeder routes. The major routes are to Chiang Mai, Phuket, Surat Thani, Had Yai and Phitsanulok. Other prominent routes are to Sakon Nakhon, Khon Kaen and Udon Thani. Passengers are the major revenue source and domestic air cargo does not play a considerable role.

Bangkok Airways Company has been operating domestic charter flight since 1968. In October 1985, the cabinet approved to allow private companies to participate in the fixed-schedule air-route services. The company received the licenses from the Ministry of Communications to operate domestic flights on the following routes: Bangkok-Nakhon

Ratchasima, Bangkok-Surin, Bangkok-Ko Samui, and Bangkok - Krabi.

2. TRAFFIC

2.1 Introduction

The purpose of this section is to distinguish the major classes of traffic within each transport mode, namely passenger traffic and freight traffic. In the section that follows, each mode is examined individually in terms of passenger movement and freight movement.

2.2 Passenger Movement

This section gives a brief overview of passenger movements in the country by road, rail and air transport.

2.2.1 Road Transport

Passenger road transport in Thailand can be divided into public and private transport. Private transport consists of car and pick-up vehicles. Public transport consists of various bus types (small, medium and large) and other public transport modes e.g. taxi, silor, samlor etc. The 1979 Land Transport Act distinguishes between fixed and non-fixed bus routes. Fixed bus routes are divided into four categories:

Category 1 - Urban bus routes (Bangkok excluded)
Category 2 - Intercity bus routes between Bangkok and the provincial centers
Category 3 - Inter-provincial bus routes
Category 4 - Inter-provincial routes, mainly rural routes

There is a fifth category for minibuses.

Bus routes between Bangkok and the provincial centers are granted to the State owned Transport Company Ltd. Licenses to operate other fixed routes are granted subject to public bidding.

The data base in road passenger transport is weak, since several means of transportation are used (heavy bus, medium bus, small bus/minibus/pick-up, truck, car), and surveys have only occasionally been carried out. The data in Table 2.1 on vehicle kilometers should be viewed with this in mind.

Table 2.1
Passenger Transport on National and Provincial Highways
(Million Vehicle Kilometers)

Vehicle Type	1985	1986	1987	1988	1989
Car & Taxi	8,013	8,936	10,610	11,449	14,179
Light Buses	3,125	3,208	3,472	3,403	3,717
Heavy Buses	1,956	1,978	2,184	2,214	2,626
Total	13,094	14,122	16,266	17,066	20,522

Table 2.2
Passenger Transport on National and Provincial Highways
(Million Passenger Kilometers)

Vehicle Type	1985	1986	1987	1988	1989
Car & Taxi	28,847	32,170	38,196	41,216	51,044
Light Buses	17,500	17,965	19,443	19,057	20,815
Heavy Buses	46,944	47,472	52,416	53,136	63,024
Total	93,291	97,607	110,055	113,409	134,883

Average Growth Rates (Percent per Annum)

Vehicle Type	1985-89
Car & Taxi	15.3
Light Buses	4.4
Heavy Buses	7.6
Total	9.6

In order to determine passenger-km in inter-urban operation, the counted vehicle-km by type can be multiplied by the average occupancy rate by vehicle type. Average occupancy rates have been compiled from previous feasibility studies. These suggest that the average occupancy rate for car/taxi is 3.6; for light bus, 5.6; and for heavy bus, 24.0. Assuming these figures for the period 1985-89, the passenger-kms. are given in Table 2.2.

2.2.2 Rail Transport

Between 1985 and 1990 passenger traffic has increased at an average rate of 1.8 per cent in numbers of passengers and at 4.9 per cent in passenger kilometers. The larger increase in passenger-kms. reflects the fact that the average length of trips increased from about 117 km in 1985 to 136 km in 1990. The numbers of passengers for the years 1985 to 1990 are shown in Table 2.3.

Table 2.3
Number of Passengers (' 000)

Year	Number	1st	2nd	3rd	Special DRC
1985	78,013	69	1,713	76,187	44
1986	76,702	65	1,775	73,913	949
1987	77,931	64	1,943	74,850	1,074
1988	82,706	45	2,140	79,433	1,088
1989	83,996	32	2,467	80,469	1,028
1990	85,303	39	2,798	81,630	836

Passengers are separated into four separate classes, 1st, 2nd, 3rd class and Special Diesel Rail Car. It can be seen that the 3rd class comprises on average around 96 per cent of total passenger movements. This is extremely high, and is a major constraint for the SRT's revenue generation.

For comparison with road transport, Table 2.4 gives the passenger-kms. in rail transport. It can be seen that the total passenger-kms. carried by the SRT comes to about 8-10% of that carried by road. If one excludes those traveling by cars or taxis in the comparison, then the ratio of the SRT ranges between 13-14%. The Table also shows that the share of the SRT has been declining fairly rapidly. In both comparisons, the ratio of the SRT's passenger-kms. to road transport has declined by *more than one percentage* point in the five years between 1985 and 1989.

Table 2.4
Rail Passenger Kilometers and Comparisons to Road Transport

	1985	1986	1987	1988	1989	1990	1991
Passenger-kms. (million)	9,140	9,247	9,583	10,301	10,935	11,612	12,046
Growth Rate (percent)		1.17	3.63	7.49	6.15	6.19	3.74
Ratio to Road (percent)	9.80	9.47	8.71	9.08	8.11		
Ratio to Road excluding cars and taxis	14.18	14.13	13.33	14.27	13.04		

2.2.3 Air Transport

Domestic air passenger traffic movements between the regions for 1989 are shown in Table 2.5. The major movements from Bangkok are to Chiang Mai, Phuket and Had Yai. In 1989, the total passenger-kms. by air transport was about 1,463.4 million passenger-kms. This is about 1% of the passenger-kms. by road, and about 13.4% of that for rail.

Table 2.5
Domestic Air Passengers ('000) 1989

Destination Region

	BKK&Vic	Northern	Northeast	Central	East	West	Southern	Total
Origin Region								
BKK & Vic	-	519.7	96.3	-	-	-	522.4	1,138.4
Northern	580.6	132.5	3.2	-	-	-	0.5	716.8
Northeastern	97.2	3.7	7.0	-	-	-		-107.9
Central	-	-	-	-	-	-		-
Eastern	-	-	-	-	-	-		-
Western	-	-	-	-	-	-		-
Southern	554.8	-	-	-	-	-	94.7	649.5
Total	1,232.6	655.9	106.5	-	-	-	617.6	2,612.6

2.3 Freight Movement

This section briefly outlines freight transportation by road, rail, inland waterways and air transport.

2.3.1 Road Transport

As with passenger movements, the data on road freight traffic is weak. This is unfortunate, since movement of freight by road is by far the most important compared to other modes. The available data are likely to be incomplete as there are many different agencies, companies and individuals involved in road freight movements. Piecing together data from a past study of the trucking industry[2] and from the Ministry of Transport and Communications gives the picture in Table 2.6. The average growth of 3.5% between 1984 and 1989 appears to be very low, when account is taken of the rapid growth in the economy since the mid 1980s. This is probably due to the incompleteness of the data.

Table 2.6
Road Freight Transport by Commodity (Million Tons)

Commodity	1978	1981	1984	1989
Earth, Sand & Gravel	30.5	38.4	50.6	63.9
Sugar & Sugar Cane	22.4	32.8	24.9	31.0
Paddy & Rice	17.9	18.2	20.3	24.6
Cassava & Tapioca	27.8	30.0	34.0	23.4
Petroleum Products	4.0	4.6	4.8	8.9
Cement	5.0	6.3	8.3	6.9
Maize	2.5	3.2	3.8	4.1
Fertilizer	1.6	1.8	2.4	3.3
Others	19.4	20.3	25.5	22.8
Total	131.1	155.6	174.6	207.0

		1978-81	1981-84	1984-89
Average Growth per Annum		5.9%	3.9%	3.5%

2. KAMPSAK-NECCO-DECONS (1988).

2.3.2 Rail Transport

Between 1985 and 1990 freight traffic has grown at an average annual rate of 7.4 per cent in terms of tonnage and at an annual rate of 2.8 per cent in terms of ton-kms. The lower growth in ton-kms. reflects the fact that the average length of haul has decreased from 484 km in 1985 to 418 km in 1990. The major commodity flows for the years 1985 to 1990 are shown in Table 2.7. Table 2.8 gives the revenues generated from the freight traffic by commodity. Since 1988, freight revenue has grown quiet quickly. However, the revenue declined from 1985 to 1987, so that for the period 1985-90, the average increase in freight revenue was only 2.8% per annum. It can be seen from Table 2.8 that the four major commodity groups of petroleum products, cement, rice and containers, account for about 73.9% of total freight revenue in 1990. Of these four, revenues from petroleum products and rice appear to be on a declining trend, while revenues from cement and containers have increased quite satisfactorily. Revenues from containers, in particular, have increased by an average 40.6% per annum between 1985 and 1990. Thus, the potential for expanded container shipment service by rail in the future appears to be very bright.

Table 2.7
Freight Traffic by Commodity (Million Tons)

Commodity	1985	1986	1987	1988	1989	1990
Petroleum Products	2.6	2.5	2.5	2.6	2.8	3.3
Cement	1.2	1.2	1.5	1.9	2.1	2.5
Rice	.4	.4	.3	.3	.3	.3
Containers	.1	.1	.1	.2	.3	.5
Gypsum	.2	.2	.2	.2	.3	.3
Rubber	.2	.1	.2	.3	.2	.2
Forest Products	.1	.1	.1	.1	.1	.1
Maize	.2	.2	.1	.1	.1	.1
Others	.5	.4	.7	.7	.8	.6
Total	5.5	5.2	5.7	6.4	7.0	7.9
Growth		-5.4%	8.5%	12.6%	10.6%	11.8%

Table 2.8
Freight Revenue by Commodity (Million Bahts)

Commodity	1985	1986	1987	1988	1989	1990
Petroleum Products	471.7	474.9	423.8	425.1	452.6	512.5
Cement	88.9	81.3	132.5	149.2	185.4	203.6
Rice	141.3	130.8	98.2	78.5	86.0	85.9
Containers	10.5	17.6	29.3	31.2	37.3	57.7
Gypsum	26.1	21.6	18.2	22.0	25.6	31.9
Rubber	37.5	28.2	23.0	50.7	38.9	34.4
Forest Products	16.4	18.0	24.5	22.6	29.0	32.9
Maize	73.0	72.4	65.0	16.4	28.7	34.1
Others	149.8	109.1	136.8	174.0	172.2	170.7
Total	1,015.2	953.9	951.3	969.7	1,055.7	1,163.7
Growth		-6.0%	-0.3%	1.9%	8.9%	10.2%

2.3.3 Inland Waterways Transport

While inland water transport has declined in importance compared to its role in the past, it still performs some role for freight transport, especially for agricultural products and construction materials. Cargo flows in river transport are very difficult to ascertain given the fact that various sources do not show a complete picture on cargo flows and that the volumes from the different sources vary considerably. The Royal Irrigation Department (RID) record numbers and kinds of vessels and commodity flows which pass through 54 navigation locks. The resulting pattern, however, is not complete and does not cover the whole of the Inland Waterway System as most carryings have their origin south of the three locks on the so-called Chai Nat line. South of this Chai Nat line, cargo originating on the Chao Phraya river and remaining on this river cannot be recorded as their are no RID locks en route. The same is true for the Pasak river where most traffic originates and for the Tha Chin river south of the Pho Phaya Reg lock.

Table 2.9 gives freight traffic by commodity for the years 1985 to 1990 from data collected from the Harbours Department of the Ministry of Communications. This table may also include some coastal shipments tonnage, since the total volume seems to be rather high. In particular, tapioca and construction materials feature very prominently, as these two product groups alone account for 78.2% of the volume in 1990. The data collected by RID, mentioned above, give a total of 2.15 million tons shipped via inland waterways in 1989 (excluding freight transported in Pasak and Bang Pakong rivers), which is much lower than the data in Table 2.9 from the Harbours Department. If the data in Table 2.9 are correct, then it means that inland waterways shipment of freight is greater in tonnage than that by rail.

Table 2.9
Freight Traffic by Commodity 1985-1990 (Tons)

Commodity	1985	1986	1987	1988	1989	1990
Rice & Paddy	719,758	580,367	522,139	524,434	513,090	201,655
Maize	1,004,406	1,369,232	1,469,874	1,442,943	852,290	347,000
Tapioca	1,672,664	2,064,446	2,468,166	2,659,395	3,797,264	3,481,867
Agricultural Goods	160,600	143,891	140,114	146,158	137,650	131,000
Consumption Goods	723,913	834,420	978,238	1,219,902	4,479	78,417
Drinks	74,049	89,163	167,836	180,148	14,400	77,760
Logs & Wood	101,539	26,387	26,574	41,634	144,042	288,296
Minerals	266,959	231,139	288,483	574,707	284,189	251,450
Construction	4,100,893	4,891,622	6,736,653	6,934,328	4,213,310	4,473,129
Fuel	234,695	210,553	150,978	71,872	125,280	414,353
Other	18,366	34,120	77,140	50,558	143,915	427,479
Total	9,077,842	10,475,340	13,026,195	13,846,079	10,229,909	10,172,406
Growth		15.4%	24.3%	6.3%	-26.1%	-0.6%

2.3.4 Air Transport

Domestic cargo movement does not play a significant role. In 1989 only 10,000 tons of freight was moved by air, this represented 6.5 million ton-kms. These figures represent only 0.005 per cent of total domestic tons moved and 0.01 per cent of total domestic ton-kms. moved by all modes.

2.4 Origin-Destination Matrix for Passenger and Freight

The projection of future transportation demand at the macro level will be done through origin-destination (O-D) matrices. Inter-provincial travel matrices (73*73) are generated for persons and freight for a base year (1990). The growth in travel demand are then linked to changes in provincial GDP and population (see below).

2.4.1 O-D Matrices Estimation

The first step is to estimate O-D transportation matrix for road transport. This is necessary since the available information on persons and freight movements by road is very incomplete (see above). The matrix estimation models using ME2 (matrix estimation by maximum entropy) was used to estimate inter-provincial travel matrices for person and freight movement. The basic data required were road network, traffic volume along major roads, and finally a starting matrix.

Firstly, road network (main roads and some important minor roads) were taken from highway control section data available at the Department of Highway (DOH). The data were modified to be used with the "Advance Transport Models" of the Transport Research Unit of Chulalongkorn University (TRUCU). Included were data related to speed-flow which were developed from available data from the traffic Engineering Section of DOH. The network was skimmed for some major origins and destinations to check travel times between known travel time zones.

Secondly, traffic volume were taken straight from ADT annual reports from the DOH. The study area was divided into zone groups, and volume across boundaries were taken as the main data, and were used to estimate demand for the whole country. Volume data within the zone groups on other highways were also used as a minor data set, and used to estimate travel demand within the zone groups. This process can take account of repetitions of the same car in more than one province.

Finally, the starting matrix was taken from an available matrix from DOH and also readjusted with other available matrices in 1988 from MOTC and TRUCU. This starting matrix was tested before using, by checking with 1988 traffic volume data on major highways.

When, all the required data were finished, the study team estimated base year 1990 matrices for three types of vehicles: light (passenger car, pick up and van), bus (light and heavy buses), and truck (light, medium and heavy trucks). After that, the occupancy factors derived from recent O-D surveys from "The Toll Highway Development Study in the Kingdom of Thailand" were applied to finally arrive at person trips and freight trips between provinces. The provincial matrices (73*73) were compressed to regional matrix

(16*16) in order to be easily understood and suitable for use in conjunction with matrices for other transport modes.

The persons and freight matrices of the SRT, air transport, and inland water transport were derived from available data. These matrices are then combined with the generated inter-regional matrices for road transport to arrive at the total travel demand matrices for passenger and freight in 1990.

The country is divided into 16 regions as shown in Table 2.10. These have been chosen so that some inter-regional routes that are likely to be important in the future can be separated out, for example, between the BMR and the Eastern Seaboard area.

Tables 2.11 and 2.12 gives the inter-regional travel matrices for person and freight movement respectively for 1990. It should be noted that travel movement within a single region refers to movements across provincial boundaries with that region, and excludes movement within various provinces making up the region.[3] Table 2.11 gives the passenger movement measured in persons per day, while Table 2.12 gives the freight movement in tons per day. As a convention, 220 days per year are assumed for person movement, and 225 days per year are assumed for freight movement. The results of the matrix estimations indicate that total inter-provincial person movements for the country comes to about 2.32 million persons per day. Of these, about 35% have their origin or destination in the BMR. The main reason was the transportation network configuration which mostly radiated from the BMR, and therefore most of these trips had to pass through the BMR. Another reason is that the BMR is the economic and social center of the whole country. 17.2% of total inter-provincial movements are among the provinces making up the BMR. Most of the movements to/from the BMR have their origin-destinations in the Upper Central provinces (C1 and C3) and the Eastern Seaboard corridor provinces (C2C). Movements within a region (outside of the BMR) are also fairly large in the southern-most provinces (S3), and the Eastern Seaboard provinces (C2C).

In the course of this study, freight trips data by road was the most confusing. Reports from MOTC and LTD showed a lot of conflict. DOH data (which was used partially by MOTC) showed that freight movements on highways were very high, while LTD data was much lower, both in terms of volume and weight. In this study, the DOH

3. This is because the inter-regional matrices were derived from agrregations of inter-provincial travel matrices which excludes travel within a single province (i.e. with zero diagonal elements).

data were employed because of two main reasons; most of the basic data such as network and traffic volume were taken from DOH, and also a Japanese study which also carried out an extensive survey for the whole country showed consistent results with DOH data.

Using these data and the methodology described above, it was found that, for freight, total inter-provincial freight movement comes to about 1.4 million tons per day. Similar to the situation for person movement, about 30% of all freight movements have their O-D in the BMR. However, only about 7% of the freight movement is account for by inter-provincial movement within the provinces of the BMR. Freight movements into/out of the BMR has similar patterns to person movements, with O-D in the Upper Central and Eastern Seaboard provinces.

Table 2.10
Definition of Regions and Divisions

Region	Division	Changwat
Northern	N1	Mae Hong Son-Chiang Mai-Lamphun-Lampang
	N2	Chiang Rai-Phayao-Nan-Uttaradit-Phrae
	N3	Tak-Sukhothai-Phitsanulok-
		Phetchabun-Phichit-Kamphaeng Phet
Northeastern		
	NE1	Loei-Udon Thani-Mahasarakham- Khon Kaen
	NE2	Nong Khai-Nakhon Phanom-Mukdahan-
		Sakhon Nakhon-Kalasin
	NE3	Roi Et-Yasothon-Ubon Ratchathani- Si Sa Ket
	NE4	Nakhon Ratchasima- Buriram-Surin-Chaiyaphum
Central	C1	Uthai Thani-Nakhon Sawan-Lop Buri-
		Saraburi-Sing Buri-Chai Nat
	C2A	Nakhon Nayok-Prachin Buri
	C2B	Chanthaburi-Trad
	C2C	Rayong-Chon Buri-Chachoengsao
	C3	Kanchanaburi-Suphan Buri-
		Ang Thong-Ayutthaya-Ratchaburi
		Samut Songkhram-Phetchaburi-Prachuap Khiri Khan
	BMR	Nakhon Pathom-Nonthaburi-Pathum Thani-
		Bangkok-Samut Prakan- Samut Sakhon
Southern	S1	Chumphon-Ranong-Surat Thani
	S2	Phuket-Phanga-Trang-Krabi-Nakhon Si Thammarat
	S3	Satun-Phatthalung-Songkhla-
		Pattani-Narathiwat-Yala

Table 2.11
Inter-Regional Person Trip Matrix 1990 (Unit : Persons/Day)

O/D	BMR	C1	C2A	C2B	C2C	C3	N1	N2	N3	NE1	NE2	NE3	NE4	S1	S2	S3	TOTAL
BMR	399813	121341	13046	3852	101231	67535	5885	8847	18848	3965	1462	7866	26932	11798	3930	5901	802253
C1	113073	25033	2749	516	3094	30483	2165	3521	11267	1732	1136	1217	3024	464	243	511	200227
C2A	13667	4164	4538	217	4810	4063	859	941	689	126	268	540	304	173	78	600	36038
C2B	3836	397	810	454	10765	624	184	275	677	963	384	1145	1378	562	376	257	23084
C2C	91032	1011	1287	10968	59522	22899	495	608	17230	576	544	1848	8015	1093	367	541	218035
C3	73361	41115	3011	1742	19118	18735	2665	8954	13199	2732	1713	3110	2186	8400	1630	914	202584
N1	7469	1487	749	307	570	2330	3516	8408	22143	1256	1467	581	566	617	733	545	52743
N2	13565	1812	633	353	1569	5654	10352	16277	18785	1718	1752	1287	2101	147	121	439	76563
N3	28110	14049	525	481	4189	12723	25191	21736	10016	6169	5305	2025	4350	657	297	503	136327
NE1	5623	1653	122	354	1765	2874	972	2841	3670	3430	4442	1675	7619	870	619	230	38759
NE2	3492	1248	213	191	1426	1651	492	1423	1653	8027	40742	13094	3220	832	518	223	78446
NE3	6404	1421	240	71	1592	2642	168	1022	1624	1418	12580	13555	12798	604	291	569	57002
NE4	20312	2508	2009	1938	7373	5995	2424	3066	8653	5530	4333	11774	19866	1546	577	629	98531
S1	14639	948	324	692	4536	5131	290	375	639	885	1146	1273	2308	2045	6864	11099	53194
S2	5549	194	82	80	450	1649	552	80	181	357	512	586	563	12386	37984	34976	96181
S3	3875	463	293	478	336	1941	506	335	411	119	228	175	515	10958	38581	95767	154982
TOTAL	803820	218841	30632	22696	222346	186928	56714	78709	129686	39003	78012	61752	95746	53151	93210	153704	2324951

Table 2.12
Inter-Regional Freight Trip Matrix 1990 (Unit : Tons/Day)

O/D	BMR	C1	C2A	C2B	C2C	C3	N1	N2	N3	NE1	NE2	NE3	NE4	S1	S2	S3	TOTAL
BMR	102893	65847	8368	624	150272	84623	862	180	1689	410	304	377	2672	1820	64	161	421166
C1	58068	10296	832	308	170	5988	5580	1646	6733	3742	1702	1510	3964	1243	216	186	102184
C2A	15459	499	430	446	400	726	1390	152	836	200	90	161	763	41	25	51	21669
C2B	17227	795	232	159	16252	1751	1041	211	849	924	242	375	181	303	49	64	40655
C2C	159386	200	201	15891	16459	14415	452	228	372	753	433	427	6836	189	65	168	216475
C3	77186	22232	8114	4615	21493	8822	3618	7187	13812	3185	2657	1250	2994	10252	967	2839	191223
N1	1068	5874	1151	456	153	3217	2568	9417	11966	750	683	493	1439	1600	949	910	42694
N2	684	2857	339	255	241	2158	10678	9041	9990	227	233	261	1294	845	490	434	40027
N3	1793	6386	325	131	11837	6824	15721	10509	8644	1337	960	1885	7079	719	122	140	74412
NE1	310	3868	664	970	378	3284	2392	894	981	1541	4646	1800	4140	3764	195	190	30017
NE2	201	1321	269	1467	25	757	528	561	521	5481	8629	5999	2937	2826	265	252	32039
NE3	382	1181	176	252	16	1404	822	252	1489	2189	5176	1402	2866	7435	101	114	25257
NE4	2344	5447	185	783	14179	1316	2497	1968	7190	4190	3245	3313	9467	1275	111	121	57631
S1	2121	884	89	948	110	7913	482	212	1178	5292	4154	5652	1885	15	4013	5240	40188
S2	63	130	42	209	82	813	708	374	264	292	279	144	142	7241	15024	12729	38536
S3	163	166	55	61	59	3196	572	680	200	170	143	195	332	5208	9940	30456	51596
TOTAL	439348	127983	21472	27575	232126	147207	49911	43512	66714	30683	33576	25244	48991	44776	32596	54055	1425769

Table 2.13
Share of SRT by Origin and Destination (1990)

Region	Person Share		Freight Share	
	Origin	Destination	Origin	Destination
BMR	20.73%	20.72%	4.07%	1.90%
C1	14.56%	14.00%	4.18%	10.27%
C2A	24.68%	28.67%	0.20%	0.00%
C2B	0.46%	0.45%	0.00%	0.00%
C2C	1.96%	1.76%	0.51%	0.65%
C3	9.88%	10.15%	0.13%	0.31%
N1	9.74%	8.98%	4.82%	3.05%
N2	15.39%	14.42%	1.79%	1.19%
N3	12.21%	12.70%	1.64%	3.23%
NE1	15.79%	15.33%	2.63%	2.96%
NE2	1.36%	1.38%	0.26%	0.18%
NE3	17.56%	16.32%	1.69%	3.25%
NE4	39.43%	41.02%	1.95%	1.98%
S1	29.88%	30.65%	2.81%	4.76%
S2	16.56%	16.72%	1.59%	1.46%
S3	24.23%	24.44%	7.91%	3.72%
TOTAL	16.68%	16.68%	2.46%	2.46%

As for the share of the SRT in these movements, the SRT accounts for about 16.7% of the person movements, and only about 2.5% of the freight movements (Table 2.13). For person movements, the largest share of the SRT among the O-D regions is for NE4, which presumably refers to travel along the Nakhon Ratchasima-Buriram-Surin line. Here the SRT accounts for about forty percent of the person movements. Other O-D regions where the SRT accounts for over 20% of the person movements are BMR, C2A, NE4, S1 and S3.

For freight, the SRT is currently a relatively minor player in total freight movement. Only for freight with destination in the Upper Central provinces (C1) and some southern provinces (S3) is the share of the SRT greater than 5%. For the Eastern Seaboard corridor provinces (C2C), which is the second largest O-D for freight after the BMR, the SRT's share is tiny. From these figures, it appears that there is much potential for the SRT to tap into the freight market in the future. However, because the SRT relies so much on only a few major freight commodities, one cannot rely mainly on macro information and projections. Thus, later in this chapter, detailed analyses will conducted into the future transportation demand for the four major SRT freight products, petroleum products, rice, cement, and containers (see section 5).

3. ECONOMIC AND POPULATION PROJECTIONS

To carry out the macro transportation demand projections, changes in the transportation demand matrices will be related to changes in the economic and social conditions of the various provinces in the country. In particular, changes in real provincial GDP and in provincial population will be linked to the demand for inter-provincial transportation. This section thus presents the projections of GDP and population. The projections are carried out from the present to the year 2011, or the end of the 10th Five-Year National Economic and Social Development Plan.

This section is divided into two major sub-sections. The first sub-section briefly describes the economic projections, namely (1) projections of Gross Domestic Product (GDP); (2) Gross Regional Products (GRP); and (3) Gross Provincial Products (GPP). The second sub-section presents the population projections.

3.1 Economic Projections

As stated earlier, the objective of this section is to forecast GDP, GRP, and GPP. A brief report of the methodology adopted is presented below.

3.1.1 Scope and Methodology

To achieve the above objectives, this project has adopted and extended the TDRI's regional economic model for these purposes. However, TDRI's projections covered only Gross Regional Products (GRP) and Gross Domestic Products (GDP) up to the end of the Eighth Five-Year Plan (2001). Therefore, this study extended the previous projections till the year 2011. In addition, the whole set of the Gross Provincial Products (GPP) has to be newly estimated. The shift-share analysis is used to generate the GPP from the existing GRP projections. For the extension of the estimates beyond 2001, the simple trend (regression) analysis is employed. The conceptual framework of the TDRI regional economic model is presented in Working Paper No. 1.[4]

3.1.2 Gross Domestic Product (GDP)

In order to predict the GDP, the study has adopted the TDRI's macroeconomic projection up to 2011 as a guideline for this study. The study also adjusted the results of the study to be consistent with the NESDB's projection for the 7th Five-Year Plan. The results of growth rate of GDP are presented in Table 3.1 (which also includes the GRP projections).

The results of this study indicate that the country's economic growth should gradually decline from the average rate of 8.2% per annum in the 7th Plan, to an average rate of 6.8% for the period of the 10th Plan. While the trend is downward, the rate of growth of the economy is still expected to be satisfactorily high over the next two decades. The growth performance of GDP depends mainly on the contributions of the manufacturing and services sectors as indicated below.

The growth rate in the agricultural sector has fluctuated slightly over the last several years, currently agriculture accounts for approximately 15 percent of GDP, down from almost 17 percent in 1985. There is some cause for optimism, however, in the performance of livestock and fisheries, which nearly achieved two-digit levels of growth between 1986 and 1988. Their relatively strong performance implies that these sectors could still contribute to the growth of the economy. However, it is expected that the growth of agricultural GDP as a whole should be at between 2 to 3 percent per annum over the next two decades.

The industrial and service sectors appear to have a bright future, since they have been expanding very quickly over the past few years. During the period between 1985 and 1990, the average rate of GDP growth in the industrial sector was about 13.9 percent per annum, while that of the services sector was about 9.7 percent per annum. These statistics indicate that sustaining economic growth in Thailand requires growth of manufactured exports and services, which in turn implies maintaining competitive manufacturing conditions in comparison to the world market. Currently, it appears that Thailand may have difficulties sustaining competitive conditions due to predicted shortages of educated manpower and a severe lack of both basic and sophisticated infrastructure. Thus, rapid growth as in the last few years is probably not sustainable, although the growth rates

4. For more details see Chalamwong (1992a) and (1992b).

should still be reasonable. It is expected that the average growth rate of real GDP of industry should be about 10 percent by the end of the Seventh Plan, and drop slightly to about 9 percent by the year 2000 and continue to decline to about 6.8 percent by 2011.

The services sector has contributed to the growth of the country in the past and is expected to continue in the future. The average annual growth rate of total services in GDP is expected to be around 7 to 8 percent during the studied period. The major subsectors contributed to the growth of these sectors are transportation and communications, trade, banking, and general services (e.g., hotel and restaurant).

Table 3.1
Regional GDP (GRP) Growth 1992-2011

	7th Plan	8th Plan	9th Plan	10th Plan
	1992-96	1997-2001	2002-06	2007-11
Northeast	5.86%	5.94%	5.68%	6.15%
North	5.81%	6.04%	5.69%	6.24%
South	6.55%	6.50%	5.97%	6.39%
East	12.87%	11.04%	8.45%	7.15%
West	8.54%	7.84%	6.71%	6.61%
Central	8.34%	8.19%	7.09%	6.86%
BMR	8.66%	8.16%	7.34%	7.05%
Whole Kingdom	8.20%	7.88%	7.01%	6.83%

3.1.3 Gross Regional Product (GRP)

TDRI's study assumed that the GRP projection by sector will partly follow its past performance component and another component that includes improvement of sectoral GRP through new business projects. The estimates are based on 7 major regions of the country.

The overall picture of future trends of the major regions are presented in Table 3.1. It can be seen that areas of high growth are basically those areas surrounding the

BMR. The fastest growing region is expected to be the East, mainly in the Eastern Seaboard area. The growth patterns indicate that future growth in the country should still be concentrated in the central part of the country. Therefore, to effectively narrow the regional income disparities, much more efforts will be needed to decentralize industries and services to different parts of the country.

3.1.4 Gross Provincial Products (GPP)

The Gross Provincial Product was imputed directly from GRP. It was assumed that the provincial shares in the future would be the same as those in the past. Then the forecasted value of GRP is disaggregated to each province based on the existing share as mentioned above. Lastly, the GPP's were adjusted to be consistent with the sectoral macroeconomic projections reported in Appendix D of Working Paper No. 1.[5]

3.2 Population Projection

This section presents the estimate of population projections based on a joint effort between the Human Resources Planning Division, NESDB and TDRI.[6] This forecast is divided into three levels, namely national level, regional level and provincial level. The national level data was projected up to 2015 while the regional projection was estimated up to 2010. For the provincial population, NESDB reported the projections up to 2000.

However, to serve the purpose of projecting the macro transportation demand, it is required that the provincial population projection must be estimated up to 2011. Therefore, the provincial population projections from 1990 to 2000 were brought directly from NESDB. The provincial population projections from 2001 to 2011 were estimated by assuming that they should follow their past trend. After the population projections of each province up to 2011 were completed, the projected population figures were adjusted to generate the same aggregate results as those projected by NESDB both at the national and regional levels. The results of the estimation of population growth rates at the regional level are presented in Tables 3.2.[7]

5. Chalamwong (1992a).
6. For more details see NESDB (1991).
7. For provincial population projections, see Chalamwong (1992a).

Table 3.2
Regional Population Growth Rates 1992-2011

	7th Plan	8th Plan	9th Plan	10th Plan
	1992-96	1997-2001	2002-06	2007-11
Northeast	1.17%	1.07%	0.90%	0.68%
North	0.98%	0.80%	0.63%	0.52%
South	1.94%	1.63%	1.52%	1.37%
East	1.85%	1.74%	1.60%	1.44%
West	1.06%	0.99%	0.87%	0.72%
Central	1.03%	0.93%	0.78%	0.65%
BMR	1.95%	1.72%	1.56%	1.42%
Whole Kingdom	1.39%	1.24%	1.09%	0.93%

4. MACRO TRANSPORT DEMAND

This section presents the results of the projections of macro transport demand to the year 2011.

4.1 Methodology

In this study, the study team decided to employ a conventional transport model normally calibrated for urban area, to apply to inter-provincial travel. The basic methodology started by first formulating origin-destination tables for person and freight movement for the whole country as already presented in section 2. From these tables, regression equations were formulated to explain trip ends as a function of two important socioeconomic variables: population and gross provincial product. From the equations, the trip ends were forecasted using future GPP and provincial population as described in the last section to finally come out with future trip interchange among provinces.

For the macro transportation demand forecast, starting from the base inter-provincial travel demand matrices, 2 main types of conventional transport modeling were applied.

- Trip ends formulation models, and
- Trip distribution by furnace methods

4.1.1 Trip Ends Models

Trip interchange in the matrices were added to derive trip ends (both generation and attraction) in each province. Then the trip ends were related to the socioeconomic data according the following equation.

$NT_e = T_e$ (growth factors).
For both generation and attraction, the growth factors were equal to:
$G_{pup}.E_{pup} + G_{Gpp}.E_{Gpp}$

where,
NT_e = new trip ends (for both generation/attraction in each province)
G_{pup} = growth rate of population in each province
E_{pup} = elasticity of population and trip ends
G_{Gpp} = growth rate of gross provincial product
E_{Gpp} = elasticity of gross provincial production and trip ends.

The various elasticities were obtained through regression analyses. The resulting elasticity coefficients are as given in Table 4.1.

4.1.2 Trip Distribution Models

After forecasting future trips ends, these trip ends must be converted back to trip interchange again, in order to obtain the inter-provincial travel demand patterns. This process was done by using Turners' method. The formula for this method is as follows :

$T_{ij} = G_i A_i T_{ij} R_i C_j$

where
T_{ij} = future trip interchange between zone i and j
$G_i A_j$ = future trip ends generated at zone i, and attracted at zone j
T^{ij} = existing trip interchange between zone i and j
R^i and C^j = row and column balancing factor computed by trial and error method.

Therefore, this formula is just a method to expand the computed trip ends back to trip interchanges between provinces based on the former pattern of trip interchanges. The results of the computation of this process are demands for person and freight movements between provinces.

Table 4.1
Elasticity Coefficients

	Person Trip Elasticity		Freight Trip Elasticity	
	Generation	Attraction	Generation	Attraction
	With Respect to GPP			
BMR	0.7914	0.8161	0.6002	0.6811
Central	0.7914	0.8161	0.6002	0.6811
Northeast	0.3075	0.2976	0.4162	0.4118
North	0.3312	0.2822	0.2714	0.3650
South	0.6451	0.8621	0.4583	0.5705
	With Respect to Population			
BMR	1.0460	1.0601	0.6499	0.7077
Central	1.0460	1.0601	0.6499	0.7077
Northeast	0.3645	0.3243	0.3243	0.2994
North	0.3812	0.3072	0.2945	0.3829
South	0.5056	0.8438	0.4018	0.4314

4.2 Future Demand

4.2.1 Person Demand

Demand for person trips is expected to increase quite rapidly over the next 20 years in line with the satisfactory pace of economic growth in the country. Table 4.2 presents the number of person trips by O-D regions and the average growth rates during the various 5-year Plan periods. Between 1990 and 1996 , total person trip is expected to increase at an average annual rate of 7.79%. The average growth rate is expected to decline slowly over time, but still remains high till the end of the Tenth Plan, with the average growth rate for the latter period amounting to 6.49%.

Examining the average growth rates may not indicate very vividly the magnitudes involved, however. If one looks at the number of person trips, then it can be seen that in the 21 year period between 1990 and 2011, the total number of person trips is expected to increase 4.28 times, totaling about 9.96 million daily person trips in 2011 compared to about 2.32 million daily person trips in 1990.[8] The most important O-D region will obviously still be the BMR, where in 2011 the person trips origination or ending in the BMR is expected to be more than 4.3 million person trips per day, which is close to twice the total number of person trips for the whole country in 1990.[9] However, the most rapid growth occurs in the Eastern Seaboard corridor region (C2C). By 2011, the total person trip originating from or arriving in this region is expected to increase spectacularly to about 1.7 million person trips per day, which is over 74% of the total inter-provincial person trips for the whole kingdom in 1990. Clearly, the demand for transportation infrastructure both within the Eastern Seaboard corridor and to connect it with other regions (particularly the BMR) will be very large. Other regions that have high total person trips in 2011 include the regions surrounding the BMR and the Southern part of the country.

Table 4.3 shows the inter-regional person trip matrix in 2011, together with a matrix showing the ratio of the person trips in 2011 to the person trips in 1990. Apart from the usual pattern with much of the traffic centering on the BMR, the Eastern Seaboard corridor region becomes more of a center than at present. Movements between the BMR and C2C reaches about 750 thousand person trips per day. Also within the C2C region itself, inter-provincial movements comes to over 617,000 person trips daily. Movements among the C2C region and near by areas in the Central and Eastern region also become quite high. For the Southern regions, which is another important O-D region, much of the person trips are within the Southern region itself. This is to be expected from the geographical nature of the country.

8. The increase in total person trips found in this study is similar in magnitudesto that arrived at in another study made by a Japanese team using different methodology and data grouping. The Japanese study "The Toll Highway Development Study in the kingdom of Thailand" showed that the future demand on road alone will increase by 4.3 times from 1989 travel demand. Total demand will increase from 2.15 million to 9.35 million, while SRT demand will increase from .23 million to almost 1.0 million.

9. Remember than this excludes travel with each provinces of the BMR.

Table 4.2
Person Trips by O-D Regions 1990-2011 ('000 Persons/day) and Average Growth

	1990		1996		2001		2006		2011	
	Origin	Destin	Origin	Destin	Origin	Destin	Origin	Destin	Origin	Destin
BMR	802.3	803.8	1,392.0	1,382.1	2,117.3	2,116.9	3,076.4	3,061.8	4,334.7	4,332.8
C1	200.2	218.8	313.9	310.2	428.8	427.6	561.0	565.4	745.2	744.9
C2A	36.0	30.6	50.3	48.9	68.8	69.7	95.5	95.6	149.8	150.7
C2B	23.1	22.7	45.6	44.6	77.7	76.1	116.5	111.8	166.8	165.0
C2C	218.0	222.3	474.1	475.6	824.9	812.7	1,215.0	1,226.8	1,727.8	1,724.7
C3	202.6	186.9	308.7	315.8	446.8	447.6	598.5	598.0	789.5	803.3
N1	52.7	56.7	63.4	67.4	77.2	76.7	92.8	91.7	119.4	115.9
N2	76.6	78.7	88.5	89.1	101.0	98.6	114.2	113.5	134.3	134.4
N3	136.3	129.7	151.4	151.1	168.4	170.1	185.9	189.9	210.8	210.1
NE1	38.8	39.0	44.5	43.9	49.7	48.0	53.4	53.1	58.9	57.5
NE2	78.4	78.0	86.2	86.9	95.1	94.2	103.4	103.1	111.3	111.1
NE3	57.0	61.8	66.3	68.5	74.3	76.2	83.1	84.8	94.8	95.0
NE4	98.5	95.7	112.0	111.1	124.8	126.7	139.8	139.3	158.1	158.3
S1	53.2	53.2	84.1	81.7	116.2	111.1	149.2	147.5	193.2	192.9
S2	96.2	93.2	144.7	148.9	194.3	214.4	276.5	279.1	375.9	375.9
S3	155.0	153.7	221.6	221.3	300.1	298.7	409.7	409.2	586.7	585.0
TOTAL	2,325.0	2,325.0	3,647.2	3,647.2	5,265.4	5,265.4	7,270.7	7,270.7	9,957.5	9,957.5

Average Annual Growth Rate in Person Movement by O-D Regions

			1990-96		1996-2001		2001-06		2006-11	
	Origin	Destin	Origin	Destin	Origin	Destin	Origin	Destin	Origin	Destin
BMR			9.62%	9.45%	8.75%	8.90%	7.76%	7.66%	7.10%	7.19%
C1			7.78%	5.99%	6.44%	6.63%	5.52%	5.75%	5.84%	5.67%
C2A			5.73%	8.11%	6.46%	7.34%	6.77%	6.53%	9.42%	9.52%
C2B			12.00%	11.94%	11.26%	11.24%	8.45%	8.01%	7.44%	8.09%
C2C			13.82%	13.51%	11.71%	11.31%	8.05%	8.58%	7.30%	7.05%
C3			7.27%	9.13%	7.67%	7.22%	6.02%	5.97%	5.70%	6.08%
N1			3.12%	2.93%	4.01%	2.61%	3.76%	3.62%	5.17%	4.81%
N2			2.44%	2.09%	2.67%	2.06%	2.49%	2.85%	3.30%	3.44%
N3			1.76%	2.59%	2.16%	2.39%	2.00%	2.23%	2.55%	2.04%
NE1			2.33%	1.99%	2.24%	1.81%	1.44%	2.04%	1.98%	1.61%
NE2			1.59%	1.81%	1.99%	1.64%	1.67%	1.81%	1.49%	1.51%
NE3			2.54%	1.75%	2.32%	2.16%	2.25%	2.15%	2.69%	2.30%
NE4			2.16%	2.51%	2.19%	2.67%	2.29%	1.91%	2.50%	2.58%
S1			7.93%	7.43%	6.69%	6.34%	5.13%	5.85%	5.30%	5.50%
S2			7.05%	8.12%	6.07%	7.57%	7.31%	5.42%	6.34%	6.14%
S3			6.14%	6.26%	6.25%	6.18%	6.42%	6.50%	7.45%	7.41%
TOTAL			7.79%	7.79%	7.62%	7.62%	6.67%	6.67%	6.49%	6.49%

Table 4.3
Person Trip Matrix 2011 ('000 Persons/Day)

O/D	BMR	C1	C2A	C2B	C2C	C3	N1	N2	N3	NE1	NE2	NE3	NE4	S1	S2	S3	TOTAL
BMR	2378.4	481.7	75.8	27.0	768.2	342.6	22.1	22.4	34.6	7.3	3.1	15.5	51.4	53.8	20.9	29.8	4334.7
C1	487.0	71.9	11.6	2.6	17.0	112.0	5.9	6.5	15.8	2.5	1.9	1.8	4.4	1.5	0.9	1.9	745.2
C2A	61.8	12.6	20.0	1.2	27.7	15.7	2.5	2.0	1.1	0.2	0.4	1.0	0.5	0.6	0.3	2.3	149.8
C2B	28.6	2.0	5.9	4.0	102.4	4.0	0.9	0.9	1.6	2.2	1.0	2.8	3.3	3.2	2.5	1.6	166.8
C2C	740.5	5.5	10.2	105.1	617.7	158.9	2.5	2.1	43.2	1.4	1.6	5.0	20.9	6.8	2.7	3.7	1727.8
C3	345.3	129.1	13.8	9.7	114.8	75.2	7.9	18.0	19.3	4.1	3.0	5.1	3.4	30.3	6.9	3.7	789.5
N1	30.4	4.0	3.0	1.5	3.0	8.1	9.3	15.8	31.9	1.8	2.3	1.0	0.9	1.9	2.7	1.9	119.4
N2	33.9	3.1	1.5	1.0	5.0	12.0	17.4	23.7	25.7	2.3	2.4	1.8	2.9	0.3	0.3	0.9	134.3
N3	51.3	20.0	0.9	1.0	9.8	19.8	37.6	29.9	13.7	8.4	7.3	2.8	5.9	1.0	0.5	0.8	210.8
NE1	10.2	2.3	0.2	0.8	4.0	4.8	1.4	3.9	5.0	4.7	6.1	2.3	10.4	1.4	1.2	0.4	58.9
NE2	6.3	1.9	0.4	0.4	3.3	2.6	0.7	1.9	2.3	11.0	55.7	17.9	4.4	1.3	1.0	0.4	111.3
NE3	17.2	2.5	0.6	0.2	5.4	6.0	0.3	1.5	2.2	1.9	17.2	18.8	17.5	1.2	0.7	1.3	94.8
NE4	38.3	3.6	3.7	4.3	17.7	9.6	3.7	4.2	11.8	7.6	5.9	16.1	27.2	2.3	1.1	1.0	158.1
S1	61.1	2.6	1.3	3.4	24.2	18.3	0.8	0.7	0.9	1.3	1.9	1.9	3.3	6.5	25.7	39.3	193.2
S2	25.4	0.6	0.4	0.4	2.6	6.4	1.6	0.2	0.3	0.6	0.9	1.1	1.0	43.4	155.4	135.7	375.9
S3	17.2	1.4	1.3	2.5	1.9	7.3	1.4	0.7	0.7	0.2	0.4	0.3	0.9	37.2	153.1	360.3	586.7
TOTAL	4332.8	744.9	150.7	165.0	1724.7	803.3	115.9	134.4	210.1	57.5	111.1	95.0	158.3	192.9	375.9	585.0	9957.5

Ratio to 1990 Person Trips

O/D	BMR	C1	C2A	C2B	C2C	C3	N1	N2	N3	NE1	NE2	NE3	NE4	S1	S2	S3	TOTAL
BMR	5.95	3.97	5.81	7.00	7.59	5.07	3.76	2.54	1.83	1.83	2.13	1.97	1.91	4.56	5.33	5.05	5.40
C1	4.31	2.87	4.21	5.07	5.49	3.67	2.72	1.84	1.40	1.44	1.67	1.48	1.46	3.30	3.86	3.66	3.72
C2A	4.52	3.02	4.41	5.32	5.77	3.86	2.85	2.09	1.65	1.63	1.64	1.81	1.66	3.47	4.05	3.84	4.16
C2B	7.46	4.98	7.28	8.78	9.51	6.36	4.71	3.18	2.30	2.30	2.63	2.46	2.39	5.72	6.68	6.33	7.22
C2C	8.13	5.43	7.94	9.58	10.38	6.94	5.14	3.47	2.51	2.51	2.89	2.69	2.61	6.24	7.28	6.91	7.92
C3	4.71	3.14	4.60	5.54	6.00	4.01	2.97	2.01	1.46	1.50	1.78	1.64	1.55	3.61	4.21	4.00	3.90
N1	4.07	2.72	3.98	4.80	5.20	3.47	2.65	1.88	1.44	1.43	1.58	1.65	1.56	3.12	3.65	3.46	2.26
N2	2.50	1.69	2.44	2.94	3.19	2.13	1.68	1.46	1.37	1.37	1.37	1.37	1.37	1.92	2.38	2.13	1.75
N3	1.83	1.43	1.78	2.15	2.33	1.56	1.49	1.38	1.37	1.37	1.37	1.37	1.37	1.47	1.82	1.67	1.55
NE1	1.82	1.40	1.86	2.12	2.26	1.66	1.44	1.36	1.36	1.36	1.36	1.36	1.36	1.57	1.95	1.75	1.52
NE2	1.79	1.50	1.68	2.04	2.33	1.60	1.43	1.37	1.37	1.37	1.37	1.37	1.37	1.55	1.89	1.62	1.42
NE3	2.68	1.79	2.62	3.16	3.42	2.29	1.85	1.51	1.37	1.37	1.37	1.39	1.37	2.05	2.51	2.27	1.66
NE4	1.88	1.43	1.84	2.22	2.40	1.61	1.52	1.38	1.37	1.37	1.37	1.37	1.37	1.48	1.85	1.66	1.60
S1	4.18	2.79	4.08	4.92	5.33	3.56	2.64	1.80	1.39	1.44	1.67	1.48	1.42	3.20	3.74	3.55	3.63
S2	4.57	3.05	4.46	5.38	5.83	3.90	2.89	2.15	1.69	1.67	1.80	1.85	1.71	3.50	4.09	3.88	3.91
S3	4.43	2.96	4.33	5.22	5.65	3.78	2.80	2.13	1.68	1.66	1.68	1.84	1.70	3.40	3.97	3.76	3.79
TOTAL	5.39	3.40	4.92	7.27	7.76	4.30	2.04	1.71	1.62	1.47	1.42	1.54	1.65	3.63	4.03	3.81	4.28

4.2.2 Freight Demand

In carrying out the freight demand forecast, it was found that the pattern of inter-provincial freight movement, in general, related well to economic and population patterns. This was true except for one major category; construction materials. Therefore the construction materials were taken out and forecasted separately based on a previous study of the trucking industry,[10] and then added to the matrix for the other freight.

Table 4.4 gives the projected freight trips by O-D regions and the average growth rates. Table 4.5 gives the inter-regional freight trip matrix in 2011, together with a matrix showing the ratio of the freight tonnage in 2011 to that in 1990. The overall growth in freight tonnage traffic is not expected to be as high as the growth in person trips. The volume is expected to increase by an average 6.25% per annum between 1990 and 1996, with the growth rate declining to an average 4.7% per annum during the period of the 10th Plan. Overall, by 2011 the volume of inter-provincial freight movement is expected to be 3.08 times the level in 1990, compared to the more than 4 folds increase in person trips.

The pattern of freight movement is similar to that for person movement. The BMR is still the main O-D region. By 2011, the volume of freight with origin or destination in the BMR is expected to be greater than the total volume of freight traffic for the whole kingdom in 1990. The share of total freight with O-D in the BMR to that for the whole country goes up from about 30% in 1990 to 36% 2011. However, as with person movement, the growth in the Eastern Seaboard corridor region (C2C) is expected to be the most rapid, and the relative gap between the volumes in C2C and the BMR declines over time. By 2011, total volume of freight with O-D in C2C is expected to be about one million tons per day. This is certainly very substantial, and is more than 60% of the volume with O-D in the BMR. Other areas near to the BMR also show large increases in freight volume, as was the case in person movement. However, in the case of freight, the Southern region is not as important as was the case with person movement.

In 1990, the largest volume of inter-provincial freight movement was between the BMR region and the Eastern Seaboard corridor. The volume was bigger than freight movement between provinces of the BMR by about 50%. In 2011, this pattern remains true, and the relative importance of the BMR-C2C movement increases. Volume of freight traffic between the BMR and C2C reaches about 700,000 tons per day in 2011.

10. KAMPSAK-NECCO-DECONS (1988).

Table 4.4
Growth in Freight Movement by O-D Regions ('000 Tons/Day)

	1990		1996		2001		2006		2011	
	Origin	Destin	Origin	Destin	Origin	Destin	Origin	Destin	Origin	Destin
BMR	421.2	439.3	654.0	670.4	913.3	930.1	1,216.2	1,235.6	1,579.0	1,605.2
C1	102.2	128.0	145.0	170.1	191.2	215.2	239.7	263.4	297.5	322.9
C2A	21.7	21.5	28.9	28.6	37.2	36.8	46.9	46.2	59.6	58.5
C2B	40.7	27.6	64.9	50.5	94.7	79.1	124.2	103.5	161.8	134.4
C2C	216.5	232.1	378.9	421.4	567.6	635.9	759.3	861.6	986.2	1,122.2
C3	191.2	147.2	269.2	208.7	351.0	272.9	439.8	339.6	549.4	422.5
N1	42.7	49.9	48.3	56.7	53.4	63.1	58.2	68.7	63.9	75.8
N2	40.0	43.5	44.2	47.8	48.0	51.9	52.2	56.2	57.1	61.4
N3	74.4	66.7	83.1	74.4	91.0	81.5	98.9	88.3	107.8	96.3
NE1	30.0	30.7	35.4	34.4	40.7	37.9	46.4	41.6	53.3	46.1
NE2	32.0	33.6	37.5	37.7	42.8	41.5	48.6	45.4	55.5	50.2
NE3	25.3	25.2	29.3	28.1	33.2	30.8	37.8	33.9	43.2	37.5
NE4	57.6	49.0	69.2	56.7	80.4	63.8	92.2	70.5	105.9	78.4
S1	40.2	44.8	51.6	58.0	62.7	71.1	74.2	84.4	88.1	100.6
S2	38.5	32.6	49.0	42.0	59.1	51.2	69.9	61.0	82.9	73.0
S3	51.6	54.1	62.9	66.0	74.3	78.2	87.1	91.9	103.1	109.4
TOTAL	1,425.8	1,425.8	2,051.4	2,051.4	2,740.6	2,740.6	3,491.9	3,491.9	4,394.3	4,394.3

Average Annual Growth Rate in Freight Movement by O-D Regions

			1990-96		1996-2001		2001-06		2006-11	
	Origin	Destin	Origin	Destin	Origin	Destin	Origin	Destin	Origin	Destin
BMR			7.61%	7.30%	6.91%	6.77%	5.90%	5.85%	5.36%	5.37%
C1			6.01%	4.86%	5.68%	4.81%	4.63%	4.13%	4.41%	4.16%
C2A			4.94%	4.87%	5.18%	5.18%	4.74%	4.66%	4.90%	4.84%
C2B			8.11%	10.63%	7.86%	9.37%	5.56%	5.52%	5.43%	5.36%
C2C			9.78%	10.45%	8.42%	8.58%	5.99%	6.26%	5.37%	5.43%
C3			5.86%	5.99%	5.45%	5.50%	4.61%	4.47%	4.55%	4.46%
N1			2.06%	2.14%	2.05%	2.16%	1.74%	1.74%	1.88%	1.97%
N2			1.65%	1.58%	1.68%	1.64%	1.70%	1.61%	1.81%	1.79%
N3			1.85%	1.83%	1.83%	1.83%	1.69%	1.63%	1.74%	1.74%
NE1			2.80%	1.90%	2.83%	1.96%	2.65%	1.89%	2.79%	2.09%
NE2			2.66%	1.93%	2.67%	1.96%	2.58%	1.83%	2.71%	2.01%
NE3			2.49%	1.78%	2.53%	1.88%	2.63%	1.92%	2.71%	2.08%
NE4			3.09%	2.45%	3.06%	2.40%	2.77%	2.04%	2.82%	2.13%
S1			4.24%	4.41%	3.98%	4.14%	3.45%	3.51%	3.47%	3.57%
S2			4.08%	4.32%	3.81%	4.03%	3.44%	3.57%	3.47%	3.64%
S3			3.37%	3.38%	3.38%	3.46%	3.23%	3.27%	3.43%	3.55%
TOTAL			6.25%	6.25%	5.96%	5.96%	4.96%	4.96%	4.70%	4.70%

Table 4.5
Freight Trip Matrix 2011 ('000 Tons/Day)

O/D	BMR	C1	C2A	C2B	C2C	C3	N1	N2	N3	NE1	NE2	NE3	NE4	S1	S2	S3	TOTAL
BMR	341.2	182.3	24.7	2.6	760.6	250.0	1.6	0.3	2.5	0.6	0.5	0.6	4.5	5.0	0.2	0.4	1577.6
C1	195.2	28.9	2.5	1.3	0.9	17.9	10.6	2.7	10.7	6.1	2.9	2.5	6.9	3.5	0.6	0.5	293.6
C2A	45.5	1.2	1.1	1.6	1.8	1.9	2.3	0.2	1.2	0.3	0.1	0.2	1.2	0.1	0.1	0.1	59.1
C2B	59.9	2.3	0.7	0.7	86.3	5.4	2.0	0.3	1.4	1.5	0.4	0.6	0.3	0.9	0.1	0.2	163.1
C2C	707.3	0.7	0.8	88.5	111.5	57.0	1.1	0.5	0.7	1.6	0.9	0.9	15.5	0.7	0.2	0.6	988.5
C3	238.5	57.3	22.3	17.9	101.4	24.3	6.3	10.7	20.1	4.8	4.1	1.9	4.8	26.4	2.5	6.6	549.9
N1	2.0	9.6	2.0	1.1	0.4	5.5	3.5	12.8	16.2	1.0	0.9	0.7	2.0	2.7	1.6	1.4	63.4
N2	1.2	4.3	0.5	0.6	0.6	3.4	14.6	12.2	13.5	0.3	0.3	0.4	1.8	1.3	0.8	0.6	56.5
N3	2.5	8.6	0.4	0.2	20.8	9.3	21.3	14.2	11.7	1.8	1.3	2.6	9.6	1.0	0.2	0.2	105.7
NE1	0.7	7.8	1.4	2.9	1.4	7.0	3.5	1.2	1.3	2.1	6.4	2.5	5.8	7.7	0.4	0.4	52.5
NE2	0.5	3.1	0.7	5.0	0.1	1.9	0.9	0.8	0.7	7.9	12.9	8.7	4.5	6.7	0.6	0.5	55.5
NE3	0.9	2.4	0.4	0.7	0.1	3.0	1.2	0.3	2.0	3.0	7.2	1.9	4.1	15.3	0.2	0.2	42.9
NE4	4.3	8.6	0.3	1.8	40.0	2.2	3.4	2.7	9.7	5.7	4.4	4.5	12.8	2.0	0.2	0.2	102.9
S1	6.5	2.3	0.2	3.6	0.5	21.6	0.9	0.3	1.8	8.2	6.7	8.8	3.1	0.0	10.4	12.3	87.4
S2	0.2	0.3	0.1	0.7	0.3	1.9	1.1	0.5	0.4	0.4	0.4	0.2	0.2	16.2	33.8	26.0	82.8
S3	0.4	0.3	0.1	0.2	0.2	7.1	0.9	0.9	0.3	0.2	0.2	0.3	0.5	11.0	21.1	59.2	103.0
TOTAL	1607.0	320.1	58.4	129.5	1126.9	419.6	75.2	60.8	94.3	45.5	49.8	37.0	77.5	100.4	72.9	109.4	4384.4

Ratio to 1990 Freight Movement

O/D	BMR	C1	C2A	C2B	C2C	C3	N1	N2	N3	NE1	NE2	NE3	NE4	S1	S2	S3	TOTAL
BMR	3.32	2.77	2.95	4.16	5.06	2.95	1.84	1.56	1.49	1.57	1.64	1.57	1.69	2.76	2.77	2.50	3.75
C1	3.36	2.81	3.00	4.22	5.13	3.00	1.90	1.61	1.58	1.63	1.70	1.62	1.75	2.80	2.81	2.53	2.87
C2A	2.95	2.46	2.62	3.70	4.50	2.62	1.67	1.45	1.41	1.45	1.49	1.46	1.53	2.45	2.46	2.22	2.73
C2B	3.48	2.90	3.10	4.37	5.31	3.10	1.93	1.63	1.60	1.65	1.72	1.64	1.77	2.89	2.91	2.62	4.01
C2C	4.44	3.70	3.95	5.57	6.77	3.95	2.45	2.07	1.99	2.10	2.19	2.09	2.26	3.69	3.71	3.35	4.57
C3	3.09	2.58	2.75	3.88	4.72	2.75	1.74	1.49	1.46	1.49	1.56	1.49	1.60	2.57	2.58	2.33	2.88
N1	1.88	1.64	1.72	2.37	2.87	1.72	1.38	1.36	1.36	1.35	1.35	1.35	1.36	1.67	1.67	1.53	1.49
N2	1.73	1.52	1.59	2.18	2.64	1.59	1.37	1.35	1.35	1.35	1.35	1.35	1.35	1.54	1.55	1.46	1.41
N3	1.40	1.35	1.37	1.49	1.76	1.37	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.42
NE1	2.37	2.01	2.12	2.98	3.62	2.13	1.46	1.38	1.37	1.36	1.38	1.37	1.40	2.05	2.06	1.89	1.75
NE2	2.72	2.32	2.44	3.42	4.15	2.45	1.68	1.44	1.41	1.44	1.50	1.45	1.54	2.36	2.37	2.17	1.73
NE3	2.36	2.02	2.12	2.97	3.61	2.13	1.46	1.38	1.37	1.37	1.39	1.38	1.42	2.05	2.06	1.89	1.70
NE4	1.85	1.58	1.68	2.32	2.82	1.66	1.37	1.35	1.35	1.35	1.35	1.35	1.36	1.60	1.62	1.54	1.79
S1	3.07	2.56	2.73	3.85	4.68	2.73	1.81	1.55	1.50	1.55	1.62	1.55	1.66	2.58	2.59	2.35	2.17
S2	2.66	2.22	2.37	3.34	4.06	2.37	1.58	1.40	1.38	1.39	1.41	1.40	1.45	2.24	2.25	2.04	2.15
S3	2.50	2.10	2.23	3.14	3.82	2.23	1.50	1.38	1.37	1.37	1.38	1.38	1.42	2.11	2.12	1.94	2.00
TOTAL	3.66	2.50	2.72	4.70	4.85	2.85	1.51	1.40	1.41	1.48	1.48	1.47	1.58	2.24	2.24	2.02	3.08

This is more than twice the inter-provincial freight movement between the various provinces of the BMR.

4.2.3 Conclusions

It is to be expected that transportation demand will inevitably increase a great deal in the future as the Thai economy expands. The above macro projections of transportation demand indicate this well. To meet these demand, huge investment in transportation infrastructure will be needed over the next two decades. As for the SRT, the opportunities are clearly there for much expansion to meet part of the transportation needs in the future. How much of the future increase in transportation demand could the SRT or should the SRT try to cater for will be examined in the next Chapter. However, to indicate the potential for the SRT, if one assumes that the SRT can maintain its inter-provincial passenger and freight trip shares as of 1990 up to 2011, then the volumes of passenger and freight that the SRT can capture would be as given in Table 4.6.

This shows that, assuming fixed shares of the market, total SRT inter-provincial movement of passengers could increase to almost 1.5 millions persons per day by 2011, compared to about 388,000 persons per day in 1990, representing an increase of 3.9 times. Much of this increase, however, occurs for inter-provincial travel between provinces of the BMR. In the future, this is likely to be met by various mass transit systems, one of which presumably would be the Hopewell Project. Thus, while these passengers would be traveling by rail, much of the system may not be directly operated by the SRT. Thus, Table 4.6 also gives the passenger travel excluding inter-BMR travel. With inter-BMR travel excluded, the total SRT passenger movement is expected to reach about 926,600 persons per day by 2011 compared to about 289,900 persons per day in 1990, or an increase of about 3.2 times. The total number of passengers increases by about 6.5-7.0% per annum through out the period from 1990 to 2011.

As for freight, the expected tonnage shipped by SRT, given fixed shares, increases to about 86,500 tons per day in 2011, compared to about 35,000 tons per day in 1990, or an increase of about 2.5 times. With freight, however, the macro picture only provides a very rough guide to what the SRT can expect, as the SRT is dependent on only a small number of major freight items. The market for the transportation of the various commodity items have details of their own that the macro approach cannot cover. Thus, for freight, the future development of the major SRT freight items will be covered in detailed in the next section.

Table 4.6
Growth in SRT Traffic Assuming Fixed 1990 Shares

	Passenger		Passenger Excluding Inter-BMR		Freight	
	Person /Day	Average Growth	Person /Day	Average Growth	Tons/Day	Average Growth
1990	387,741		289,950		35,049	
1996	580,383	6.95%	405,836	5.76%	46,204	4.71%
2001	808,568	6.86%	537,028	5.76%	57,871	4.61%
2006	1,101,692	6.38%	697,176	5.36%	70,843	4.13%
2011	1,508,319	6.48%	926,578	5.85%	86,539	4.08%

Overall, the potential is there for the SRT to play a much greater role in meeting the transportation needs of the nation. The potential is in fact even greater than that indicated in Table 4.6. The reason is that the major growth region in terms of transportation demand is the Eastern Seaboard corridor region (C2C), as indicated above. However, for this region, the SRT currently has a very low share of the traffic; about 1.8-2.0% of the passenger traffic with O-D in C2C, and only 0.5-0.65% of the freight traffic (Table 2.13 above). If efforts can be made to increase the SRT's share of the traffic in the Eastern Seaboard corridor region, then the SRT will be able to play an even greater role in meeting the future transportation needs.

5. TRANSPORTATION DEMAND ANALYSIS (MICRO)

Because the SRT's freight market is highly concentrated on a few major items (as indicated in Section 2), it becomes necessary to examine the future trends of these commodities in detailed. This section summarizes current and future transportation requirements for the four major revenue-earning commodities of the SRT, namely petroleum products, rice, cement and containers. The main objective of this section is to provide estimates of the amount of these four commodities that will be transported between the major geographical regions in the future. The mode of transportation for the commodities will not be identified in this section except in the case where there will certainly be only one alternative, such as oil pipeline, to transport a particular commodity.

This section intends to provide future outlook of the amount of the major commodities that could potentially be transported by rail. However, actual modal spilt analysis on the transportation of these commodities will be done in the next Chapter.

5.1 Petroleum Products

Oil products are being distributed widely in all geographical regions of the country. The main oil products being consumed in upcountry provinces are high-speed diesel (HSD), regular gasoline and liquefied petroleum gas (LPG). On the other hand, jet fuel and fuel oil are being used primarily in some specific locations where major industrial plants or airports are situated.

5.1.1 Oil Demand and Supply in Thailand

Total oil demand in Thailand in 1991 was 24,368 million litres (see Table 5.1). The demand consisted of 22,524 million litres of oil products and 1,845 million litres of LPG. Oil demand in Thailand has been characterized by high growth. The level of consumption in 1991 was nearly twice the amount of oil consumed in 1986. The average annual growth rate of oil demand in Thailand during the past five years was 13.2%.

In 1991, oil products in Thailand were being supplied from two main sources; domestic production and import. As for the domestic production, the three local refineries and two gas separation plants produced 15,251 million litres of oil in 1991. The level of production could satisfy about 63% of total domestic requirement. Thus, the rest of the demand were met by imports which came mainly from Singapore. In 1986, the share of import was only 19.7%.

On a regional basis, the 1991 oil demand in the Bangkok Metropolitan Region was 11,585 million litres, whereas the demand in Central region was 872 million litres. (see Table 5.2) The combined BMR and Central areas demand represented about 55 % of the total demand in Thailand. Thus most of the oil were consumed in and around the Bangkok area. The same was also true for LPG, where the combined BMR and Central areas demand was 63 % of the total country's consumption.

Table 5.1
Oil Demand, Production and Import

Unit: Million Litres

	1986	1991
Oil Demand	13,107.1	24,368.3
- Oil Products	11,928.0	22,523.5
- LPG	1,179.1	1,844.8
Oil Supply	13,011.1	24,652.1
Production	10,452.3	15,251.1
- Oil Products	9,373.8	13,433.9
- LPG	1,078.5	1,817.3
Import	2,558.8	9,400.9
- Oil Products	2,453.5	9,209.7
- LPG	105.2	191.2

Source: Department of Commercial Registration, Ministry of Commerce.

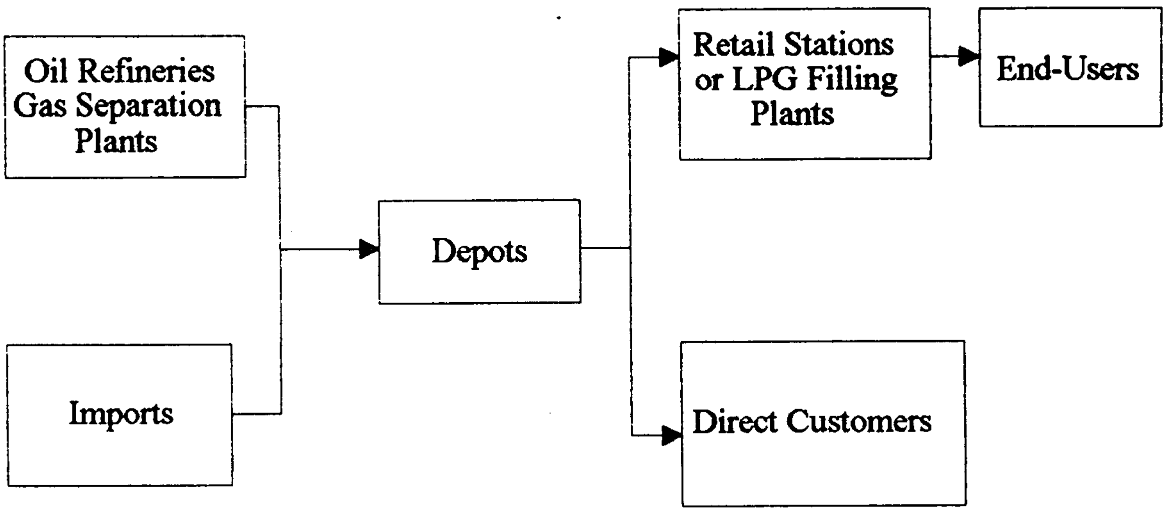
Table 5.2
1991 Oil Demand by Region

Unit: Million Litres

	Oil Products	LPG
BMR	11,584.5	1,089.4
Upper North	925.8	106.7
Lower North	986.3	60.6
Upper Northeast	839.3	45.7
Lower Northeast	865.3	62.1
West	1,035.5	99.4
Central	872.3	81.2
East	3,150.8	151.5
Upper South	1,478.5	78.2
Lower South	785.2	69.8
Total	22,523.5	1,844.8

Source: Department of Commercial Registration, Ministry of Commerce.

Figure 5.1
General Oil Distribution System in Thailand



5.1.2 Thailand's Oil Distribution System

Oil distribution system in Thailand consists of oil refineries, gas separation plants, oil terminals or depots, filling stations and end-users. The network of the distribution system is depicted in figure 5.1.

First, crude oil are refined into oil products at the three main refineries in the country. Thai Oil and ESSO refineries are located in Sriracha, Chon Buri, which is about 130 kilometers from Bangkok. On the other hand, Bangchak refinery is situated in Bangkok (see Table 5.3). Refined products from refineries are transported to main oil terminals in Bangkok area for further distribution. Furthermore, there are two gas separation plants (GSP) that produce LPG from the natural gas supply. The first GSP is located in Rayong and the second GSP, which is a much smaller one, is located in Kamphaeng Phet. LPG from the first GSP are transported by pipeline from Rayong to PTT's storage in Chon Buri for further distribution to LPG depots throughout the country (see Table 5.4). On the other hand, LPG produced from the second GSP are sent to PTT's depot in Nakhon Sawan.

Table 5.3
Location of Oil Refineries and Gas Separation Plants

	Operators	Distance from Bangkok (Km)
Bangkok	Bang Chak	
Chon Buri	Esso, Thai Oil, PTT	130
Rayong	PTT	179
Kamphaeng Phet	Shell	358

Refined oil products from domestic and imported sources are sent mainly to oil terminals in the Bangkok area. Part of the products are sent further to oil depots located in the North and Northeast (see Table 5.4). However, oil depots in the South usually receive oil products directly from refineries or from import.

Table 5.4
Location of Oil/LPG Depots

	Product Type	Operators	Road/Rail Distance from Bangkok (Km)	
Bangkok	Oil/LPG	PTT, Esso, Shell, Caltex, Siam Gas, Susco	-	
Samut Prakarn	Oil/LPG	Charoen Munkong, Hart Oil, Unique Gas, Cosmo	29	
Samut Songkram	Oil	PTT, Shell	72	
Chon Buri	Oil/LPG	PTT, Esso, Shell, Caltex, World Gas, World Petroleum	81	
Chachoengsao	Oil	Unique Gas, World Gas, World Petroleum	82	
Chiang Mai	Oil	PTT, Shell, Caltex	696	(755)
Lampang	Oil/LPG	PTT, Esso, Shell, Caltex	599	(646)
Phrae	Oil	PTT, Esso	551	(538)
Phitsanulok	Oil	PTT, Esso, Shell, Caltex	377	(393)
Nakhon Sawan	Oil/LPG	PTT, Shell	240	(250)
Ubol	Oil	PTT, Esso, Shell, Caltex	629	(579)
Udon	Oil	PTT, Esso	564	(573)
Khon Khen	Oil	PTT, Esso, Shell, Caltex	449	(454)
Nakhon-ratchasima	Oil	PTT, Shell	259	(268)
Nong Khai	Oil	PTT, Shell	615	
Surat Thani	Oil/LPG	PTT, Esso, Shell, Caltex, Siam Gas, Susco	644	
Songkhla	Oil/LPG	PTT, Esso, Shell	950	
Phuket	Oil	PTT, Esso, Shell, Caltex	862	
Chumphon	Oil	PTT, Esso, Shell, Caltex	463	
Nakhon Si Thammarat	Oil	PTT, Shell, Caltex	780	

Note: Figures in parentheses are rail distance.
Source: Department of Commercial Registration, Ministry of Commerce.

From the central or local oil terminals, oil products are supplied to retail stations for sales to end-users. The products are also sent from the terminals to direct customers such as industrial users. As for LPG, the product is either sent directly from LPG depots to retail stations, LPG cylinder filling plants, or direct customers as in the case of oil.

Table 5.5
Retail Stations by Regions in 1991

	Number	% Share
BMR	729	21
Central	207	6
East	405	12
West	319	9
Northeast	693	20
North	668	19
South	452	13
Total	3,473	100

Source : Department of Commercial Registration, Ministry of Commerce

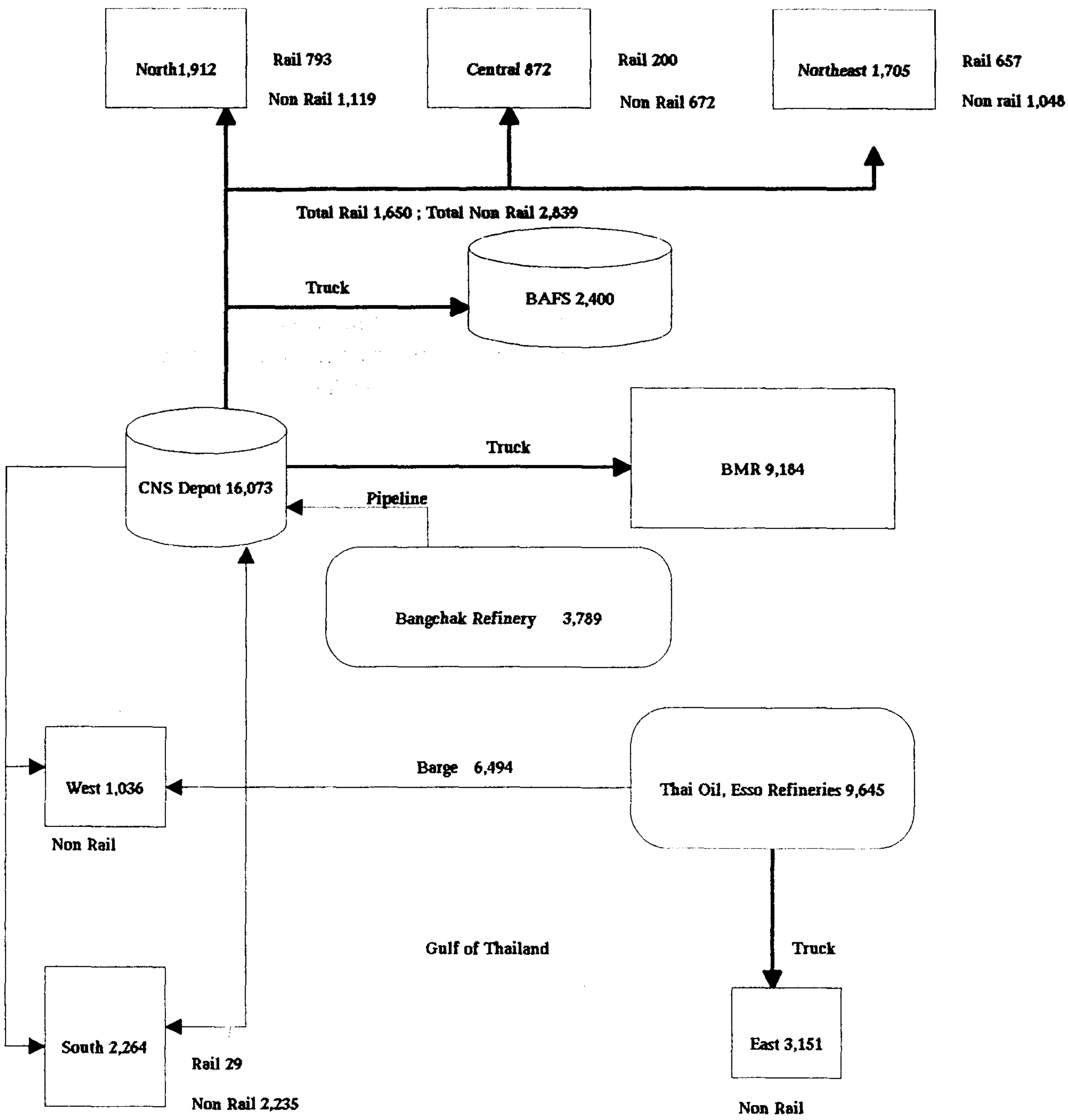
Table 5.6
LPG Filling Plant by Region in 1990

	Number	% Share
BMR	29	23
Central	9	7
East	17	14
West	11	9
Northeast	12	10
North	15	12
South	31	25
Total	124	100

Source : Department of Commercial Registration, Ministry of Commerce

In 1991, there were 3,473 retail stations in Thailand. About 21% of them, or 729 stations, were in the BMR. The Northeast had 693 retail stations whereas the North had 668. By far, the Northeast has the largest share of retail stations outside of the BMR. There were 452 stations in the South, while the Central, East and West altogether had about 900 stations (see Table 5.5).

Figure 5.2
Distribution of Oil Products in 1991 (Million Litres)



As for LPG, there were about 103 retail stations in 1990, most of which were in the BMR area. In addition, there were also 124 LPG cylinder filling plants. These plants receive bulk LPG supply directly from LPG depots. Most of the filling plants were in up-country provinces (see Table 5.6).

5.1.3 Oil Transportation by Mode

Oil Products and LPG

There are four main modes of oil transportation in Thailand; 1) coastal barge, 2) truck, 3) pipeline, and 4) rail. Barges are used mainly to transport oil from Thai Oil and ESSO refineries in Sriracha to central terminals in Bangkok, and to oil depots in Samut Songkhram and other southern provinces. According to Figure 5.2, about 6,494 million litres of oil were transported by coastal barges from refineries in Sriracha in 1991. Barges are also used to transport LPG from Sriracha to PTT's terminals in Surat Thani and Songkhla.

In addition, Bangchak transports oil products via pipeline over a short distance to PTT's terminal located nearby. Pipelines are also used to transport LPG from GSP in Rayong to Sriracha.

From the central terminals in Bangkok, oil products are transported to local depots in the North and Northeast exclusively by rail. In 1991, about 1,450 million litres of oil were shipped by rail to the North and Northeast.

The central terminals also supply users in the North and Northeast directly by trucks. In 1991, about 2,167 million litres of oil were transported to users in the North and Northeast by trucks directly from the central terminals. Thus the shares of truck and rail transportation from central terminals to the two regions were 60% and 40%, respectively.

Users in the Central areas are served from the central terminals in Bangkok by trucks. Users in the West are served partly by trucks from the central terminals, and partly by coastal barges from Sriracha. Users in the East are served mainly by trucks from oil depots in Sriracha.

Table 5.7 presents the amount of oil products transported by rail during the past seven years. The volume of oil business of SRT grew slightly from 2.6 million tons in the mid 1980's to 3.0 million tons in 1991. On the other hand, the volume of LPG business rose sharply from 0.056 million tons in 1986 to 0.427 million tons in 1990 before falling to 0.22 million tons in 1991. Compared to the total country's demand, the shares of rail transport in 1991 were 7.5% for oil products and 22% for LPG.

Table 5.7
Rail Transportation of Petroleum Product and Crude Oil

Unit: '000 Tons

	Oil Product	LPG	Crude	Total
1985	1,433	0	1,206	2,639
1986	1,300	56	1,167	2,523
1987	1,313	239	970	2,522
1988	1,398	179	1,041	2,618
1989	1,287	387	1,171	2,845
1990	1,508	427	1,320	3,255
1991	1,464	220	1,320	3,004

Source: State Railway of Thailand.

Crude Oil

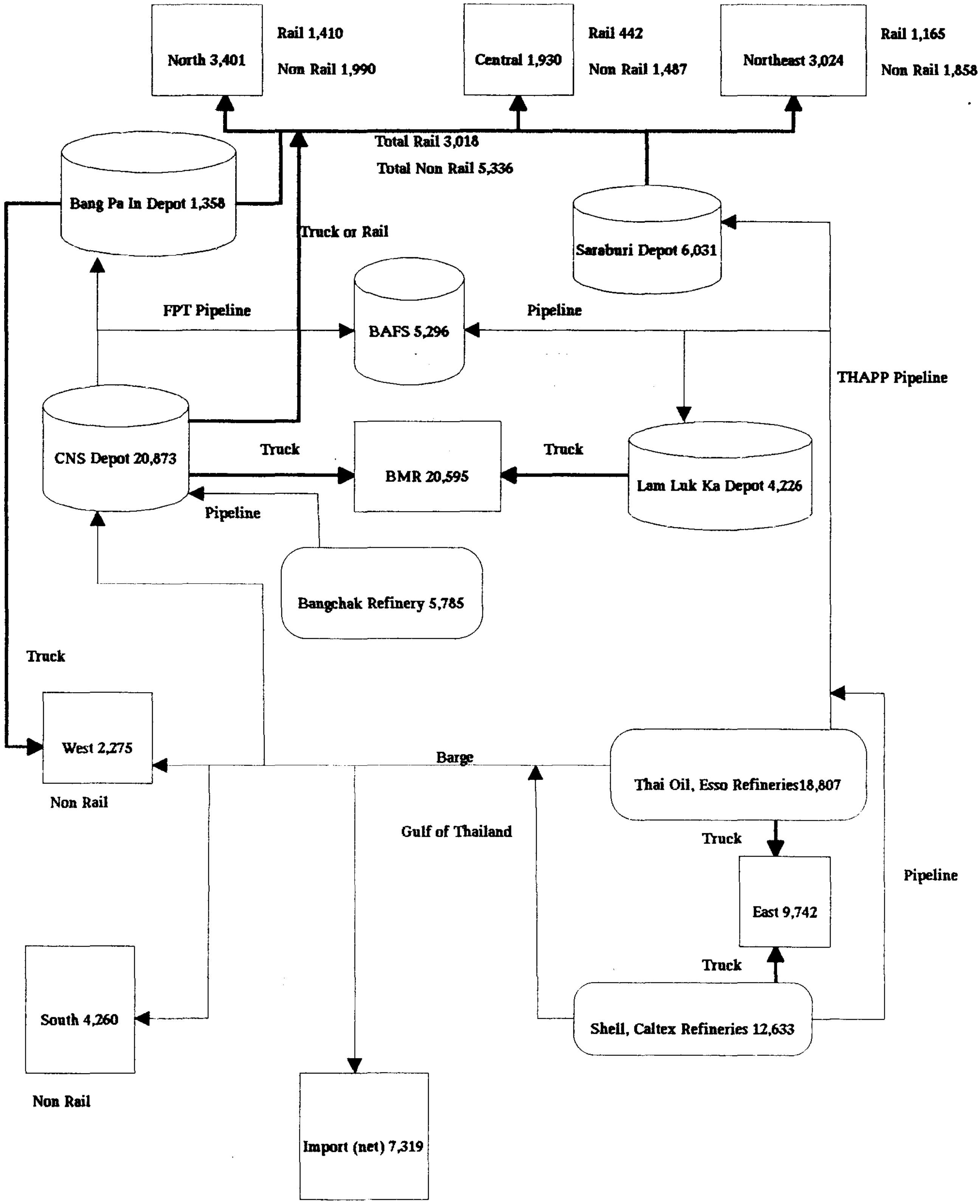
Rail has also been used to transport crude oil from Thai Shell's Sirikit oil field in Kamphaeng Phet. The volume of crude produced by Thai Shell varied from 0.97 million tons in 1987 to 1.32 million tons in 1991 (see Table 5.7). The crude are transported by rail to Bangkok for refining into oil products.

5.1.4 Oil Demand Forecast

This section provides oil demand forecasts by region for the year 2001 and 2011. The forecasts also include an analysis of future oil supply and distribution system in Thailand. The objective of this section is to forecast the amount of oil that could potentially be transported by rail ten and twenty years from now.

Figure 5.3
Distribution of Oil Products in 2001 (Million Litres)

Base case : volume of rail = share of 1991



Oil Demand in 2001

Table 5.8 provides oil demand forecast by region for the year 2001. The figures were estimated using intensity ratios of GDP.

Table 5.8
Oil Demand Forecast

Unit: Million Litres.

	1991	2001	2011
BMR	11,585	25,891	46,554
Central	872	1,930	3,787
East	3,151	9,742	20,649
West	1,036	2,275	4,335
Northeast	1,705	3,024	5,371
North	1,912	3,401	6,069
South	2,264	4,260	7,759
Total	22,524	50,522	94,524

Note: Excluding LPG.
Source: BERA estimate.

According to the projection in Table 5.8, total oil demand in Thailand is expected to grow from 22,524 million litres in 1991 to 50,522 million litres in 2001. The average annual growth rate of the demand is 8.4% during this ten year period. From the Table, it is quite obvious that future oil consumption will continue to concentrate in and around the Bangkok area. In fact, about 51% of total oil demand will be in BMR, while the rest of the country will be consuming only 49% of the oil in 2001.

By 2001, there will be at least five major refineries operating in the country. Four of these refineries will be located in the East (see Figure 5.3). Thai Oil and ESSO refineries are expected to produce 18,807 million litres of the oil, whereas Shell and Caltex refineries are expected to produce 12,633 million litres of the product. On the other hand, Bangchak refinery in Bangkok will produce 5,785 million litres of oil. Altogether, local refineries will be producing 37,225 million litres of oil products.

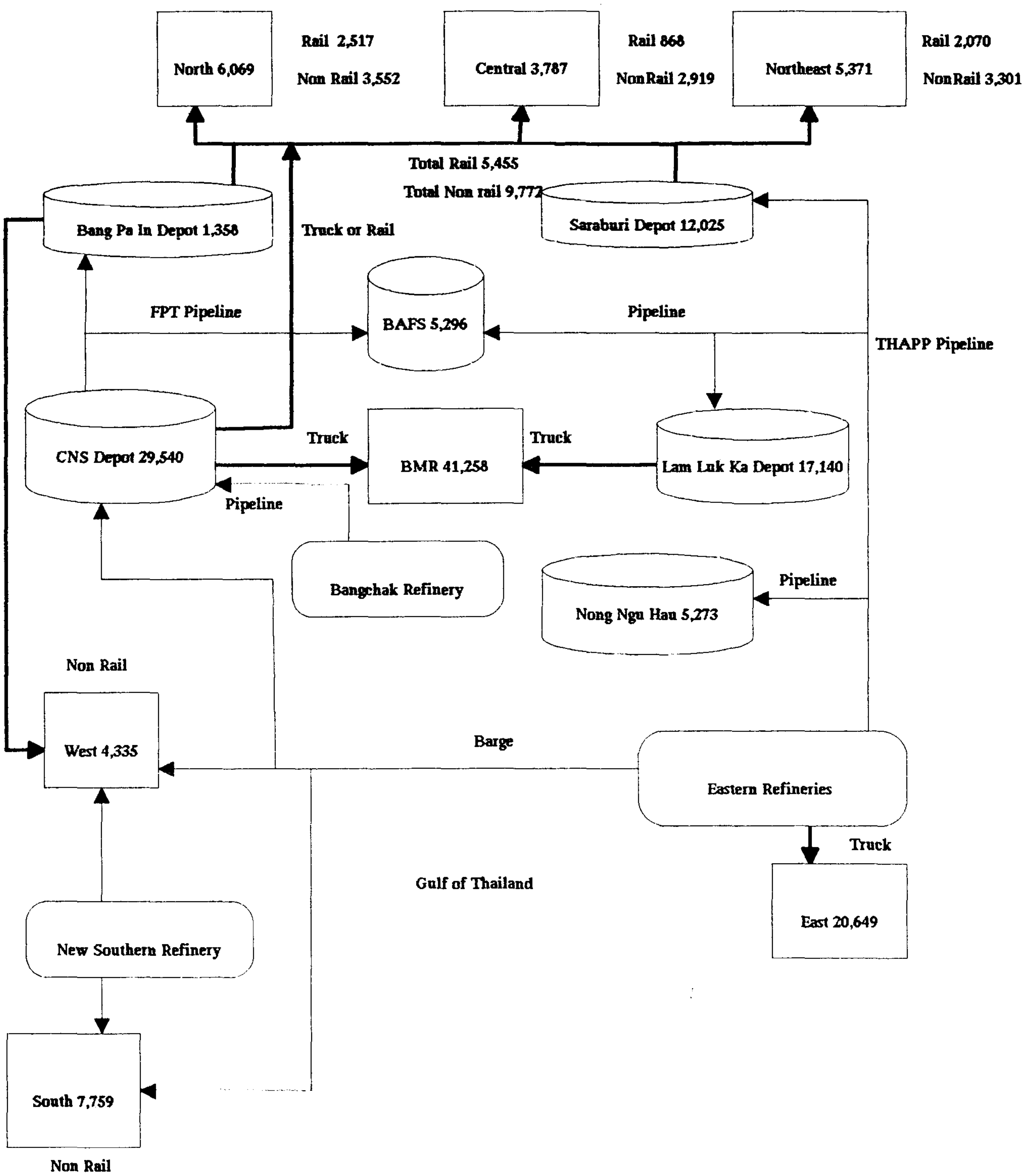
In deriving Figure 5.3, several assumptions have been made which are as follows.

- The central oil terminals at Chong Non Sri (CNS) in Bangkok will not be expanded. The throughput of the CNS depots will be capped at 1991's level (excluding fuel oil). This is consistent with the government's policy to limit the growth of CNS depots because of severe traffic conditions in the area.
- The refining capacity of Bangchak will not expand beyond 105,000 B/D.
- Future demand in Bangkok will be met from new oil terminals in Lam Luk Ka which are in the north of Bangkok.
- CNS terminals will mainly serve users in the Bangkok area and part of the West. Therefore, users in the Central, North and Northeast will be served from new oil terminals in Saraburi.
- New oil terminals in Bang Pa In will serve users in the Central region and part of the West.
- Both Saraburi and Bang Pa In terminals will be fed by pipelines. THAPP line will run from Thai Oil and ESSO refineries to Saraburi with branch lines connecting to Lam Luk Ka depots and the Bangkok Aviation Fuel Service (BAFS) terminal at Don Muang airport. FPT line will run from CNS terminals to Bang Pa In with a branch line connecting to BAFS terminal.
- Shell and Caltex refineries will be connected to THAPP pipeline.
- Consumers in the South will continue to be served by barges directly from refineries.

Thus, the regions that could potentially be served by rail in 2001 are the North and Northeast. These regions will be supplied from Saraburi depot. The amount of oil that will be transported to the North and Northeast in 2001 are 3,401 and 3,024 million litres, respectively (see Table 5.8 and Figure 5.3).

Figure 5.4
Distribution of Oil Products in 2011 (Million Litres)

Base Case : Volume of Rail = Share of 1991



Oil Demand in 2011

By 2011, total oil demand in Thailand is expected to reach 94,524 million litres. The average annual growth rate of the demand will be 6.5% during 2001-2011 period (see Table 5.8). The forecast shows that the rate of growth of oil demand in the BMR will be relatively low compared to most other regions in the country. This is consistent with future economic development trend where long term future growth will occur in new industrial areas particularly in the East. The growth rate of oil demand in the BMR will be 6% per year during 2001-2011 which is lower than the national average. On the other hand, average annual growth of the demand in the Central and West will be significantly higher than the national average. The demand in the North and the Northeast will grow at about the same rate, which will be slightly lower than the national average.

Figure 5.4 presents the forecast of the oil distribution system in Thailand in 2011. The system will be similar to that of 2001 with the exception of a few possible changes.

- The new Nong Ngu Hau airport will be opened. The airport will be linked to THAPP pipeline which will deliver jet fuel from refineries in the East.
- The refining capacity in the country will be further expanded beyond the 2001 level. New refining capacity could be added in the East. Or a greenfield refinery could be built in the South.
- THAPP line's capacity will probably be expanded to meet the growing demand.

The study assumes that Bangchak refinery, CNS depots and FPT pipeline will not expand their capacity beyond the 2001's level. This is a plausible assumption since all of the above mentioned facilities are in the Bangkok area. This also means that the future source of oil supply for the BMR will come from the Lam Luk Ka depot. Saraburi depot will also be expanded to serve the increasing demand from the Central, North and Northeast. Both the Lam Luk Ka and Saraburi depots will continue to be served by THAPP pipeline.

The future potential for rail transportation is from Saraburi to the North and Northeast. The demand for oil in the North and Northeast will reach 6,069 and 5,371 million litres in 2011, respectively. Part of these oil volumes could be transported by rail. The study thus concludes that the opportunity for rail transportation of oil products exists only for the transportation to oil depots in the North and Northeast. Long range oil transportation from refineries to other regions will be done by barges or pipelines which will be difficult for rail to compete with. A summary of oil demand forecast for the North and Northeast are shown in Table 5.9 below.

Table 5.9
Oil Demand in the North and Northeast

	Volume	Share of rail
1991	3,617	40%
2001	6,425	
2011	11,440	

The next chapter will explain in detail the amount of oil that could be transported by rail in the future.

LPG Demand

Table 5.10 presents the forecasts of LPG demand by region in the year 2001 and 2011. It is expected that total LPG demand in the country will grow from 0.996 million tons in 1991 to 2.2 million tons in 2001, and to 4.3 million tons by 2011. The average annual growth rate of LPG demand during the two ten-year periods are 8.3% and 7.0%, respectively. High growth rates are expected to come from the East as the demand from both domestic and industrial users will grow strongly. Consumption in the East will reach 0.253 million tons in 2001 and 0.536 million tons in 2011.

However, the potential for rail transport of LPG will continue to be between the East and the North and Northeast. LPG demand in the North and Northeast will grow at slightly lower rates than the national average. However, consumption in 2001 will be about twice the 1991's level. This means that about 0.264 million tons of LPG will be transported to the two regions in 2001, rising to 0.47 million tons in 2011.

The major LPG producing region in the future will continue to be the East where major refineries and GSP are situated. LPG could be supplied directly to the North and Northeast by rail from the central terminals in Sriracha. It is also technically feasible to transport LPG via oil pipeline to Saraburi. Then rail shipment of LPG could be used

Table 5.10
LPG Demand Forecast (Million Kilograms)

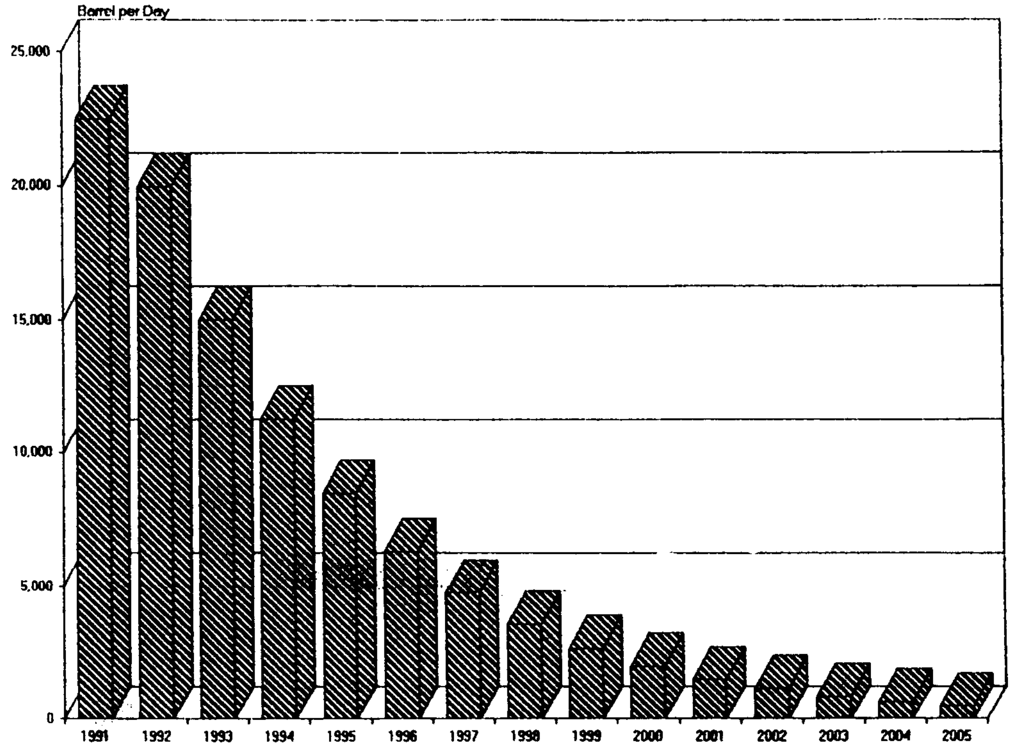
	1991	2001	2011
BMR	588	1,319	2,643
Central	44	97	190
East	82	253	536
West	34	118	225
Northeast	58	103	183
North	90	161	287
South	80	150	274
Total	996	2,202	4,338

Source: BERA estimate.

Table 5.11
Forecast of Phet Crude Production

	Unit: Barrel per Day
1991	22,500
1992	20,000
1993	15,000
1994	11,250
1995	8,450
1996	6,300
1997	4,750
1998	3,550
1999	2,650
2000	2,000
2001	1,500
2002	1,150
2003	850
2004	650
2005	500

Figure 5.5
Forecast of Phet Crude Production



from Saraburi to the North and Northeast. However, LPG shipment via oil pipeline has not been discussed by energy planners.

Crude Oil Production

Production of Phet crude at Sirikit oil field has already passed its peak. It is expected that the production will decline rapidly beginning in 1993. Production of the field was 22,500 B/D in 1991. By 1993, production will fall to 15,000 B/D (see Table 5.11). By the end of the Seventh Plan, the field will be producing only 6,300 B/D. The level of production will be depleting further to 1,500 B/D by the end of the Eighth Plan (See Figure 5.5).

Production of BP's field in Suphan Buri already started. However, the field is very small and is expected to produce only 2,500 B/D at its peak. The field will also be depleting very rapidly. No other significant inland crude oil discoveries are expected.

5.2 Rice

In Thailand, paddy has always been the major crop for millions of farmers. Paddy are grown practically in all regions of the country with major production coming from the North and Northeast regions as well as the Central plain. Part of paddy produced are retained by farmers for own consumption and as seed for the next cultivation. The rest are sold to paddy traders or rice mills. Paddy/rice trading is a complex business as the products will change hand several times from farmers to final consumers. Each step of paddy/rice trading requires a particular form of transportation, the details of which are given below.

5.2.1 Demand and Supply of Rice in Thailand

Demand for Rice

In 1991, total domestic consumption of rice amounted to 8.3 million tons (see Table 5.12). In general, the demand for rice is proportional to the number of the population. Thus, a region with large population base will consume proportionally more rice compared to smaller regions. For example, the Northeast region, with 17 million people, consumed 3.3 million tons of rice, whereas the North, with 10.92 million people, consumed only 1.8 million tons in 1991. Rice demand in the Central plain was 1.7 million tons and consumption in the South amounted to 1.0 million tons. As for Bangkok, the city consumed 0.54 million tons of rice in 1991.

Table 5.12
Rice Consumption by Region in 1991

			Unit: Tons
Region	Rice	Glutinous	Total
North	768,968	1,002,848	1,771,816
Northeast	903,899	2,419,259	3,323,158
Bangkok	534,467	1,608	536,075
Central	1,645,535	19,492	1,665,027
South	990,675	20,218	1,010,893
Total	4,843,544	3,463,425	8,306,969

Source: TDRI.

There are two kinds of rice in Thailand; 1) non-glutinous rice, or rice, and, 2) glutinous rice. Glutinous rice are grown in the North and Northeast and are mainly consumed locally. The demand for glutinous rice in the North and Northeast were 1.0 and 2.4 million tons in 1991, respectively. The share of glutinous rice to rice in the two regions are, respectively, 56% and 72%. In this study, both rice and glutinous rice are aggregated for simplicity. However, there are relatively small amounts of glutinous rice being transported from the North and Northeast to other regions

Supply of Rice

As for the supply, paddy are grown in all regions of the country. According to Table 5.13, paddy production in the North and Northeast in 1991 were 4.48, and 7.98 million tons, respectively. Production in the Central region (including East and West) amounted to 3.96 million tons, whereas production in the South was 0.77 million tons.

Of the total paddy production of 17.2 million tons in Thailand in 1991 (or 1990/1991 crop year), the share of production in the Northeast was 46.4% while the share

Table 5.13
1991 Paddy Production by Region

Region	Production of Paddy (Tons)	Percent
North	4,485,072	26.09
Northeast	7,976,351	46.39
Central	3,958,234	23.02
South	773,565	4.50
Total	17,193,222	100.00

Source: Office of Agricultural Economics, Ministry of Agriculture and Cooperatives.

Table 5.14
Regional Demand Supply Balance of Rice

Unit : Million Tons

	North	Northeast	Central	South
Paddy Production	4.485	7.976	3.958	0.773
If processed in to Rice[11]	2.85	5.00	2.51	0.49
Regional Consumption	1.99	3.37	2,46	1.13
Net Regional Surplus /Deficit	0.86	1.27	0.05	-0.64

of the Central was 23%. The shares in the North and South were 26% and 4.4%, respectively. Thus, the Northeast is the largest paddy producing region. It also has the largest population and land area compared to the other regions of the country.

Demand and Supply Balance

A quick look at the regional demand and supply balance of rice will give a clearer picture of the amount of rice being transported between regions. The Northeast

11. Less paddy kept for seed and other uses. The figures exclude stocks at the beginning of the crop year.

produced 7.97 million tons of paddy, which is equal to about 5 million tons of rice. About 3.37 million tons of rice were consumed in the region, leaving a surplus of 1.27 million tons. The surplus was sent to other regions and to the export market. The North also produced a surplus of about 0.86 million tons.

Rice production in the Central region yielded a net surplus of about 0.05 million tons. In practice, a significant part of rice produced in the Central region have been exported. Local consumption in the region have been supplied from the North and Northeast. As for the South, the demand far exceeded production. Furthermore, some of the rice produced in the South have also been exported. Thus the actual "import" of rice to the South was somewhat greater than the 0.6 million tons deficit shown in Table 5.14.

5.2.2 Paddy/Rice Distribution System

Figure 5.6 presents a general paddy/rice distribution system in Thailand. In general, farmers sell their paddy to paddy traders or 'middlemen'. It is convenience for farmers, particularly the smaller ones, to sell paddy this way because traders will come to pick up paddy at the villages. Farmers usually sell only part of their crops to traders and keep the rest for better prices at a later time.

Farmers will get a better price for their crops if they sell paddy in central paddy markets. However, this will usually require large trading volume and farmers must transport paddy to the market. Thus few farmers could take advantage of the central markets and the trading at the markets are done mainly by paddy traders.

Small- and medium-scale rice mills, particularly those in the Northeast, usually buy paddy directly from farmers because they could get better prices than buying from paddy traders. However, large-scale rice mills buy mainly from central paddy markets because these mills need a steady supply of paddy in large quantities. The central markets thus serve as a 'meeting place' for paddy traders and rice mills. Major central markets are in the Lower North in Phitsanulok, Nakhon Sawan and Chai Nat. There are also central markets in the Central and the West, such as in Singhaburi and Suphan Buri. Most of these markets are accessible both by rivers and by roads. None are accessible by rail. There are few central markets in the East and Northeast.

Figure 5.6
Paddy/Rice Distribution System

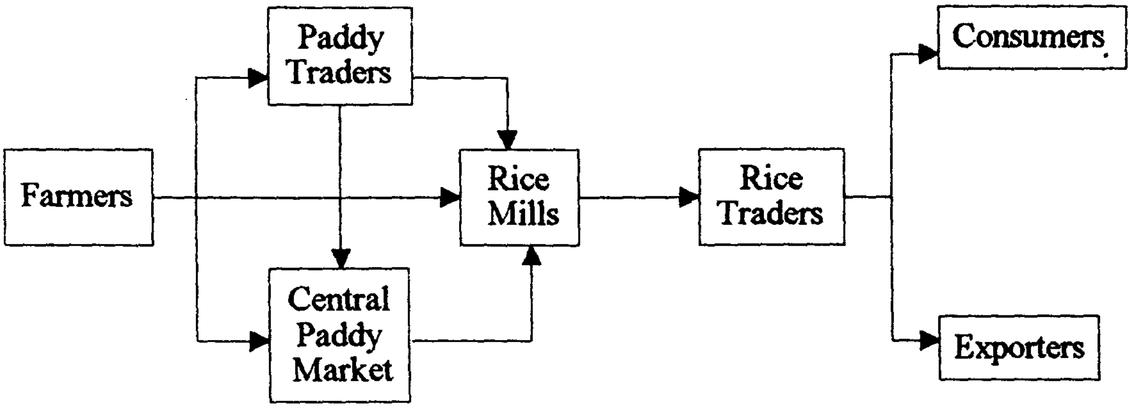


Figure 5.7

Flow of Paddy and Rice in the Northern Thailand 1990/91

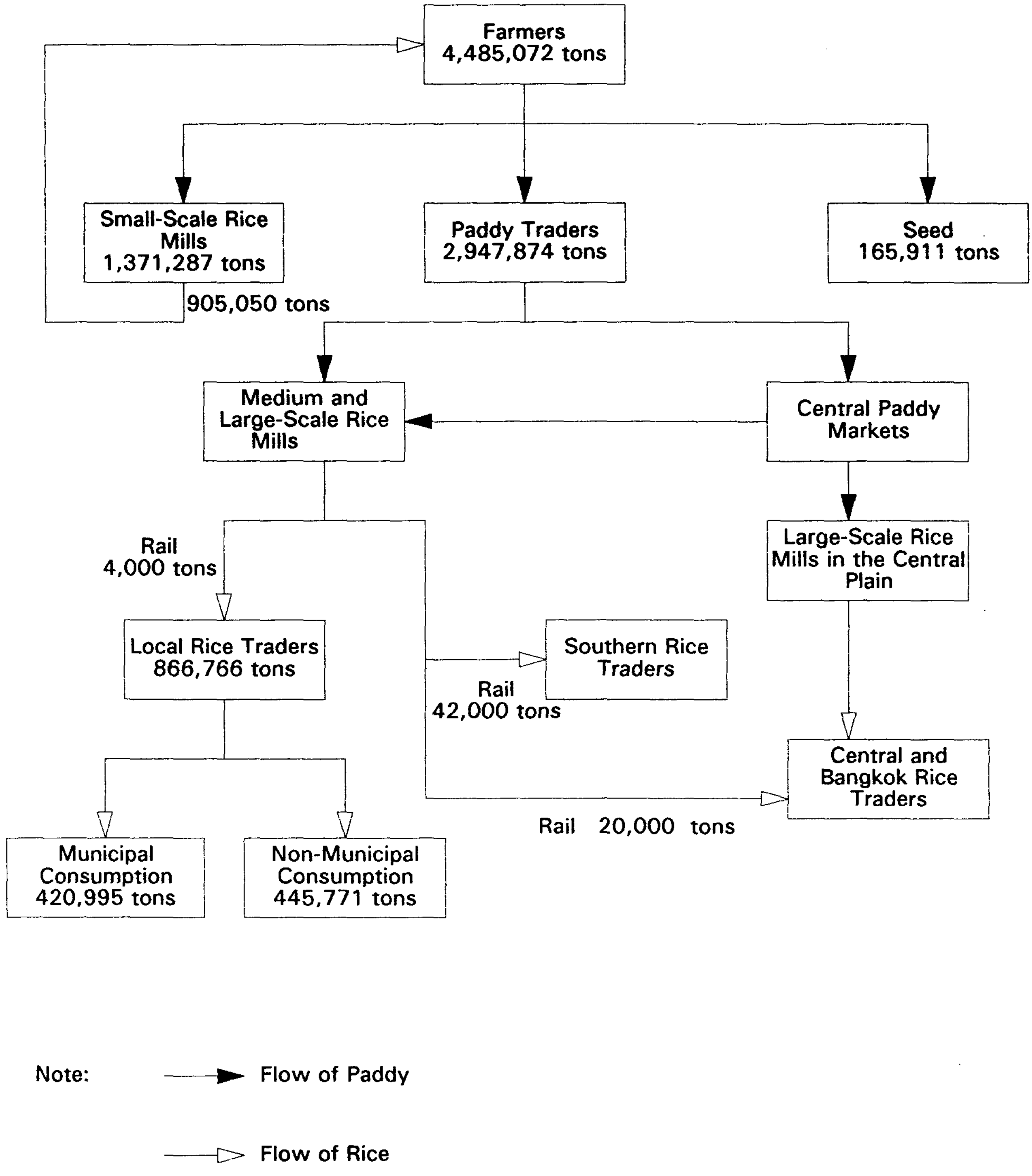


Figure 5.8

Flow of Paddy and Rice in the Northeastern Thailand 1990/91

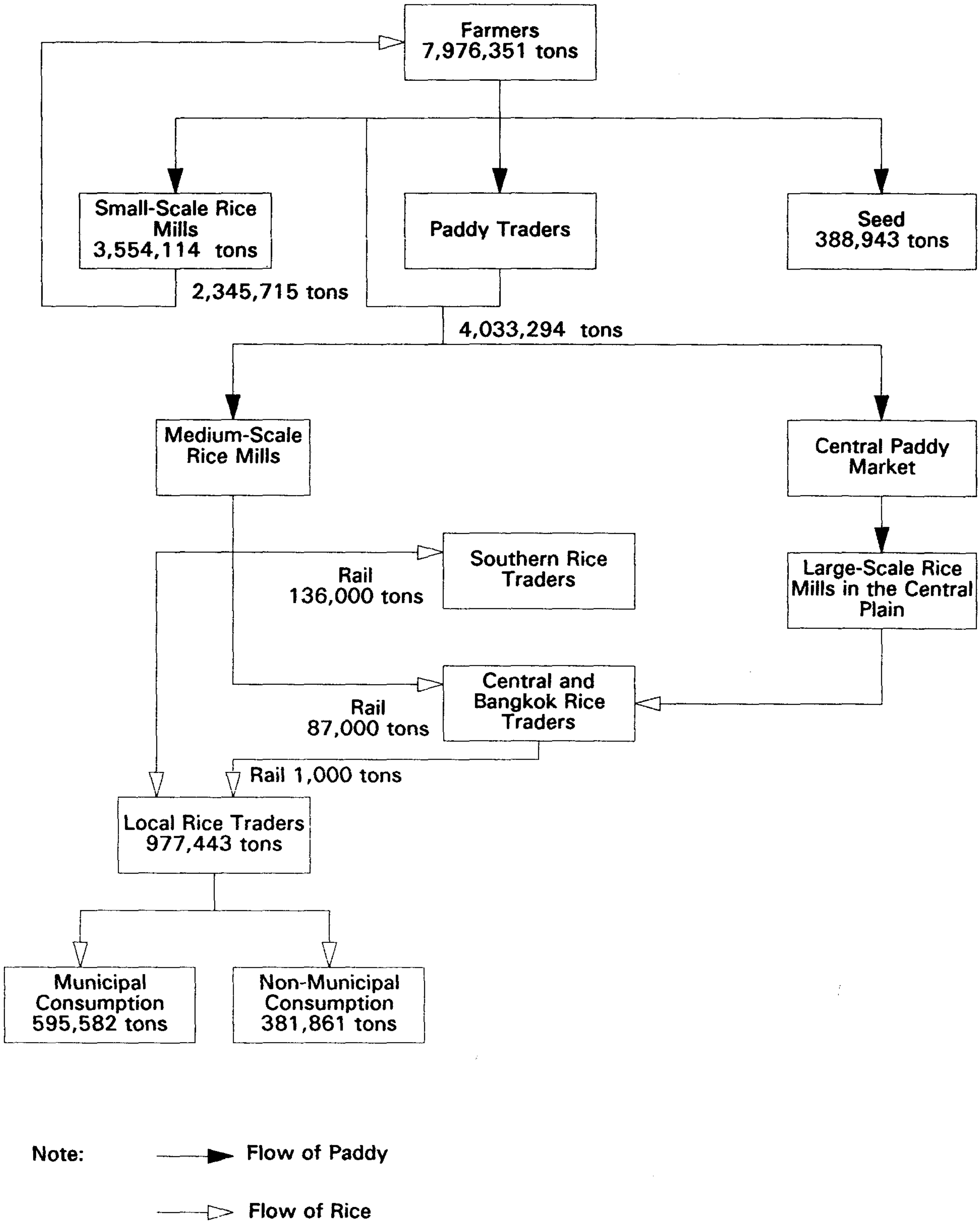


Figure 5.9

Flow of Paddy and Rice in the Central Thailand 1990/91

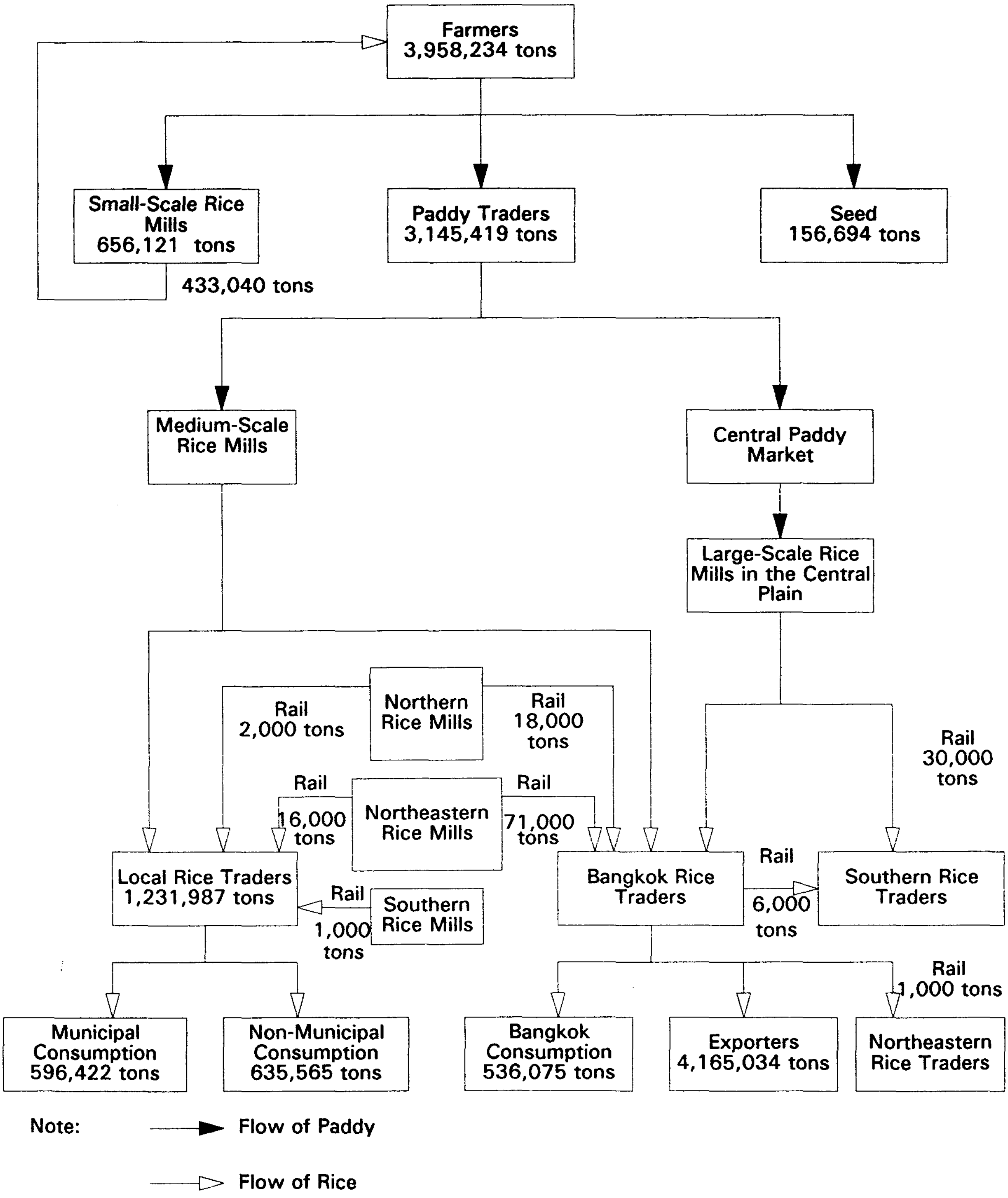
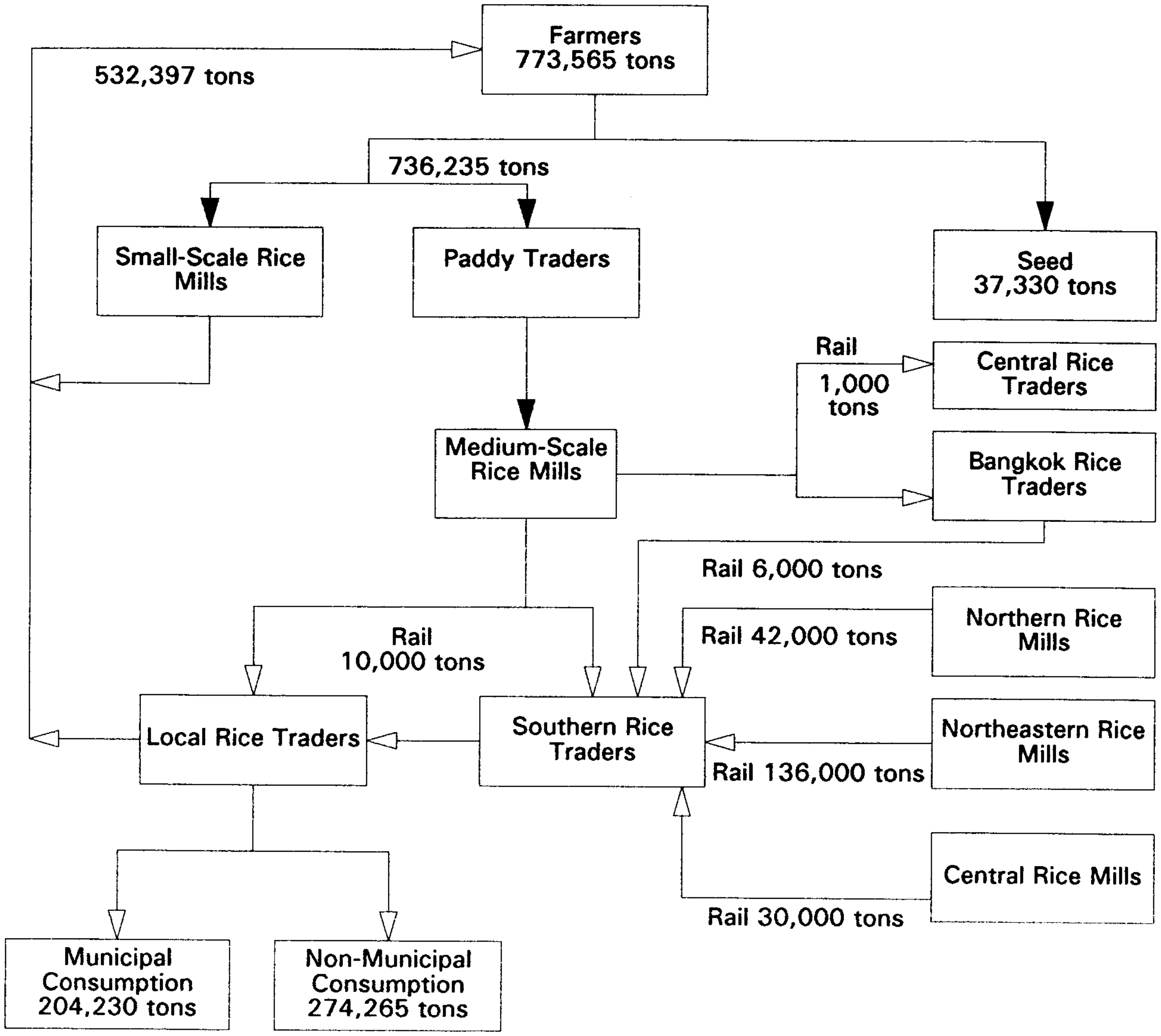


Figure 5.10
Flow of Paddy and Rice in the Southern Thailand 1990/91



Note: ──▶ Flow of Paddy

──▷ Flow of Rice

Small-scale rice mills usually serve only local farmers who have the rice milled for their own consumption. Medium-scale rice mills sell rice to local rice traders, whereas large-scale rice mills sell to major rice traders in Bangkok. Rice are then further distributed to exporters and also to domestic consumers through wholesale and retail sales channels.

5.2.3 Transportation of Paddy/Rice in Thailand

There are three modes of paddy/rice transportation in Thailand; 1) truck, 2) rail, and 3) barge. Trucks are being used as the main mode for paddy/rice transportation, while the use of river barges have been gradually declining. On the other hand, rail continues to have small share of rice transportation and is being used only on specific routes.

Northern Region

Figure 5.7 presents the flow of rice from farmers to traders and consumers. Of the 4.48 million tons of paddy produced in the 1990/1991 crop year, 1.5 million tons were kept by farmers for own consumption or as seed. About 2.95 million tons of paddy were transported, mostly by trucks and some by river barges but none by rail, to regional rice mills or down further to central paddy markets. Paddy bought from central markets were transported mainly by trucks, and some by barges, to large-scale rice mills in the Central plain.

The role of rail freight service in the North was to transport rice from local mills to rice traders in Bangkok and in the South, the volumes of which were 20,000 tons and 42,000 tons, respectively. Furthermore, a small volume of rice of about 4,000 tons were transported within the region from local mills in the lower North to Chiang Mai.

Of the 1.95 million tons of rice (equivalent) traded in the North, the share of rail transport was 3.1%.

Northeastern Region

In the Northeast, the role of central paddy markets is still limited. In this region, paddy farmers usually sell their own surplus directly to medium-scale rice mills. Paddy are then transported by trucks from farmers to the mills (see Figure 5.7). The role of rail freight service in the Northeast is to transport rice from local mills to rice traders in

Bangkok and in the South, the volume of which were 87,000 tons and 136,000 tons in 1991, respectively (see Figure 5.8).

A small amount of rice was also shipped by rail (about 1,000 tons) from Bangkok to consumers in the Northeast. Of the 2.38 million tons of rice (equivalent) traded in the Northeast, the share of rail transport was 9.4%.

Central Region (including East and West)

Compared to other regions, rice trading in the Central area is somewhat more complex. Farmers in the Central area sell most of their crops to paddy traders, who, in turn, sell to rice mills or central paddy markets. Paddy movements between paddy traders and central markets are mainly by trucks. However, there are also paddy movements between central markets in the North to large-scale rice mills in the Central Plain. These are transported mainly by trucks and some by river barges. (see Figure 5.9).

Rail service is not being used to transport rice within the Central zone. However, the service is being used to transport rice from rice mills in the Central plain to rice traders in the South, the volume of which was 28,000 tons in 1991.

About 4.8 million tons of rice were transported from various rice mills in the Central, North and Northeast to major rice traders in Bangkok. Part of the rice were for local consumption in the Bangkok area, but the majority of them were for export. The main mode of transportation from these mills was by truck with some by river barges and rail. Total rail shipment of rice to Bangkok in 1991 was 89,000 tons. This was equal to 1.8% of total rice transported to Bangkok in 1991.

A small amount of rice (about 6,000 tons) was shipped by rail from Bangkok to rice traders in the South, and about 1,000 tons were sent to the Northeast.

Southern Region

As shown in Table 5.15, rice demand in the South far exceeded local supply. Thus, a significant amount of rice must be sent from other producing regions to consumers in the South. Rail volume of rice shipments to the South in 1991 were as follows.

Total rice shipments by rail to the South was 224,000 tons. This was about 31% of total rice shipments to the region in 1991 of about 718,000 tons. The rest of the shipments was done entirely by trucks.

Part of the rice produced in the South were sent to Bangkok for export. The estimated volume of rice export from the South was 150,000 tons in 1991. The shipments to Bangkok were done entirely by trucks. Rice were also exported to Malaysia. The volume of rail shipments to Malaysia in 1991 was 50,000 tons. (see Figure 5.10).

Table 5.15
Rice Shipments to the South

Unit: Tons

From	Volume
North	42,000
Northeast	136,000
Central	28,000
Bangkok	6,000
Total	212,000

5.2.4 Forecast of Rice Production and Consumption by Region

Production in 2001 and 2011

Table 5.16 presents the forecasts of paddy production by region for 2001 and 2011. The figures include both rice and glutinous rice. Total paddy production in 2001 is expected to reach 24.8 million tons and will increase further to 28.9 million tons in 2011. Compared to normal rice production of about 21 million tons in the past, the average growth rate of rice production during the next ten years will be about 1.6% per year. The growth rate is expected to decline slightly to 1.5% per year during 2001-2011. TDRI's study assumes that the increase in rice production will come mainly from increased productivity, not from the expansion of cultivated land like in the past. Farmers will probably change to grow high yield crops. The use of fertilizer and farm mechanization will also increase, resulting in higher paddy output.

On a regional basis, the Northeast will continue to be the leading paddy growing region of the country. About 11 million tons of paddy will come from the region in 2001 compared to 8 million tons in 1991.

The North will be producing 6 million tons of paddy, whereas about 5.7 million tons will come from the Central area. The South will continue to be a small paddy growing region, with output in 2001 of about 1 million tons.

Table 5.16
Forecast of Total Paddy Production by Region

		Unit: Tons
Region	2001	2011
North	6,464,363	7,539,280
Northeast	11,494,128	13,405,412
Central	5,703,704	6,652,136
South	1,114,973	1,300,374
Total	24,777,168	28,897,202

Source: TDRI Estimate.

In the longer term, paddy production in the Northeast will continue to rise to 13 million tons by 2011. This will be followed by 7.5 million tons in the North and 6.6 million tons in the Central region. About 1.3 million tons will be produced in the South.

Consumption in 2001 and 2011

The level of regional consumption is important because it will determine the amount of regional rice surplus and consequently, the amount of rice to be transported to other regions or export. Rice consumption is determined by the amount of population in the region, which will grow at about 1.4% per year. However, some regions will grow faster or slower than the others. This will affect long term rice consumption which is shown in Table 5.17.

Total rice demand in Thailand is expected to reach 9.5 million tons in 2001, and 12 million tons in 2011. The forecasts include the amount of rice kept by farmers for own consumption.

Table 5.17
Forecast of Total Rice Consumption by Region

		Unit: Tons
Region	2001	2011
North	2,188,122	2,846,194
Northeast	3,612,365	4,620,755
Bangkok	809,261	967,831
Central	1,405,678	1,775,126
South	1,484,151	1,892,583
Total	9,499,577	12,102,489

Source: TDRI Estimate.

Over one third of total rice demanded will be consumed in the Northeast region. Consumption in the Northeast will reach 3.6 million tons in 2001 and will rise further to 4.6 million tons in 2011. The second largest consuming region is the North, followed by the South and Central. About 2 million tons of rice will be consumed in the North, whereas consumption in the South and Central will be around 1.4 million tons in 2001.

In order to determine the amount of rice to be transported, the study has calculated the quantity of rice surplus or deficit in each of the regions. The quantity is the difference between regional rice production and the amount consumed or kept for seed by farmers within the region.

According to Table 5.18, the Northeast region will be producing 7.6 million tons of rice, and 3.6 million tons of which will be consumed within the region. This leaves about 4.0 million tons of rice to be transported to other regions. Most of the surplus rice will probably be transported to the Central region for export. As for the North, the region will have about 2.07 million tons in surplus. The Central region will also have a surplus of about 1.56 million tons. On the other hand, the Southern region will produce about 0.7 million tons of rice while consuming 1.48 million tons. Thus, the region will need to 'import' rice from other regions of about 0.77 million tons in 2001. Overall, about 5-6 million tons of rice will be transported inter-regionally in 2001.

Table 5.18
Inter-regional Transportation of Rice

Unit: Million Tons

	North	Northeast	Central	South
		2001		
Paddy Production	6.46	11.5	5.70	1.10
Rice Equivalent[12]	4.27	7.59	3.76	0.74
Regional Consumption	2.20	3.60	2.20	1.48
Regional Surplus/Deficit	2.07	3.99	1.56	-0.74
		2011		
Paddy Production	7.50	13.40	6.60	1.30
Rice Equivalent[3]	4.98	8.85	4.39	0.86
Regional Consumption	2.85	4.60	2.74	1.89
Regional Surplus/Deficit	2.13	4.25	1.65	-1.03

During the period of 2001-2011, regional consumption of rice will be growing steadily. However, the study predicts that the production of rice will also grow by about the same proportion. Thus the amount of rice surplus in each of the three regions will change only slightly. However, the deficit in the South will reach 1 million tons in 2011. Overall, the total amount of rice to be transported inter-regionally will be about 6 million tons in 2011.

12. Adjusted for paddy saved for seed.

5.3 Cement

Cement has been one of Thailand's leading industries for a number of years. Domestic production capacity has been continuously expanded to meet the growing demand for construction. The study projects that cement demand in Thailand will continue to grow at a strong rate well into the future to serve the need of growing economic activities. Meanwhile, the mode of transportation of cement has been dominated by truck. Rail has played an important but relatively minor role compared to that of truck.

5.3.1 Demand and Supply of Cement

Total demand for cement in Thailand was 22.67 million tons in 1991. About 45% of the total demand came from Bangkok, and about 26% came from the Central area. Thus 71% of total cement consumption came from these two areas (see Table 5.19). On the other hand, demand in the North and Northeast were about 2 million tons a year each, whereas the demand in the South was about 1.7 million tons.

High cement demand in Bangkok and the Central areas were directly related to the high growth in construction in these two areas during the past years. There were large construction projects from both the public and private sectors, including highway expansions and office building constructions.

About half of the cement consumed in 1991 were in bagged form, while the rest were in bulk. Bagged cement were used in small projects such as construction of residential housing or small commercial buildings. On the other hand, bulk cement were supplied to large construction sites such as major infrastructure projects, or large commercial buildings. Most of the bulk cement were used in the Bangkok areas, whereas most construction projects in up-country provinces used bagged cement. This consumption pattern has had significant implications on the distribution and transportation of cement (see below).

As for the long term growth rate, the demand for cement in Thailand has grown at an average annual rate of 13.5% since 1981 (see Table 5.20). However, very high growths have occurred during the last few years, when changes in demand were as high as 25-30% per year. On the other hand, domestic production of cement has grown at a moderate rate during the period. The production was 11.6 million tons in 1988 and rose to 15.1 million tons and 18.1 million tons in 1989 and 1990, respectively. Furthermore,

Table 5.19
Demand for Cement by Region in 1991

			Unit: Tons
Region	Bagged	Bulk	Total
North	1,633,551	434,235	2,067,786
Northeast	1,834,196	786,084	2,620,280
Bangkok	3,084,978	7,198,281	10,283,259
Central	3,666,064	2,343,877	6,009,941
South	1,321,379	372,697	1,694,075
Total	11,540,167	11,135,174	22,675,341

Source: Department of Internal Trade, Ministry of Commerce.

Table 5.20
Production, Import and Export of Cement

				Unit: Tons
Year	Production	Import	Export	Domestic
				Demand
1981	6,312,192	108,045	55,861	6,364,376
1982	6,663,984	883	173,677	6,491,190
1983	7,319,819	11,016	135,166	7,195,669
1984	8,300,897	6,351	44,969	8,262,279
1985	7,973,353	2,052	36,443	7,938,962
1986	7,965,656	3,486	41,534	7,927,608
1987	9,916,733	3,237	153,686	9,766,284
1988	11,588,829	3,258	62,089	11,529,998
1989	15,105,050	94,195	43,381	15,155,864
1990	18,145,515	842,080	11,820	18,975,775
1991	19,298,148	3,399,131	21,938	22,675,341

Note: The cement in this table includes Mixed&Portland, White and Other Cement.
Source: Bank of Thailand, Business and Industrial Statistics, Various Issues.

production grew only slightly during 1990-1991. As a result of a time-lag in production capacity expansion, import had grown significantly during the past few years.

Imports that averaged about 3,000 tons per year during the mid-1980's, grew substantially to 94,000 tons in 1989, and to 0.8 million tons and 3.4 million tons in 1990 and 1991, respectively.

The production capacity of domestic cement plants in 1991 was 16.6 million tons. About 86% of the total capacity was in Saraburi province. This consisted of two large cement plants in Kaeng-Khoi and Tub-kwang and another plant in Ta-luang, with combined capacity of 12.72 million tons (see Table 5.21). There are three other plants, one in the North and two in the South, which are relatively small.

Table 5.21
1991 Production Capacity of Cement Plants

Company	Location	Million Tons/Year
Siam Cement		9.82
-Kaeng-khoi	Saraburi	
-Ta-luang	Saraburi	
-Khow-wong	Saraburi	
-Thung-song	Nakhon Si Thammarat	
Siam City Cement		5.35
-Tub-kwang	Saraburi	
Jalaprathan Cement		1.4
-Takhli	Nakhon Sawan	0.5
-Cha-am	Phetchaburi	0.9
Total		16.57

Note: The Plants in Khow-wong produce only white cement.
Source: Department of Internal Trade, Ministry of Commerce.

Figure 5.11
Cement Distribution System

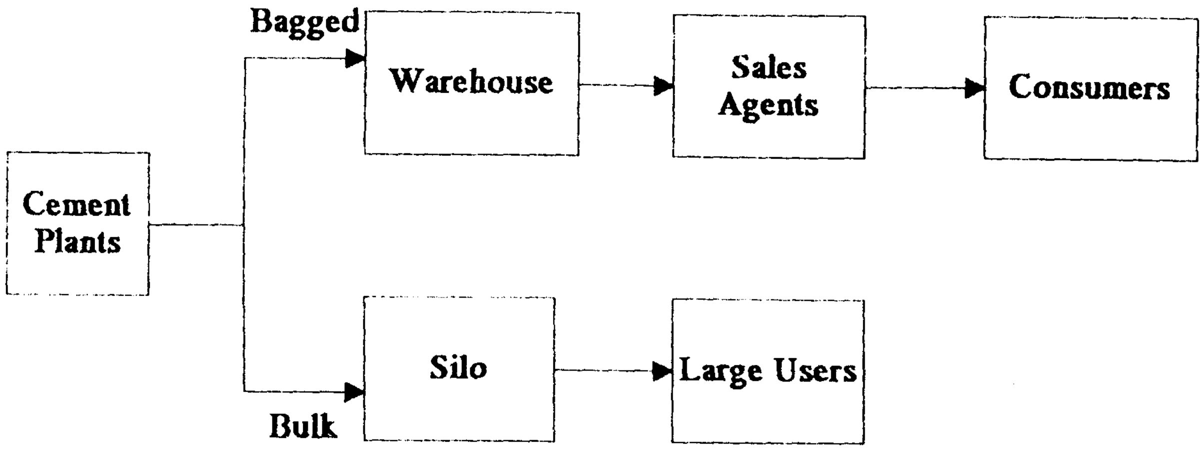
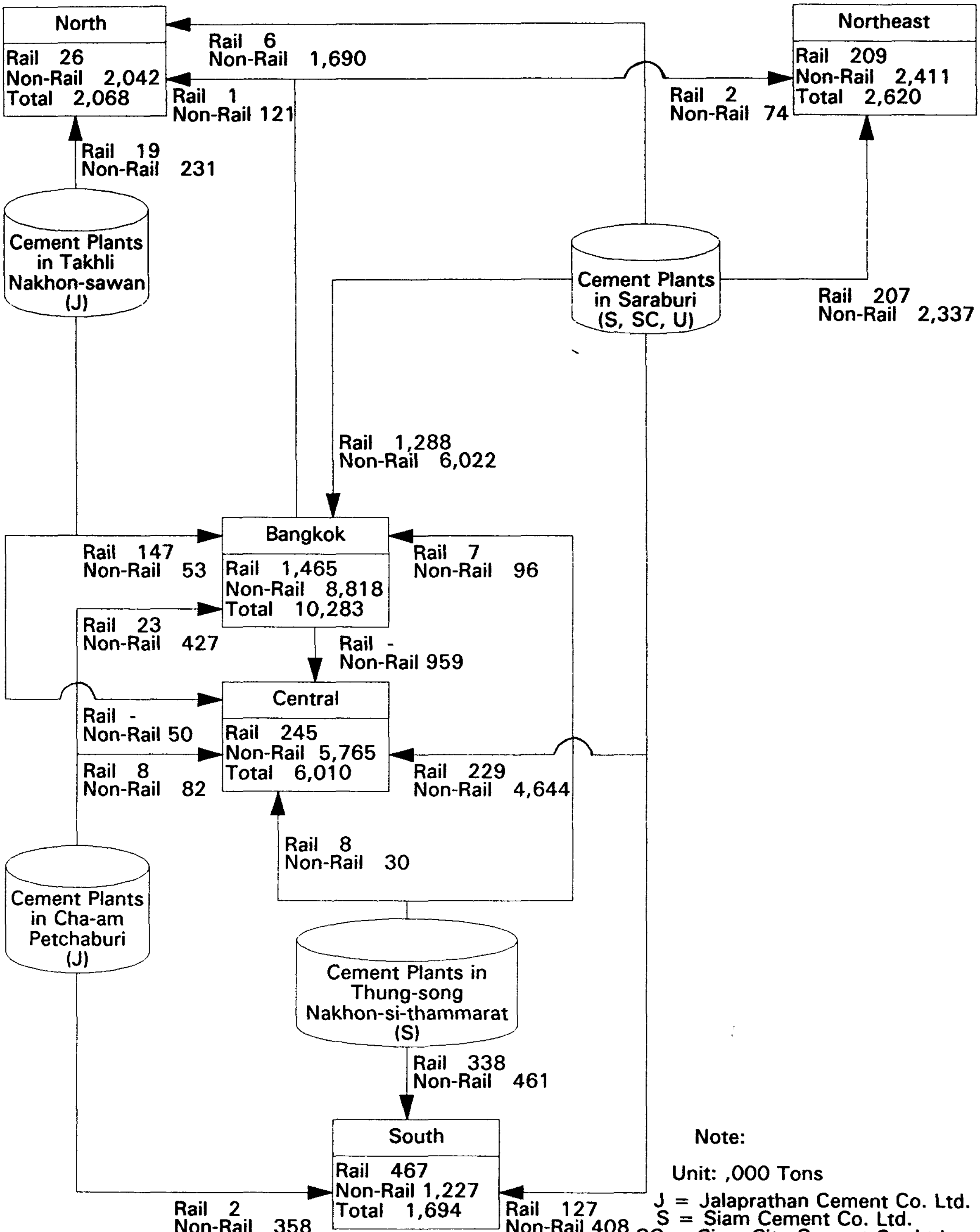


Figure 5.12
Distribution of Cement in 1991



Note:

Unit: ,000 Tons

J = Jalaprathan Cement Co. Ltd.
S = Siam Cement Co. Ltd.
SC = Siam City Cement Co. Ltd.
U = Universal White Cement Co. Ltd.

5.3.2 Distribution System of Cement

Compared to rice, the distribution system of cement is less complex. From cement plants (or imports), bagged cement are sent to warehouses located in various parts of the country. In general, large regional cities will have cement warehouses which serve as main distribution centers for cement in the area. From the warehouses, bagged cement will be further distributed to sale agents which are retailers of construction materials (see Figure 5.11).

On the other hand, bulk cement are sent to silos for bulk storage. There are much fewer number of silos in the country compared to warehouses. Most of the silos are in the Bangkok area because the demand are high. From bulk silos, cement are transported to large users, which include factories producing cement products.

5.3.3 Transportation of Cement

According to Figure 5.12, the major cement producing center is located in Saraburi which is in the Central part of the country. From cement plants in Saraburi, both bulk and bagged cement are transported to dealers by rail and truck. There are also other cement plants in the North and South where cement are being distributed to consumers by various modes of transportation, including barge.

Cement Transportation to Bangkok and theCentral Area

Users in Bangkok and the Central area consumed 10.3 and 6.0 million tons of cement in 1991, respectively. These users received most of their cement supply from Siam Cement's and Siam City Cement's plants in Saraburi. Cement were shipped mainly by truck from the plants to users, with rail playing a minor role in the transportation.

Of the 10.3 million tons of cement demanded in Bangkok in 1991, 1.465 million tons, or 14.2%, were transported by rail (see Table 5.22). About 1.29 million tons of rail supply to Bangkok came from cement plants in Saraburi, 0.147 million tons came from Takhli's plant in Nakhon Sawan, and 0.023 million tons came from Cha-am's plant in Phetchaburi. In addition, there were 7,000 tons of cement shipment by rail from Thungsong's plant in the South to Bangkok.

Most of the cement shipment by rail to Bangkok are in bulk form. In 1991, bulk rail shipment to Bangkok amounted to 1.3 million tons, which was equal to 91% of the total rail transportation of cement to the city. Bulk cement shipment has been popular because most major construction projects now use pre-mixed concrete for convenience and economy. However, truck also plays a significant role in bulk cement shipment, because it accounted for 45% of total bulk cement transport to Bangkok in 1991. In addition, a small quantity of 0.29 million tons of bulk cement was shipped by barge from Cha-am to Bangkok.

Bagged cement shipment by rail was even less popular, as records show that rail was used to transport only 0.1 million tons, or 5% of bagged cement demanded in Bangkok. The rest was supplied by truck.

As for the Central region, rail transportation of cement amounted to 0.245 million tons in 1991, which was about 4% of total cement consumed in the region. The rest of the demand was met by truck supply, with a small quantity of barge shipment from Tha-luang.

Table 5.22
1991 Transportation of Cement by Region, by Mode

Unit: Tons

Cement Plants-Destination	Rail	Non-Rail
North	26,000	2,041,786
Northeast	209,000	2,411,280
Bangkok	1,465,000	8,818,259
Central	245,000	5,764,941
South	467,000	1,227,075
Total	2,412,000	20,263,341

Source: State Railway of Thailand.

Cement Transportation to the North

Users in the North consumed 2 million tons of cement in 1991. The region was being supplied by cement plants in Nakhon Sawan and Saraburi, with the latter being the major supplier. Cement plants in Saraburi, particularly that of Siam Cement's, use lignite as the main fuel. Lignite supply for Siam Cement comes by truck from Ban Pu's mine in Lampang. These trucks then carry cement back to dealers in the North on their return trips. Thus the use of trucks to transport cement to the North has strong cost advantage over rail. As for Siam City Cement, the supply of lignite comes by truck from Nong Ya Plong in Phetchaburi Province.

Rail is being used to transport mostly bagged cement to dealers in the North. The quantity was only 26,000 tons in 1991 which was only 1.6% of total cement consumed in the region. The rest of the cement supply to the region was carried by truck.

Cement Transportation to the Northeast

The Northeast region consumed slightly more cement than the North. The demand in 1991 was 2.6 million tons. The major source of supply of cement in the Northeast has been from the cement plants in Saraburi. However, Jalaprathan Cement has also attempted to market its cement in the region, but the volume has been small. It is difficult for Jalaprathan to compete on transport cost basis with Siam Cement and Siam City Cement, who have the plants built at the door steps to the Northeast.

Like in the other regions, the popular mode of transportation of cement to the Northeast has been truck. Only 0.21 tons of cement were carried by rail in 1991, which was equivalent to 8% of the total cement demanded in the region. The rest of the demand was met by truck supply. Most of the cement consumed are in bagged form. Like in the North, bulk cement to the Northeast are supplied by truck.

Cement Transportation in the South

The Southern region has two cement plants, one located in Cha-am and the other in Thung-song. The two plants have a combined capacity of 1.5 million tons, while the demand in the South was 1.7 million tons in 1991. However, the 'import' of cement to the South have been larger than the 0.2 million tons deficit, as Jalaprathan Cement has also sold its cement from Cha-am to other regions as well.

Rail shipment to the South was relatively more significant compared to the North and Northeast. In 1991, 0.467 million tons of cement were shipped by rail to and within the Southern region. This included 0.127 million tons shipment from plants in Saraburi, 2,000 tons from Cha-am, and 0.338 million tons from Thung-song plant. Some of the rail shipment were bounded for Malaysia for export. Rail shipment to the South in 1991 accounted for 27.6% of total cement demanded in the region.

The overall rail shipment of cement in Thailand in 1991 was 2.4 million tons, which accounted for 10.6% of total cement transportation in the country.

5.3.4 Future Cement Demand and Production Capacity

The demand for cement in Thailand is expected to grow strongly in the future. This is also true for domestic production capacity which will expand at a high rate, particularly during the next five years. Table 5.23 presents the latest plan for capacity expansions by cement plants, both old and new, between 1992 and 1996. It is interesting to note that Saraburi will continue to be the center for cement production in the future. Both the existing producers and newcomers aim to expand or build their future production capacity in Saraburi. This is due mainly to the availability of limestone, one of the most important raw materials for cement production, which is available in abundance in the province. Although there are other limestone sources in the country, the deposits are not quite as large as in Saraburi. Furthermore, most of these deposits are in national parks, wild life reserves or other environmentally sensitive areas, making it difficult to build or expand cement plants in these areas of the country.

In the medium term, Siam Cement will expand its production capacity from 13.05 million tons in 1992 to 19.4 million tons in 1996. Most of the expanded capacity will be in Saraburi. This is also true for Siam City Cement, which has all of its plants built in the province. Siam City's capacity is currently at 6.7 million tons, and the capacity will be expanded to 12.3 million tons by 1996.

Jalaprathan Cement is the only company not having a plant in Saraburi. Due to some technical constraints at the two plants, Jalaprathan cement will keep its current capacity of 1.6 million tons constant for the time being.

TPI Polene is a new comer who has recently opened a new plant in Saraburi. The initial production capacity of TPI Polene is only 0.34 million tons, but this will be raised to 2.6 million tons soon. The capacity will be further expanded to 5 million tons in 1995.

Table 5.23
Production Capacity of Cement Plants

Company	Location	Million Tons/Year				
		1992	1993	1994	1995	1996
Siam Cement		13.05	15.8	18.2	18.2	19.4
-Kaeng-Khoi	Saraburi					
-Ta-luang	Saraburi					
-Khow-wong	Saraburi					
-Thung-song	Nakhon Si Thammarat					
Siam City Cement		6.7	9.3	10.8	12.3	12.3
-Tub-kwang	Saraburi					
-Tub-fha	Saraburi					
Jalaprathan Cement		1.6	1.6	1.6	1.6	1.6
-Takhli	Nakhon Sawan	0.7	0.7	0.7	0.7	0.7
-Cha-am	Phetchaburi	0.9	0.9	0.9	0.9	0.9
TPI Polene	Saraburi	0.34	2.6	2.6	5	5
Asia Cement	Saraburi		0.6	2	2	2
Other		0.1	0.45	0.85	0.85	0.85
Total		21.79	30.35	36.05	39.95	41.15

Source: Department of Internal Trade, Ministry of Commerce.

There will be several other new cement plants opening up in the country. Asia Cement will open its plant in Saraburi next year with 0.6 million tons initial capacity. This will be raised to 2 million tons in 1994. There are also other small cement plants to be opened in the province with a combined capacity of about 0.85 million tons.

The combined capacity of all the cement plants in the country is expected to be 41.15 million tons in 1996, about 25 million tons higher than the present capacity.

As for the demand, the level of consumption is expected to reach 37.1 million tons in 1996. This is equal to an annual growth rate of about 8.6% between 1991-1996. This also means that there will be about 4 million tons surplus capacity in 1996. (see Table 5.24).

Table 5.24
Forecast of Demand for Cement

						Unit: Tons
Year	North	Northeast	Bangkok	Central	South	Total
1991	2,067,786	2,620,280	10,283,259	6,009,941	1,694,075	22,675,341
1996	2,998,789	3,857,348	17,350,760	10,584,160	2,349,943	37,141,000
2001	3,811,631	4,844,743	25,736,313	16,322,997	2,922,075	53,637,758
2011	7,390,839	9,580,121	53,729,070	34,461,744	5,817,363	110,979,136

In the longer term, it is reasonable to assume that the capacity will be adjusted to correspond with the demand, i.e., there will be a net balance between production and consumption. According to TDRI's projection in Table 5.24, the long term demand for cement will grow at a rate proportional to that of the growth in GDP for construction. That is the 'intensity' of cement consumption per unit of GDP will be unchanged for the projected period. Using this methodology for the projection of regional consumption of cement yields the results as shown in Table 5.24.

Cement Demand in 2001

According to Table 5.24, cement demand in Bangkok will continue to grow at a some what lower rate compared to that in the past. The growth rate will be around 8.2% per year between 1996-2001 with the annual demand reaching 26 million tons in 2001. However, the Central area will have a slightly higher growth rate which will be about 9% per year between 1996-2001. The demand in the Central will reach 16.3 million tons per year at the end of the Eighth Plan.

However, the growth in the demand in Bangkok and the Central area will continue to surpass that in the other regions of the country. By 2001, cement demand in the North will increase from 3 million tons in 1996 to 3.8 million tons. This is equal to a 4.9% average annual growth rate. As for the Northeast, the demand will reach 4.8 million tons compared to 3.9 million tons in 1996. The average annual growth rate of the demand in the Northeast is expected to be 4.7% between 1996-2001. This will be about the same growth rate as in the South, where the demand is expected to grow from 2.3 million tons in 1996 to 2.9 million tons in 2001.

Figure 5.13 shows future cement demand by region and possible mode of transportation. As mentioned above, the center of cement production will continue to be in Saraburi. Thus, the distribution network will be largely unchanged from Figure 5.12. However, the demand in the various regions will grow significantly from 1991's level. The need to transport cement will grow by 1.8 million tons in the North, 2.2 million tons in the Northeast, and 1.2 million tons in the South between 1991-2001. Furthermore, the bulk of cement transport requirement will continue to be between cement plants and Bangkok as well as the Central areas. About 15 and 10 million tons more cement will need to be transported to Bangkok and the Central area, respectively, between now and the year 2001.

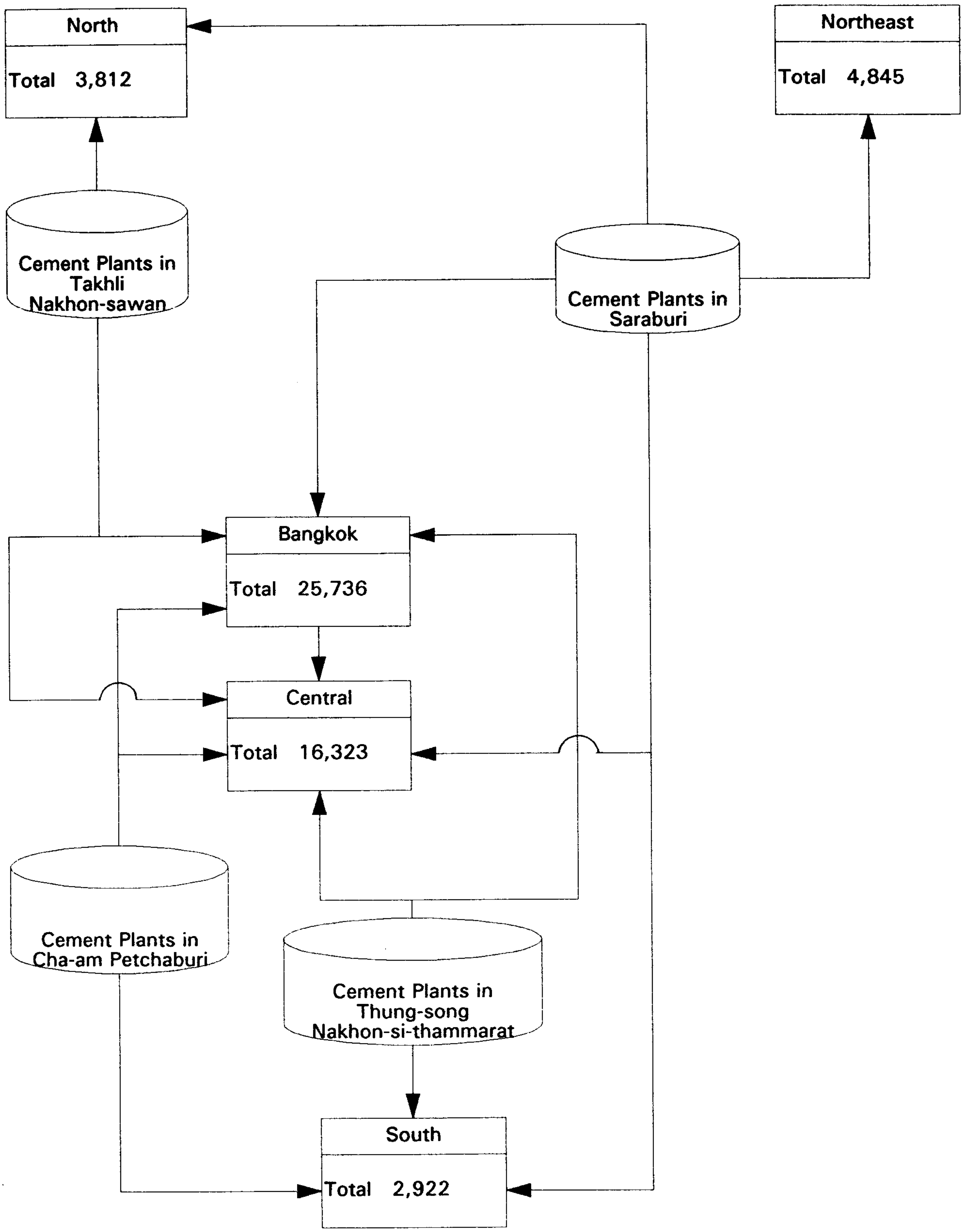
The possible modes of cement transportation will continue to be by truck and rail. Barge will probably play a decreasing role as the future production will occur in inland locations not accessible by barges. However, the possible extent of the rail business will be discussed in the next Chapter.

Cement Demand in 2011

In the long term, the demand for cement will continue to grow further. According to Table 5.24, the study expects the demand for cement in 2011 to be double the level in 2001 in all regions. In general, the average annual growth rate in Bangkok and the Central areas will gradually decline to about 7.6%, because future economic activities will be diversified to other regions of the country. This means the growth rate of the demand for cement in the North, Northeast and South will be gradually increasing to correspond with the increased economic activities in these regions. The average annual growth rates of cement demand are expected to be 6.91%, 7.2% and 7.2% for the North, Northeast and South, respectively, between 2001 and 2011.

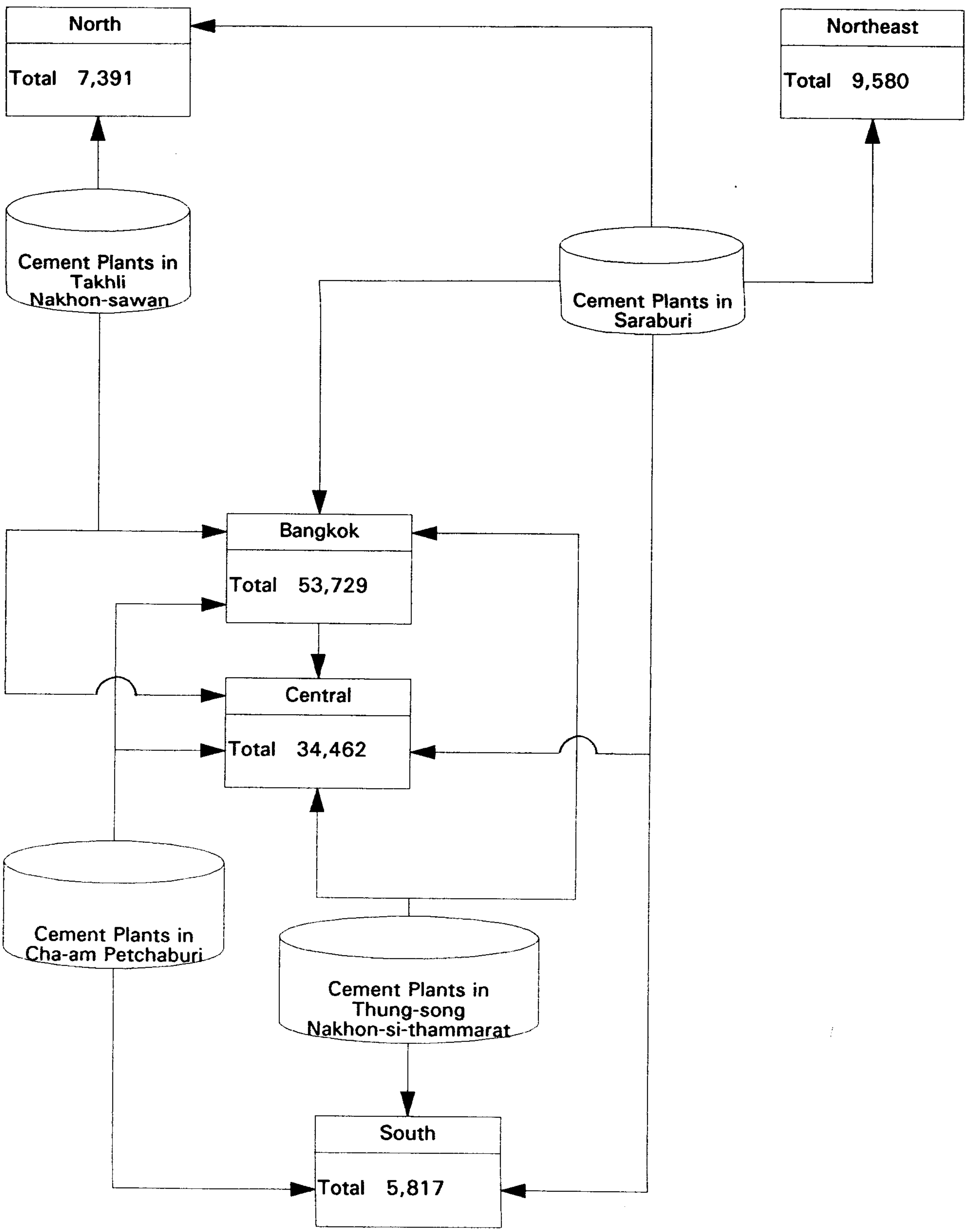
Figure 5.14 shows the long term regional cement demand and possible distribution system. The demand in the North will be increased by 5.4 million tons from 1991's level. This could be met by the supply from plants in Saraburi and Takhli. It is possible to have new cement plants built in new locations in 2011, but it is likely that Saraburi will probably continue to be the major cement producing province in the long term because of its advantage in having large limestone deposits as mentioned above. As for the Northeast, the demand in 2011 is expected to be about 7 million tons more than the region's consumption in 1991. The region will be served by cement plants in Saraburi as well.

Figure 5.13
Distribution of Cement in 2001



Unit: ,000 Tons

Figure 5.14
Distribution of Cement in 2011



Unit: ,000 Tons

The demand in Bangkok will reach 54 million tons in 2011, about 44 million tons higher than the present demand. This implies a large potential for cement transport between Saraburi and the capital city. It is expected that most of the cement demand in Bangkok will come in bulk form making it suitable for bulk rail transport. As for the Central region, the demand will reach 34 million tons in 2011, about 28 million tons higher than the 1991's level. Again, the demand will probably be served mainly from plants in Saraburi.

The Southern region will see its demand for cement growing from 2.9 million tons in 2001 to 5.8 million tons in 2011. The latter will be about 4.1 million tons higher than the present level of consumption. The scope for rail transportation of cement in the South is relatively strong because of the long distribution distance and the potential for cement export to Malaysia.

5.4 Container

5.4.1 Demand for Containerized Cargo Transportation

Containerization of cargo transportation is not new. The method was first used in the United States before World War II, and its use has gradually been accepted as an efficient way of cargo transportation world-wide[13]

Containerization will speed up cargo handling at ports and during shipments, minimize cargo damages from contamination and losses, and simplify customs procedures. All of these advantages are translated to increased convenience and reduced costs of cargo transportation. This is the reason why international cargo shipments have been increasingly containerized.

Cargo shipments in Thailand have also caught on with the above development trend as the country's international trade volume has been growing steadily during the past fifteen years. Volume of imported cargo through Bangkok's Klong Toey Port was 3.5 million tons in 1977. This has steadily grown over the years and has now reached 8.2 million tons. On the other hand, export volume has shown much stronger growth during the period. The volume of export, excluding bulk agricultural commodities and minerals, rose from 0.5 million tons in 1977 to 7.2 million tons in 1991. The average annual growth

13. JICA (1989).

rates of import and export volumes during the past fifteen years were 6.3% and 21.4%, respectively (see Table 5.25).

It is interesting to note that the share of containerized cargoes in total trade volume has grown dramatically, particularly for export. About 47% of export cargoes in 1977 were containerized. However, the share of containerized export cargo rose quickly to 88% in 1980, and to 99% in 1985. Nowadays, nearly 100% of export cargoes from Thailand, excluding bulk agricultural commodities and minerals, are containerized (see Figure 5.15)

As for import, the share of container grew from 10% in 1977 to 23% in 1980, and to 39% in 1985. The growth of containerized import cargoes was not quite as dramatic compared to that of export because of the difference in the contents of import and export cargoes. Some of imported commodities were in the form of liquid, like chemicals, while others were large machineries or iron and steel products which could not be containerized. However, the share of containerized import cargoes has continued to rise and has reached 53% at present. (see Figure 5.15)

Table 5.25
Cargo Throughput at Bangkok Port

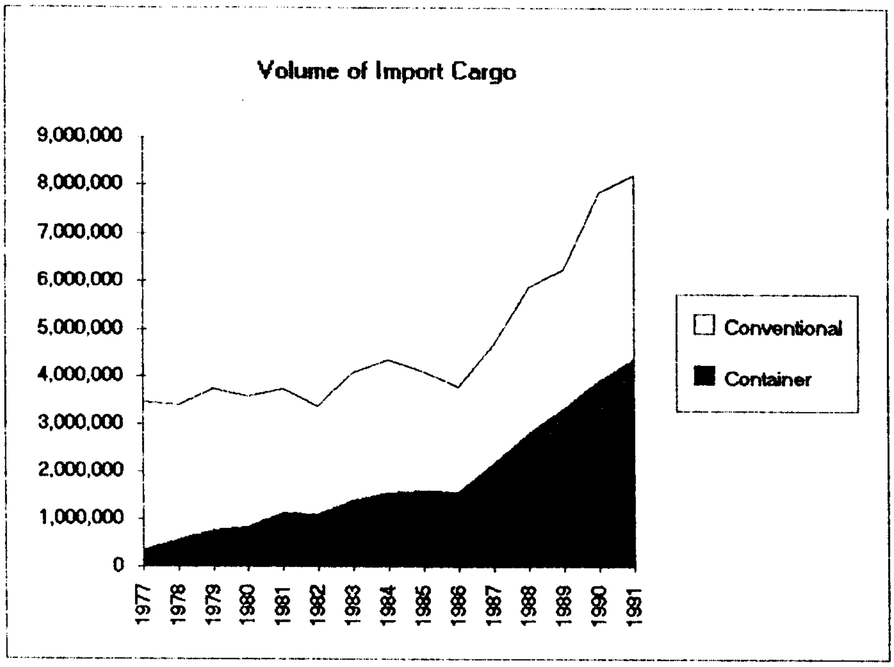
Unit: Tons

Year	Export Cargo					Import Cargo				
	Conventional	%	Container	%	Total	Conventional	%	Container	%	Total
1977	251,547	53%	223,195	47%	474,742	3,113,722	90%	354,427	10%	3,468,149
1978	255,191	35%	467,884	65%	723,075	2,814,115	83%	581,179	17%	3,395,294
1979	180,883	21%	675,799	79%	856,682	2,952,783	79%	776,172	21%	3,728,955
1980	121,720	12%	895,174	88%	1,016,894	2,746,992	77%	839,050	23%	3,586,042
1981	172,105	14%	1,058,775	86%	1,230,880	2,607,790	70%	1,126,407	30%	3,734,197
1982	282,606	20%	1,155,565	80%	1,438,171	2,270,486	67%	1,107,361	33%	3,377,847
1983	247,192	16%	1,291,107	84%	1,538,299	2,683,215	66%	1,395,573	34%	4,078,788
1984	213,651	12%	1,636,605	88%	1,850,256	2,787,821	64%	1,565,401	36%	4,353,222
1985	3,981	1%	2,218,755	99%	2,222,736	2,527,097	61%	1,591,178	39%	4,118,275
1986	5,751	1%	2,903,567	99%	2,909,318	2,186,770	58%	1,584,804	42%	3,771,574
1987	2,067	1%	3,666,444	99%	3,668,511	2,504,234	53%	2,179,687	47%	4,683,921
1988	1,515	1%	4,587,162	99%	4,588,677	3,045,339	52%	2,812,892	48%	5,858,231
1989	334,153	6%	5,397,694	94%	5,731,847	2,913,409	47%	3,339,708	53%	6,253,117
1990	202,048	3%	5,794,783	97%	5,996,831	3,920,120	50%	3,917,392	50%	7,837,512
1991	20,239	1%	7,166,033	99%	7,186,272	3,812,237	47%	4,373,538	53%	8,185,775

Source: Port Authority of Thailand.

Figure 5 . 1 5

Import and Export Volume at Bangkok Port



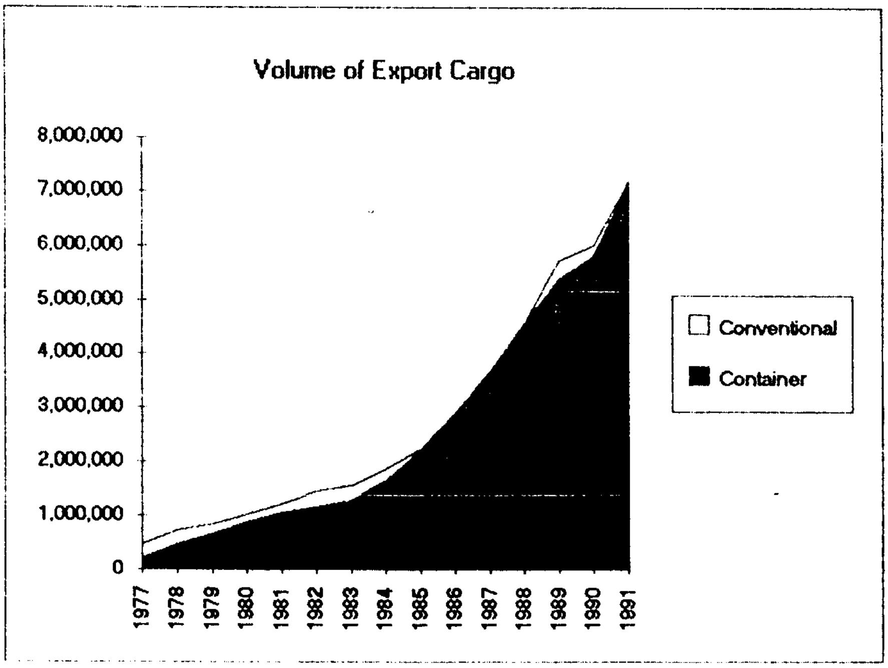


Table 5.26
Share of Containerized Cargoes in 1991

Export	%
Agricultural Products	
Rice	2
Tapioca	2
Raw Rubber	90
Others	84
Wood Products	100
Marine Products	85
Mining Products	6
Industrial Products	88
Import	
Iron and Steel	10
Chemical Products	51
Wood Products	40
Pulp and Paper	54
Industrial Materials	48
Other	57

Source: JICA (1989).

Table 5.26 presents detailed breakdowns of the share of containerized cargoes in total import and export volumes. The share was calculated by JICA in 1989, and an estimate was done for 1991. According to JICA's estimate, pulp and paper and chemical products had the highest share of containerized import cargo. On the other hand, iron and steel imports were nearly all non-containerized.

As for export, rice and tapioca are traditionally sent via bulk transport modes using specialized cargo ships. Very small amounts of rice and tapioca exports have been sent by containers. JICA's estimate shows the percentage share of only 2% for containerized rice and tapioca exports. On the other hand, about 90% of raw rubber export was containerized. Most other industrial or processed agricultural products for export were also containerized.

Up until 1988, containerized cargoes had been handled solely at the Bangkok Port (Klong Toey), under the operatorship of the Port Authority of Thailand (PAT). The amount of container traffic through Klong Toey rose from 72,874 T.E.U. in 1977 to 400,419 T.E.U. in 1985. As shown in Table 5.27, the export volume through Klong Toey has grown at very high rates, and the cargo handling facilities at Klong Toey have begun to reach the limit. However, the Port Authority of Thailand has invested heavily in new equipment at Klong Toey to handle the rapidly rising container volume at the Port. By 1990, nearly one million T.E.U. of containerized cargoes went through Klong Toey, up by 0.6 million T.E.U. from 1985.

Because of the congestion in cargo handling at Klong Toey, plans were established to build other ports to handle future cargo volume. Laem Chabang was designated as the country's future import and export cargoes handling facility, and the related Inland Container Depot (ICD) was to be constructed in Lad Krabang. However, to help relief congestion at Klong Toey, the Navy's port facility at Sattahip was temporarily leased by P.A.T. Services at Sattahip began in 1988 with only 832 T.E.U. of cargoes. However, the volume at Sattahip rose to about 45,000 T.E.U. at present. (see Table 5.27).

There is also another privately owned and operated container handling facility at Klong Toey. This facility came into operation in 1989 with 11,643 T.E.U. The volume has quickly expanded to 130,000 T.E.U in 1992.

Construction of Laem Chabang Port was completed in 1991. There are three container handling terminals at Laem Chabang, each of which is designed to handle up to 150,000 T.E.U. per year. Terminals number 3 and number 4 have already been leased to private companies under 12 year contracts with P.A.T.

- Terminal Number 3 was leased to Eastern Sea Laem Chabang (ESCO).
- Terminal Number 4 was leased to Thai International Port Service (TIPS).
- Terminal Number 2 - to be leased to private company in the near future.

Table 5.27
Container Volume Through Various Ports

Unit: T.E.U.

Year	Bangkok Ports		Sattahip	Laem Chabang	Total	Growth
	P.A.T.	Private	Ports	Ports		
1977	72,874	0	0	0	72,874	
1978	120,166	0	0	0	120,166	65%
1979	164,245	0	0	0	164,245	37%
1980	189,427	0	0	0	189,427	15%
1981	241,496	0	0	0	241,496	27%
1982	259,424	0	0	0	259,424	7%
1983	304,524	0	0	0	304,524	17%
1984	341,021	0	0	0	341,021	12%
1985	400,419	0	0	0	400,419	17%
1986	511,264	0	0	0	511,264	28%
1987	649,530	0	0	0	649,530	27%
1988	752,703	0	832	0	753,535	16%
1989	904,781	11,643	14,296	0	930,720	24%
1990	981,989	78,672	36,314	0	1,096,975	18%
1991	1,123,843	88,249	41,665	60	1,253,817	14%
1992	1,270,000	132,000	45,000	6,000	1,453,000	16%

Note: The figure in 1992 is estimated from the actual data from January to August.
:P.A.T. = Port Authority of Thailand
:T.E.U. = Twenty-Foot Equivalent Unit
Source: Port Authority of Thailand

Terminal number 1 is operated by P.A.T. and is designed to handle conventional cargo shipment as well as containers. The total designed capacity of Laem Chabang is currently at 525,000 T.E.U. per year of containerized cargo. However, actual cargo throughput at Laem Chabang this year will be only 6,000 T.E.U. which is very small compared to its designed capacity. Sources at the P.A.T. indicated that it will take a few years for the throughput at Laem Chabang to build up. Currently, shipping companies are reluctant to call at Laem Chabang Port because of the expenses these companies have to pay for transportation between Laem Chabang and the Bangkok area, where most of the customers are located. Furthermore, services at Klong Toey have continued to expand. The Bangkok Port has now been able to handle up to 1.27 million T.E.U. in 1992, up by about 0.3 million T.E.U. from 1990.

However, it is estimated that services at Klong Toey Port cannot be expanded much further beyond 1.2 million T.E.U. per year because of severe congestion conditions at the Port. Thus, future growth of container services will have to be from Laem Chabang.

Table 5.27 summarizes the changes in container volume at the various ports in Thailand during 1977-1992. The amount of containers passing through these ports was 72,874 T.E.U. in 1977. The volume of containers at these ports has increased at an average rate of 22% per year to reach 1.453 million T.E.U. in 1992.

5.4.2 Transportation System of Containerized Cargoes

A simplified transportation system of containerized cargo is shown in Figure 5.16. Filled container boxes are shipped to and from port areas, where customs procedures are performed. Containers could be stuffed or unstuffed at customer's plants and then transported directly to the port for customs clearance. This is usually done for the so-called 'full container load' cargoes, or FCL. However, there are containers that are stuffed or unstuffed at the terminal. These are usually 'less than container load' cargoes, or LCL where shippers must pack or unpack cargoes belonging to various customers. There are two broad categories of terminals. First, a marine terminal usually situates in or near the port's area. Cargoes are stuffed or unstuffed at the terminal, and the filled containers are transported over a short distance to and from the port. However, the problem of the marine terminal is the limitation of land area. The marine terminal, like that in Klong Toey, is usually located in a highly congested port area, making it difficult and inconvenient for shippers to stuff or unstuff cargoes. There are also problems of storing empty container boxes at the terminal because of the lack of space.

Second, an inland container depot, or ICD, usually locates further inland from the port. In general, ICD's are built closer to customers and will increase customers' convenience in bringing in cargoes for stuffing. There is much less of a space problem at an ICD compared to that at the marine terminal, and empty container boxes could be stored at the ICD. This helps increase efficiency in cargo handling by containers.

Currently, SRT is planning to build a large ICD at Lad Krabang. This ICD is aimed to facilitate container cargo handling between customers in the Bangkok area and Laem Chabang Port. Lad Krabang ICD is now under construction and is expected to be completed in about 2 years. When the ICD becomes operational, there will be a direct rail service for containerized cargoes to and from Laem Chabang and Bangkok.

Figure 5.16

Distribution System of Containerized Cargoes

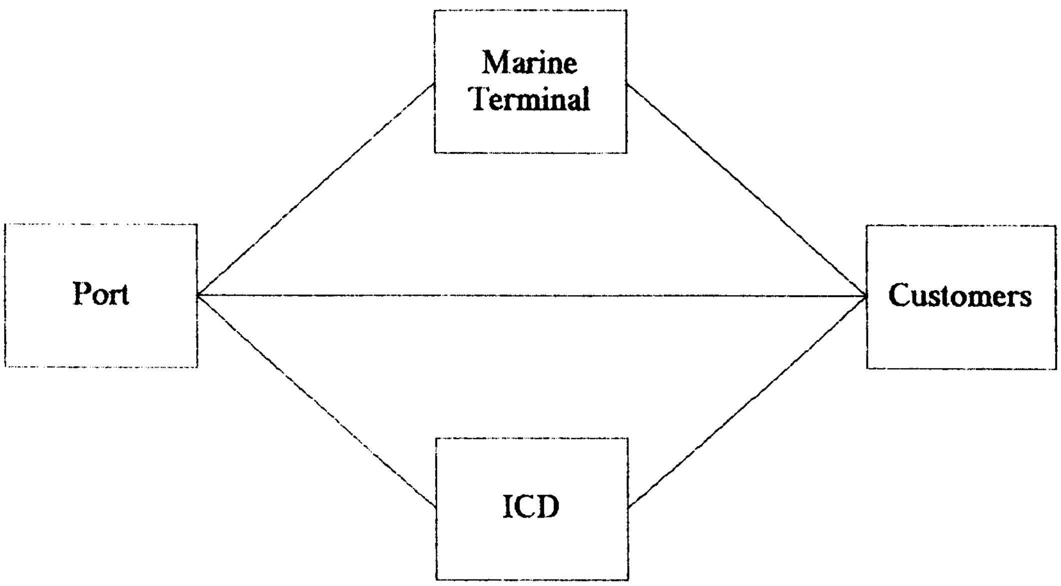
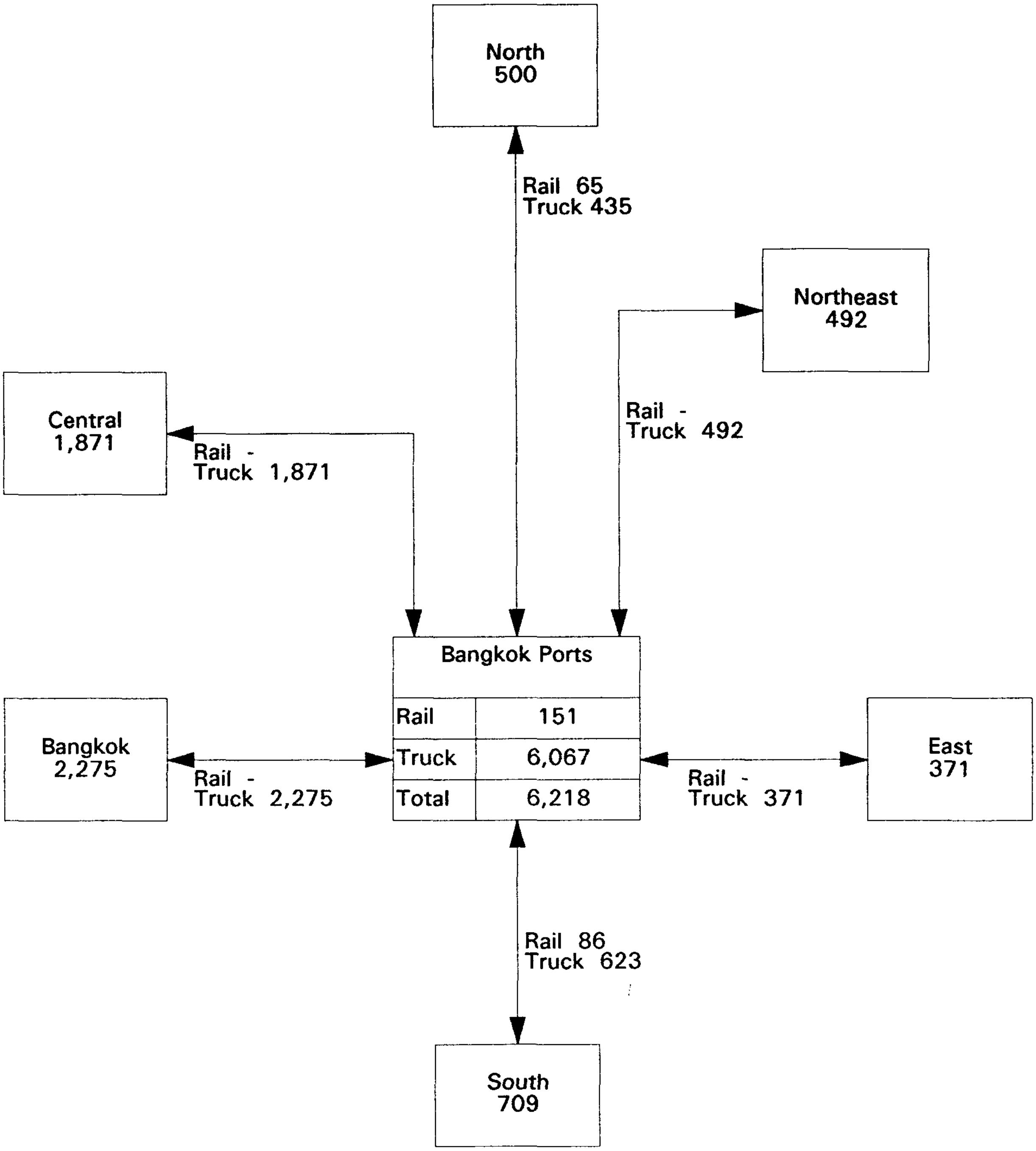


Figure 5.17

Container Movement by Region by Mode
1987



Unit: ,000 Tons

In the mean time, SRT is also building a temporary ICD at Bang Sue in order to service containerized cargoes between Bangkok and Laem Chabang. This ICD will be operated by a private company and will locate next to an ICD being operated by the American President Line (APL). In addition, a rail service linking Sriracha and Laem Chabang is now operational.

5.4.3 Transportation of Containers by Region and by Mode

It is difficult to obtain container transportation figures in Thailand as there are no good official statistics for regional road transportation of containerized cargo. However, JICA's study in 1989 provided a good basis for the historical distribution of container traffic which is shown in Figure 5.17. According to JICA, there were 500,000 tons of containerized cargo shipments between the Bangkok Port and the Northern region. Rail shipment of containers amounted to 64,765 tons, whereas shipments by truck were 435,235 tons. The shares of rail and truck shipments of containers were 13% and 87%, respectively.

About the same amount of containers were transported to the Northeast in 1987. However, all of the shipments were done by truck. This was also true for the Eastern region where all of the 371,000 tons container shipments to and from the Bangkok Port were done by truck .

As for the South, rail shipments of containers were 85,851 tons which accounted for 12% of total container transportation to and from Bangkok. The rest of the shipments of about 0.6 million tons were done by truck.

However, the bulk of the container transportation was in Bangkok and the Central areas. Containerized cargoes in Bangkok alone were as high as 2.3 million tons. These cargoes were moved to and from the Bangkok Port and customers using trucks. In addition, about 1.87 million tons of containerized cargoes were moved between the Bangkok Port and the Central areas, also all by trucks.

Thus, the overall amount of containerized cargo movements in Thailand in 1987 was 6.2 million tons. The share of Bangkok and the Central areas was 67%, and all of the cargoes were moved by truck. The total share of rail transportation of containerized cargoes was 2.4% in 1987. Rail service was considered very small because the bulk of container cargo movements were in and around the Bangkok area as mentioned above.

5.4.4 Future Transportation of Containerized Cargoes

There is no doubt that the volume of containerized cargoes in Thailand will be rapidly increasing along with the expansion of the economy in the future. As the economy expands, there will be increasing need for imports of machinery and raw materials for industrial plants. On the other hand, the bulk of the industrial products will be made for export. Thus there is a direct relationship between the expansion of industrial activities and the amount of import and export requirements.

This study follows JICA's approach in estimating the future volume of import and export requirements. First, the study uses regression techniques to estimate the relationships between the volume of export and import cargoes and the value of GDP for manufacturing (GDP_m) and total GDP, respectively.

$$\text{Export Volume} = a + b\,GDP_m$$

$$\text{Import Volume} = c + d\,GDP$$

Thus, the study uses a macro view in estimating the total amount of import and export in the future. Note that the export volume in this study excludes bulk agricultural commodities like rice, tapioca and corn, since the study assumes that these commodities will continue to be shipped by bulk cargo transport, not by containers. The same is also true for bulk mineral products.

Second, the study assumes that the share of container in total export volume will remain at the present level, which is 99%. That is nearly all of the export cargoes will be containerized. On the other hand, the study assumes that the share of container in total import volume will gradually increase from 55% at present to 60% in 2001 and 70% in 2011. This is just following the past trend.

Finally, the study utilized JICA's estimate of the share of containerized cargoes volume by region in deriving future regional container volumes. According to JICA's estimate, the share of container cargo volume in the Central and the East will be gradually increasing, while the shares in all other regions, including Bangkok, will be falling. This is consistent with the expected industrial development trends where relatively high industrial growth will occur in the Central and the East.

Table 5.28 shows regression results of future export and import volumes for 2001 and 2011. Export cargoes are expected to grow from 7.2 million tons in 1991 to 22.6 million tons in 2001. Assuming 99% share of container in total export, the volume of containerized cargoes will be 22.4 million tons in 2001. As for imports, the volume will grow from 8.2 million tons in 1991 to 14 million tons in 2001. With the share of 60% for containerized cargoes in 2001, the volume of imports in containers will be 8.4 million tons. These imports exclude petroleum products and old ships.

Table 5.28
Forecast of Volume of Export and Import Cargo

Unit: Million Tons

Year		Export Cargo			Import Cargo		Total
	Export	% Containerized	Container Volume	Import	% Containerized	Container Volume	
2001	22.6	99	22.4	14	60	8.4	30.8
2011	47.2	99	46.7	28.2	70	19.7	66.4

Note: Cargo movements through Bangkok and Laem Chabang Ports only.

The combined import and export volume in containers are expected to be 30.8 million tons in 2001. The figure is much higher than JICA's estimate which was 18.6 million tons for 2001. The difference came mainly from the growth rate of GDP, where JICA had assumed that GDP will grow at only 5% per year during the Seventh as well as the Eighth Plans. However, this study assumes that GDP will grow at 8.2% and 7.87% during the two planning periods, respectively. Furthermore, JICA's estimate appears to be rather low, as the actual container shipments in Thailand of 1.45 million T.E.U. in 1992 are already equal to JICA's forecast of 1.48 million T.E.U. for 1996.

As for 2011, the volume of export is expected to rise further to 47.2 million tons, and import to 28.2 million tons. Assuming that the share of container in total export shipments remains at 99%, the volume of containerized export cargo will grow from 22.4 million tons in 2001 to 46.7 million tons in 2011. The volume of containerized imports will grow from 8.4 million tons in 2001 to 19.7 million tons in 2011, given the assumption that the share of container in total import shipment increases to 70% in 2011.

The shares of container in total import and export shipments are debatable. The values will probably depend on the future contents of the cargoes. For example, if Thailand is to become an exporter of heavy industrialized products, not just garments or light machineries, then the share of container in total export shipment will probably be lower than 99% as assumed in the study. However, the analysis of future import and export content is beyond the scope of this study, and should be the subject of future research.

The next step in the forecast is to project the share of containerized cargoes by region. This is done using JICA'S estimate of future regional share of containerized cargo shipments to and from the main ports. JICA predicted these shares on the basis of future industrial locations, regional economic activities and other factors. The study assumes that the shares will be constant throughout the forecasting period. These shares are shown in Table 5.29 below.

Table 5.29
JICA's Estimate of Containerized Cargo Shipments through Bangkok and Laem Chabang Ports

unit : % share

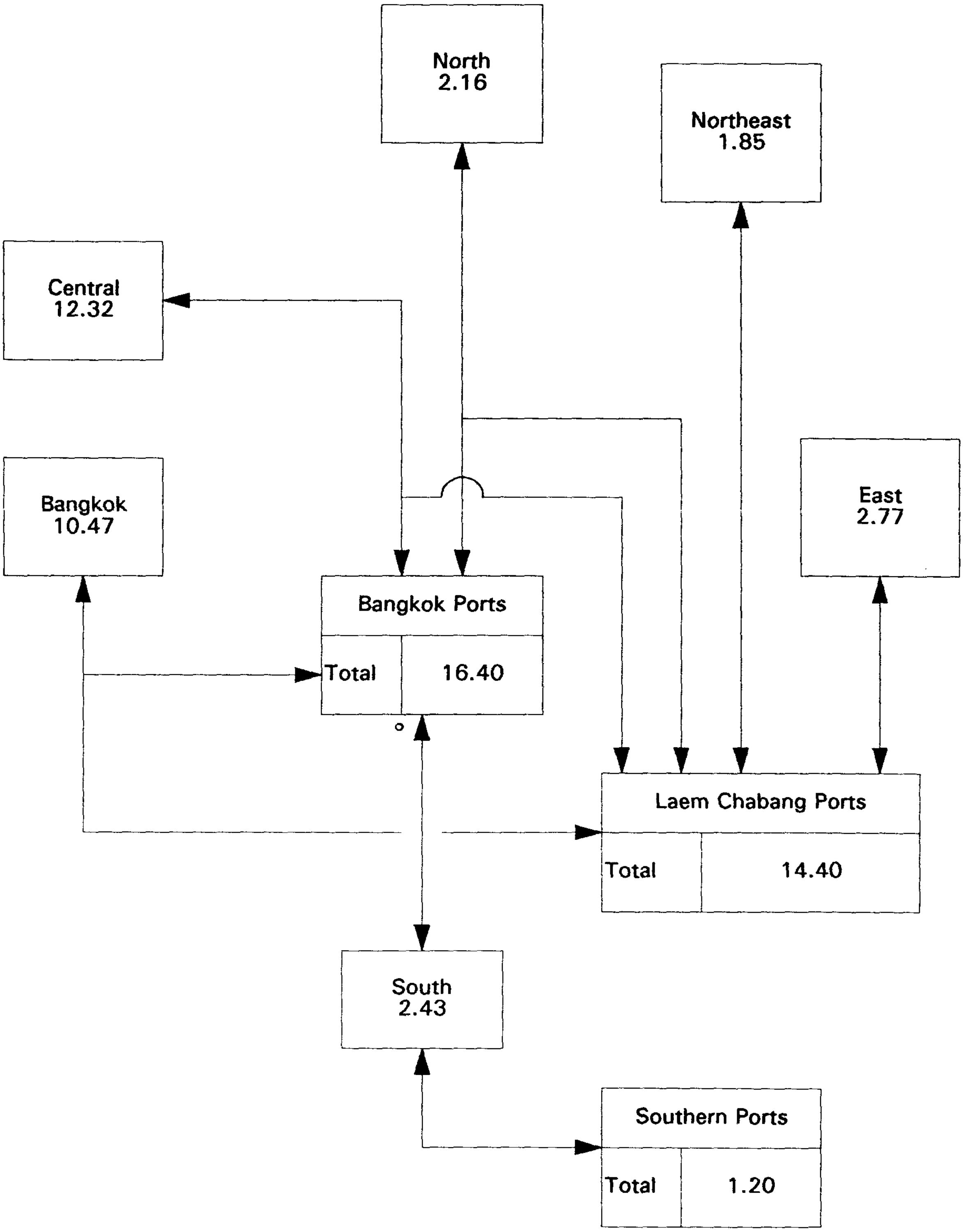
	1987	2001
Bangkok	37	34
Central	30	40
North	8	7
Northeast	8	6
East	6	9
South	11	4
	100	100

Source: JICA, 1989.

The study then proceeds to estimate the volume of container shipments by region using the estimate of total container volume in Table 5.28, and regional shares in Table 5.29 above. The results are shown in Figure 5.18 and 5.19.

Figure 5.18

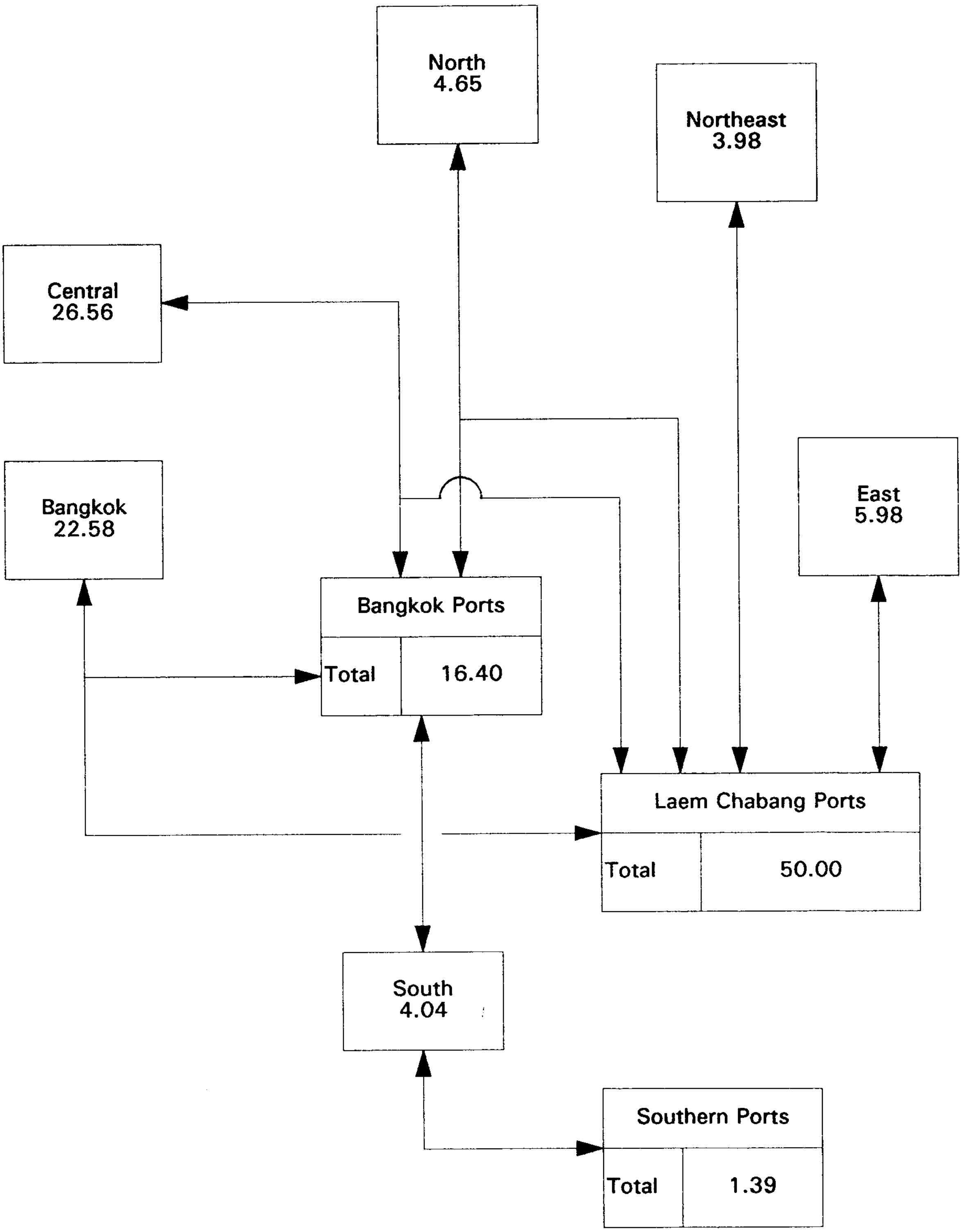
Container Movement by Region by Mode 2001



Unit: Million Tons

Figure 5.19

Container Movement by Region by Mode 2011



Unit: Million Tons

According to PAT's official, the maximum container throughput capacity at the Bangkok Port (Klong Toey) is 1.2 million T.E.U. per year. In addition, the maximum capacity of the privately owned terminal at Klong Toey is 0.4 million T.E.U. Thus the maximum combined capacity at Bangkok Ports is 1.6 million T.E.U. per year. According to the official, severe congestion at the Ports will develop if there are higher throughput of containers beyond this capacity. Thus, it is reasonable to assume that Bangkok Ports will handle 1.6 million T.E.U of containers, or 16.4 million tons, throughout the forecasting period. Any additional container shipment requirement will be served at Laem Chabang. Furthermore, Sattahip will cease its container operation when Laem Chabang Port comes into full service.

According to Figure 5.18, containerized cargoes from the Northern region will be about 2.2 million tons in 2001. The cargoes will be handled partly at Bangkok Ports, but mostly at Laem Chabang. Cargoes in Bangkok and the Central areas will amount to 10.5 and 12.3 million tons in 2001, respectively. Most of these cargoes will be passing through Bangkok Ports, while the rest will be transported to and from Laem Chabang. The Northeast will have about 1.8 million tons of containerized cargo shipment which are expected to be handled entirely at Laem Chabang via direct rail/road linkages between the Northeast and the Eastern Seaboard. Cargoes in the East will be 2.8 million tons, which will be processed entirely at Laem Chabang.

As for the South, about 1.2 million tons of container cargoes will be sent to and from Bangkok. The rest of the cargoes, which are mainly raw rubber, will be exported directly through the Southern ports of Songkhla and Phuket. Using JICA's estimate, these two Southern ports will be used to handle mainly raw rubber exports which are expected to grow at about 1.4% per year - about the same rate as the expected growth of rubber production.

Figure 5.19 shows the projection of containerized cargo movements by region for 2011. Utilizing the 2001's share, the containerized cargo transportation to and from the Northern region and the main Ports are 4.6 million tons. The capacity at Bangkok Ports are capped at 16.4 million tons, and the future growth in container handling capacity will be at Laem Chabang, which will be expanded to cope with high growth in container demand. The demand will come from 3.98 million tons of cargo from the Northeast and 6 million tons from the East. However, the bulk of the container volume will come from the Central region and Bangkok, where the amount of containerized cargoes are expected to reach 26.6 and 22.6 million tons, respectively.

The Southern ports are assumed to continue to handle raw rubber exports, the volume of which will reach 1.4 million tons in 2011. The rest of the containerized cargoes from the South will be transported to the main Ports.

Thus, by 2011, over 6 million T.E.U of containerized cargoes will be transported to and form the main ports, particularly Laem Chabang, and the various regions of the country. This study shows that there will be a great demand for the transportation of containerized cargoes in the future, and rail should be able to play a significant role in container shipments. Furthermore, the 6 million T.E.U volume indicated above excludes purely domestic containerized cargoes. There is a strong potential for the requirement of containers for domestic cargo shipments as well. However, this should be the subject of further study.

6. CONCLUSIONS

This chapter has presented an overview of the transportation sector in Thailand, and made projections at the macro and micro levels on future transportation demand. Currently, Thailand is going through a phase of rapid structural changes and rapid modernization. While the double digit growth rates achieved between 1988 and 1990 are unlikely to be sustainable over the medium term, the Thai economy is nevertheless expected to achieve satisfactorily high rates of growth over the next two decades (7-8% per annum). As a major support sector, the transport sector will inevitably grow in line with the growth in the economy. Person movements are expected to expand rapidly, and while not as fast as person movements, freight movements also show continual growth. Under these environments, much potential exists for the SRT to greatly expand its role in serving the nation's transportation needs. The extent to which the SRT can do so will depend on how well it can adapt to the rapid changes that are taking place, to provide the kind of transport services that will be demanded in the future. Account must also be taken of changes in the spatial pattern of transport movements, in particular the rapid growth in traffic expected to occur to and from the Eastern Seaboard corridor. Finally, potentials that exist in the key freight markets in the future need to be exploited fully. Analyses of the SRT's possible role in meeting the future transportation demand as presented above will be carried out in the next chapter.

CHAPTER 4

FUTURE ROLE OF THE STATE RAILWAY OF THAILAND

The last chapter analyzed the future transportation demand for Thailand from the present to 2011. In this Chapter, the role of the railway in this future transportation picture is addressed. Section 1 discusses the strengths and weaknesses of railway transport. Section 2 analyzes the passenger movement. Section 3 looks at the main railway freight items. Finally, section 4 briefly addresses the non-rail activities of the SRT.

1. STRENGTHS AND WEAKNESSES OF RAILWAY TRANSPORT

1.1 Fuel Efficiency

In an economy wide context, fuel efficiency of the nation's transportation system is an issue of some significance. As transportation is an essential supporting sector for the whole economy, gains in transportation fuel efficiency will lower production and distribution costs, household transportation-related consumption, and will also help improve Thailand's external trade position. In fact, in line with the overall growth of the economy, fuel consumption of the transport sector has been growing by more than 10 percent annually since 1984 (Table 1.1). This has contributed to high grow in fuel import after 1986, when there was a sharp downward adjustment in world oil prices (Table 1.2).

In terms of fuel efficiency, rail transport is much more superior to road transport. Recently, a study sponsored by the U.S. Federal Railroad Administration into the relative fuel efficiency of truck versus railway freight operations was concluded.[1] The objective of the study was to identify the circumstances in which rail freight service offers a fuel efficiency advantage over alternative truckload options, and to estimate the fuel savings

1. U.S. Federal Railroad Administration (1991).

Table 1.1
Transport Sector Fuel Consumption
(Million Litres)

			Av.Gr.
	1984	1990	1984-90
High Speed Diesel	3,370	7,080	13.17%
Petrol (Regular)	1,211	1,856	7.38%
Petrol (Premium)	829	1,736	13.11%
LPG	366	205	-9.21%
Low Speed Diesel	57	88	7.51%
Fuel Oil	242	481	12.13%
Jet Fuel	1,206	2,362	11.86%
Total	7,281	13,808	11.26%
As % of National			
Consumption	56.2%	59.6%	

Source: National Energy Administration (From Transport Statistics 1990, Ministry of Transport and Communications.

Table 1.2
Fuel Import

	Million Baht	Growth Rate
1986	29,619	
1987	40,742	37.6%
1988	35,210	-13.6%
1989	54,709	55.4%
1990	72,427	32.4%
1991	82,502	13.9%

Source: Bank of Thailand.

Table 1.3
Fuel Efficiency by Equipment Type
(Shipment Over 100 Miles)

Train Type	Fuel Efficiency Range Ton-Mile/Gal.	Truck Type	Fuel Efficiency Range Ton-Mile/Gal.	Rail/Truck Ratio Range
Mixed Freight		Flatbed Trailer		
	471 - 843	- w.o. Sides	141 - 167	2.82 - 5.51
	414 - 688	Van Trailer	131 - 163	2.96 - 5.25
Mixed Freight with Autos	279 - 499	Auto Hauler	84 - 89	3.32 - 5.61
Double Stack	243 - 350	Container Trailer	97 - 132	2.51 - 3.43
Trailer-on-Flatcar		Flatbed Trailer		
	229	- w.o. Sides	133	1.72
	240	- with Sides	147	1.63
	196 - 327	Van Trailer	134 - 153	1.40 - 2.14
Unit Auto	206	Auto Hauler	86	2.40

Source: Federal Railroad Administration (1991), Exhibit S-4.

associated with using rail service. The findings were based on computer simulations of rail and truck freight movements between the same origins and destinations. The simulation input assumptions and data were based on actual rail and truck operations. Input data were provided by U.S. regional and Class I railroads and by large truck fleet operators.

The study noted that design improvements have been incorporated into successive series of locomotives, with each new model containing greater levels of fuel economy improvement. These design changes are made on an evolutionary basis and work in concert to improve overall locomotive fuel efficiency. Locomotive fuel economy improvements have been added in the areas of the engine, auxiliary systems and rail lubrication.

Because of the many variables involved with the simulations, and the resultant "best/worse case scenarios", the study shows a wide range of savings in rail transport over road transport (Table 1.3). As an average, however, the study shows that, in terms of ton-miles per gallon of fuel, railways are about 4.5 times as fuel efficient when compared to trucks. If we assume the same efficiency for passenger operations, then the fuel expenditure by the SRT in 1990 of 724 million Baht would have cost the Thai economy an additional fuel cost of approximately 2,500 million Baht had all rail transport services been carried out by road transport.

1.2 Environmental Considerations

Environmental considerations also favor rail over road transport. Given more fuel efficiency of rail transport, emissions of harmful gases from fuel usage will obviously be less per unit of output for rail compared to road transport. Some numbers from Sweden, which has integrated environmental concerns into its transport pricing policy through environmental charges illustrate the difference.[2]

In 1990, the Swedish Commission on Economic Instruments in Environmental Policy proposed the following pollution charges:

- Sulfur (SO_2) $ 5.25/kg
- Nitrogen Oxides (NO_x) $ 7.00/kg
- Hydrocarbon (HC) $ 3.50/kg
- Carbon Dioxide (CO_2) $ 0.04/kg

Using these "price tags" as weights, 45% of the total emissions of SO_2, NO_x, HC, and CO_2 in Sweden originate from the transport sector. Taking the traffic level in 1990, and the above proposed charges, the cost responsibilities for the various subsectors of the Swedish transport sector are as follows:

Road	$ 16,300	Million
Maritime	$ 2,600	"
Aviation	$ 900	"
Rail	$ 60	"

Thus the emission costs for road are more than 270 times that for rail, even though road passenger traffic is only 16 times higher than that for rail (96,400 million passenger kms. for road compared to 6,120 million passenger kms. for rail), and freight traffic is only 1/3 higher for road (25,000 ton kms. for road vs. 19,100 ton kms. for rail). Thus, the unit pollution cost for road is much higher than that for rail.

These figures give a rough guide of the advantage of rail service in environmental terms. However, in Thailand, the advantage will probably not be as great as in the Swedish case, as most of the Swedish rail network is electrified, while Thailand still relies on diesel locomotives.

2. This is drawn from Hansson (1991).

1.3 Road Congestion

That traffic congestion is a serious problem for the BMR area is more than clear. The problem does not just occur inside Bangkok, but also along routes leading from the city in all directions. For major cities in other parts of the country, such as Chiang Mai or Had Yai, the traffic situations are also becoming severe.

Table 1.4 shows the rapid growth of traffic on the Bangkok expressway. From this, it is easy to understand why, for certain times of the day, the expressway becomes more of a car park than an expressway. Nation-wide, average road density has also increased rapidly. Table 1.5 shows transport flows by various types of vehicles for 1984 and 1990 on national and provincial highways, and also the length of the road stocks. It can be seen that average density on national highways has increased by over 4 times between 1984 and 1990.

With continual high growth of transport demand into the future, the situation on the roads have every prospects of getting worse and worse. More intensive use of rail transport in the future may help to alleviate the worsening trend.

Table 1.4
Bangkok Expressway Traffic 1983-90

Year	Vehicle/Day ('000)	Annual Growth
1983	93.2	
1984	110.1	16.1*
1985	128.0	16.3
1986	137.5	7.4
1987	162.1	16.0*
1988	224.0	38.6
1989	258.0	14.9
1990	285.4	10.8

* Adjusted to 16.8 km. system for the whole year.
Actual system 29/11/81 = 8.9 km., 17/1/83 = 16.8 km., 5/12/87 = 27.1 km.
Source: Expressway and Rapid Transit Authority of Thailand.

Table 1.5
Road Transport Flows-Vehicle-Kilometers on National and Provincial Highways
By Type of Vehicle and Type of Highway (Million Vehicle Kilometres)

	1984			1990		
	National	Provincial	Total	National	Provincial	Total
Car & Taxis	2,135	2,128	4,263	11,005	4,434	15,439
Light Buses	788	1,294	2,083	2,179	1,571	3,750
Heavy Buses	473	472	945	2,083	599	2,682
Light Trucks	1,756	2,263	4,020	8,949	4,770	13,719
Medium Trucks	752	1,037	1,789	3,481	1,503	4,984
Heavy Trucks	665	647	1,312	4,079	1,117	5,196
Total	6,569	7,842	14,412	31,776	13,994	45,770
Route Kilometers	15,072	18,076	33,148	17,486	27,959	45,445
Veh.Kms Per Rt.Kms						
Per Day	1,194	1,189	1,191	4,979	1,371	2,759

Note: Vehicle flows are those on DOH roads only. Dual carriage ways included in the route kilometers figures are in carriage way kilometers.
Source: Department of Highways.

Table 1.6
Accident by Mode of Transport: 1990

	Road	Rail	Waterways	Air	Total
No. of Accidents	28,398	704	26	4	29,132
No. of Casualties	17,956	684	9	42	18,691
- Death	5,753	293	7	38	6,091
- Injured	12,203	391	2	4	12,600
Property Damage ('000 baht)	228,976	n.a.	n.a.	n.a.	
Row Shares					
	Road	Rail	Waterways	Air	Total
No. of Accidents	97.48%	2.42%	0.09%	0.01%	100.00%
No. of Casualties	96.07%	3.66%	0.05%	0.22%	100.00%
- Death	94.45%	4.81%	0.11%	0.62%	100.00%
- Injured	96.85%	3.10%	0.02%	0.03%	100.00%

Source: Transport Statistics, 1990. Ministry of Transport and Communications.

1.4 Safety

In terms of safety, rail transport also has advantage over road transport. Table 1.6 shows accidents by mode of transport for 1990. It can be seen that road accounts for about 94.5-97.5 percent of all accidents, deaths and injuries, while rail accounts for about 2.5-4.8 percent. If this is compared to the 16.6 percent share of rail in inter-provincial land person trips (Chapter 3), then the safety rate for rail can be seen to be far superior to that for road. While, this comparison is not strictly accurate, as for proper comparison one needs to look at intra-provincial travel as well and also include freight traffic in the analysis, it seems fairly clear that rail transport should be much safer than road transport. Nevertheless, this does not mean that the SRT should not put continued efforts on trying to make rail travel even safer. This is particularly so in view of indications of deferred maintenance, and increasing age of rolling stock as already indicated in Chapter 2.

1.5 Competitive Considerations

In spite of all the advantages for rail transport indicated above, the railway remains a relatively minor player in the Thai transportation picture compared to road transport. As indicated earlier, the railway accounts for 16.6 percent of all inter-provincial person movement and only 2.46 percent of all inter-provincial freight movement. To a large extent, this depends on the relative competitive position of rail versus road (and also air and waterway) transport, which in turns depends on many factors; such as the geographic nature of the country, the human settlement and urbanization patterns, overall government policy concerning the transport sector through infrastructure investment, pricing, fare controls etc., and also the operational efficiencies of the various transport providers.

As far as the operational efficiency of the SRT is concerned, Chapter 2 has already indicated that it has been fairly satisfactory in operational terms, in that it has been able to provide increased services for both passenger and freight, while, at the same time, reduced the number of employees, and improved average train speed.[3] However, the principle disadvantage of rail transport is its inefficiency in door-to-door operations. This is especially true with freight services where the SRT does not connect directly with the origin or destination organizations. In this case, the overall transport costs might involve trucking at either end of the shipment route, with the high associated handling cost of

3. All this has come at the cost of deferred maintenance and deferred renewal of rolling stock due to the SRT's loss position. These have to be corrected in the future.

transferring from truck to train and train to truck. For short distances, this additional cost is greater than any savings introduced by rail transport. This explains why the railway has not been that competitive with road transport even though analyses show that the unit cost for rail transport (ignoring multiple handling costs) is much less than that for road transport for comparable commodities.[4] For example, the long-run variable cost for rail transport of petroleum trainload is about 0.35 baht per ton/km. (1991 prices), while the full cost less annual capital cost of road transport of petroleum comes to about 1.00 baht per ton/km. (at a distance of about 200 km.), similarly, for passengers, heavy bus operations at optimum operating speeds cost about 0.28 Baht per passenger-km., versus express train services which cost 0.18 Baht per passenger-km., or rapid train services which cost 0.12 Baht per passenger-km.

For the future, however, with ever more congestion on the roads, and growth of provincial cities, which may generate potentials for large distribution centers near to the rail network that can take advantage of scale economies to reduce multiple handling costs, the railway may be able to compete better with medium-long range road transport. Intensive efforts will be needed on the marketing side of railway operations however.

Another consideration is the government transportation policy. It is often suggested that in terms of the competition between rail and road, the playing field is tilted toward road transport. In particular, while the railway has to invest in its own infrastructure and take care of the debt payments, it is suggested that road users are subsidized in that the road user charges they have to pay do not cover the full cost or even the marginal cost of using the roads. This is certainly the case. The appendix to this Chapter presents an analysis of road user charges in Thailand and also some tentative comparisons with those in other countries. Based on previous studies, it is clear that the road user charge on 6-wheel and 10-wheel trucks (who do most damage to the roads) do not cover even the marginal road costs. This obviously gives an edge to road transport of freight compared to rail. On the other hand, light vehicles generally pay more road user charge than the marginal road costs.

However, from the analysis in the appendix, and also from previous studies, it is suggested that while present road user charges are biased in favor of road freight transport, this is not a major reason behind the competitive edge that road has over rail, i.e. that even if heavy trucks are required to pay the full cost of road use (not just the marginal cost) the competitive edge of road over rail is not likely to be affected in a major

4. See Bevis (1992).

way (although obviously there will be *some* effect). Basically, it is estimated that if 6 and 10-wheel trucks are charged the marginal road cost, then the vehicle operating cost is expected to increase by about 2.5-5.0 percent, while if full road cost is charged, then the vehicle operating cost is expected to increase by about 5-10 percent. Against this, it has to be borne in mind that transportation rates are often very different from vehicle operating costs, and are often 2 to 3 times the calculated vehicle operating costs. Thus, an increase in vehicle operating costs by about 5-10 percent is unlikely to have any major impact on the relative competitive position between road and rail transport.

Government policy also applies to rail fares, particularly on passengers. The SRT earns over 70% of its passenger revenue from 3rd Class passengers. Political considerations have made fares on this class of passengers extremely hard to increase. This, of course, encourages more rail use than otherwise. However, the low fare policy is a sharp two-edged sword. It leads to the continued financial loss position of the SRT. This leads to deferred maintenance, difficulty in getting investment funds, and a general lack of morale from the staff. The problem is compounded if it is difficult to ascertain the detailed operations that account for the total loss, or if policy makers are not interested in such details. In this case, if the organization feels that no matter how much effort it tries to put into improving performance the loss position will not go away, and the organization will continue to be looked upon unfavorably by outsiders as being an inefficient loss making organization, then there will not be any incentive for improved performance or improved competitive position. This is the kind of situation that the SRT is in today, and urgently needs to be changed. The key component for such a change is the implementation of the Public Service Obligation (PSO) system to be discussed in Chapter 6.

Finally, it is sometimes suggested that import duties and charges on rail equipment also adversely affect the competitive position of the railway. The data show, however, that this is unlikely to have any significant negative impact on the competitive position of the railway (appendix).

1.6 Conclusions

From the above, one can conclude that rail transport does have many advantages. The key ones relate the relatively high **negative externalities** generated by road transport; relative fuel inefficiency, pollution, congestion, and safety considerations. These externalities have not been taken into account in the nation's overall transportation policy. Without such considerations, the railway is likely to continue to play a relatively minor role in the nation's future transportation needs. Chapter 3 has already indicated the past declining share of the railway in passenger transport (Table 2.4 in Chapter 3). Without a change in transportation policy approach, this trend is likely to continue.

This suggests that in looking at the role of the railway for the future, a **strategic** approach is necessary. Analyses based on the past trends or past behaviors implicitly assume the current status quo in transportation policy, and is likely to lead to an expected scenario of declining role of the railway over time. Such an approach is unlikely to be very useful when looking at the very long horizon that is being done in this study. What will be done instead in the sections that follow is a strategic approach based on simple targets for rail transport. This presumes that the negative externalities associated with road transport are considered important, and need to be corrected over time. The detailed ways that this can be done are not analyzed here, but there are many examples and experiences in other countries that could be drawn upon, e.g. the pollution charges as in Sweden, using infrastructure development to promote rail transport, or just out-right prohibition of some specific types of road movements.

In what follows in the analyses of the future role of the railway for passenger and freight, simple share targets are suggested. At a minimum, the rail shares in future transport should not be allowed to decline below the share in the base period of the analysis (1990). While this will mean that the negative externalities associated with road transport will continue to increase along with the trend increase in the overall transportation sector of the country, the target is still not easily achieved without efforts and new investment, given the past trend. Apart from the fixed share approach, we shall also suggest targets involving much larger roles for the railway in the future, which implicitly assumes more active government actions to alleviate the harmful externalities associated with road transport.

2. PROJECTED ROLE OF THE RAILWAY IN PERSON TRIPS

As indicated in the last section, a minimum target for the railway should be to maintain its current share in person movement. The analysis here will be slightly refined in that we take as the basic target the maintenance of the rail share in land person trips, rather than the share in total person trips (land and air).[5] The reason is that the main competition with the railway is road transport. This is likely to remain in the case for the foreseeable future, given the trend in person movements. Rail may eventually become competitive with air transport for certain destinations, but given the picture on future transportation demand, this appears unlikely over the next 20 years, in that for longer trips where investment in Very High Speed Rail may reduce the trip time to make rail a real alternative to air travel, the demand is not expected to be anywhere near as high as to make such a Very High Speed Rail project economically feasible. Where High Speed Rail (not necessarily Very High Speed) may be justified are trips that are not so long distant, so that the main competition will be with road rather than air.

2.1 Fixed Rail Share in Land Person-Trip

2.1.1 Air Person Trips

Table 2.1 shows the all-mode person trip matrices by region to the year 2011, as derived in Chapter 3. We start first to make projections of future domestic air O-D traffic. Regressions were carried out to explain inter-provincial air travel between 1985 and 1990. The dependent variable is the number of passenger traveling between various O-D pair provinces (airports). Table 2.2 gives the preferred regression (the explanatory variables are as indicated in the Table).

From the regression results, the future passenger inter-provincial air movements were forecasted by using TDRI's projected real per capita GDP (as used in Chapter 3), and TDRI's forecast of foreign tourist arrivals.[6] This gives the results in Table 2.3. It can be seen that total person trips by air (domestic) is expected to increase by 5.04 times between 1990 and 2011, from 14,600 person trips/day in 1990 (with the assumption of 220 days per year), to 73,500 person trips/day in 2011. The average growth is expected to be 9.2% annually between 1990 and 2001, and 6.7% annually between 2001 and 2011. By 2011, the daily person trips[7] to and from Bangkok to airports in the Northern and Southern regions are expected to reach about 13,000 and 15,000 persons per day respectively.

5. Passenger water transport is ignored in this study.
6. From the project on "Tourism Development" carried out for the Tourism Authority of Thailand.
7. Bearing in mind the 220 days per year assumption.

Table 2.1
All Mode Person Trip Matrix 1990 to 2011 ('000 Persons/Day)

1990							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	399.8	205.8	101.2	40.2	33.6	21.6	802.3
Central-E	203.9	138.6	37.8	22.0	45.4	14.2	461.9
ESB	91.0	36.2	59.5	11.0	18.3	2.0	218.0
Northeast	35.8	25.1	12.2	164.1	28.0	7.5	272.7
North	49.1	41.1	6.3	28.6	136.4	4.1	265.6
South	24.1	12.3	5.3	8.7	3.4	250.7	304.4
Total	803.8	459.1	222.3	274.5	265.1	300.1	2325.0
1996							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	713.6	334.9	213.2	48.4	43.1	38.8	1392.0
Central-E	332.9	208.1	75.5	25.6	53.0	23.4	718.5
ESB	195.9	79.7	151.1	16.0	27.1	4.3	474.1
Northeast	43.0	29.8	17.0	179.4	30.6	9.1	309.0
North	59.6	48.3	8.9	31.3	149.9	5.4	303.2
South	37.2	18.8	9.9	9.7	3.9	370.9	450.4
Total	1382.1	719.6	475.6	310.4	307.7	451.8	3647.2
2001							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	1110.2	484.9	355.2	57.1	50.9	59.1	2117.3
Central-E	486.6	285.5	126.2	29.4	59.7	34.7	1022.1
ESB	342.4	136.0	283.0	21.2	34.8	7.4	824.9
Northeast	51.2	33.8	21.7	193.3	33.0	10.9	344.0
North	75.1	56.1	11.8	33.9	162.6	7.2	346.5
South	51.4	24.6	14.9	10.4	4.3	504.9	610.6
Total	2116.9	1020.9	812.7	345.2	345.4	624.1	5265.4
2006							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	1653.8	672.4	543.8	65.6	63.8	77.0	3076.4
Central-E	670.3	368.5	187.1	33.3	69.5	42.9	1371.5
ESB	510.9	195.0	433.8	24.3	41.4	9.7	1215.0
Northeast	60.2	37.7	26.0	208.2	35.7	11.8	379.6
North	91.3	63.3	14.5	36.7	179.0	8.1	392.9
South	75.3	34.1	21.6	12.3	5.7	686.5	835.4
Total	3061.8	1370.9	1226.8	380.4	395.1	835.8	7270.7

Table 2.1 (Continued)

2011							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	2378.4	927.1	768.2	77.3	79.1	104.6	4334.7
Central-E	922.6	491.1	261.9	37.7	82.2	55.7	1851.3
ESB	740.5	279.6	617.7	28.9	47.9	13.2	1727.8
Northeast	71.9	44.0	30.5	224.6	39.0	13.3	423.2
North	115.6	76.1	17.7	39.7	205.1	10.3	464.6
South	103.7	45.9	28.7	13.7	7.2	956.7	1155.8
Total	4332.8	1863.9	1724.7	421.9	460.5	1153.8	9957.5

Ratio 2001/1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	2.78	2.36	3.51	1.42	1.52	2.73	2.64
Central-E	2.39	2.06	3.34	1.34	1.32	2.44	2.21
ESB	3.76	3.76	4.75	1.93	1.90	3.70	3.78
Northeast	1.43	1.35	1.79	1.18	1.18	1.45	1.26
North	1.53	1.36	1.86	1.18	1.19	1.77	1.30
South	2.14	2.01	2.80	1.20	1.28	2.01	2.01
Total	2.63	2.22	3.66	1.26	1.30	2.08	2.26
RATIO 2011/1990							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	5.95	4.51	7.59	1.92	2.36	4.83	5.40
Central-E	4.52	3.54	6.93	1.72	1.81	3.92	4.01
ESB	8.13	7.73	10.38	2.63	2.61	6.61	7.92
Northeast	2.01	1.75	2.51	1.37	1.39	1.77	1.55
North	2.35	1.85	2.80	1.39	1.50	2.55	1.75
South	4.31	3.74	5.39	1.58	2.14	3.82	3.80
Total	5.39	4.06	7.76	1.54	1.74	3.85	4.28

Table 2.1 (Continued)

Average Annual Growth 1990 to 2001 (Percent)

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	9.73	8.10	12.09	3.23	3.85	9.56	9.22
Central-E	8.23	6.79	11.58	2.68	2.53	8.45	7.49
ESB	12.80	12.80	15.23	6.16	6.01	12.63	12.86
Northeast	3.30	2.74	5.41	1.50	1.51	3.46	2.13
North	3.93	2.86	5.80	1.55	1.61	5.31	2.45
South	7.15	6.54	9.81	1.70	2.26	6.57	6.53
Total	9.20	7.54	12.51	2.11	2.44	6.88	7.71

Average Annual Growth 2001 To 2011 (Percent)

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	7.92	6.70	8.02	3.08	4.51	5.88	7.43
Central-E	6.61	5.57	7.58	2.54	3.24	4.86	6.12
ESB	8.02	7.47	8.12	3.16	3.23	5.98	7.67
Northeast	3.45	2.65	3.45	1.51	1.68	1.98	2.09
North	4.42	3.10	4.18	1.62	2.35	3.73	2.98
South	7.26	6.42	6.78	2.76	5.31	6.60	6.59
Total	7.43	6.20	7.81	2.03	2.92	6.34	6.58

Note: ESB is the Eastern Seaboard Corridor (Chachoengsao, Chon Buri and Rayong), and Central-E is the Central region minus provinces in ESB.

Table 2.2
Regression of O-D Air Passenger 1985-90

Dependent Variable	=	Number of passengers travelling between various O-D provinces (airports), 1985-90.
Variables		
PERCAPOD	=	Product of real per capita income (1972 prices) of the origin and destination province for the corresponding year of the dependent variable.
TOUR	=	Number of foreign tourist arrivals in the corresponding year.
LAG	=	Lagged dependent variable (same O-D pair of the previous year).
LAG2	=	LAG squared.
TOURD1	=	TOUR times dummy if O-D is Bangkok-Chiang Mai or Chiang Mai-Bangkok.
TOURD2	=	TOUR times dummy if O-D is Bangkok-Phuket or Phuket-Bangkok.

Results

Variable	Parameter	t-Ratio
PERCAPOD	4.203E-05	2.90
TOUR	.0014817	1.92
LAG	0.92977	14.99
LAG2	-1.3476E-07	-1.57
TOURD1	0.02414	9.052
TOURD2	0.01770	10.266
Constant	-7489.86	-2.42

Multiple R	.99349
R^2	.98702
Adjusted R^2	.98673
Standard Error	10500.5

Table 2.3
Air Person Trip Matrix 1990 to 2011 ('000 Persons/Day)

1990							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	0.0	0.0	0.0	0.7	2.9	2.7	6.2
Central-E	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESB	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northeast	0.7	0.0	0.0	0.1	0.0	0.0	0.7
North	3.2	0.0	0.0	0.0	0.9	0.1	4.1
South	3.0	0.0	0.0	0.0	0.0	0.5	3.5
Total	6.8	0.0	0.0	0.7	3.8	3.3	14.6
1996							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	0.0	0.0	0.0	1.1	5.3	4.6	11.1
Central-E	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESB	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northeast	1.4	0.0	0.0	0.1	0.1	0.0	1.5
North	5.4	0.0	0.0	0.0	1.6	0.1	7.2
South	5.6	0.0	0.0	0.0	0.1	0.8	6.5
Total	12.4	0.0	0.0	1.3	7.1	5.6	26.3
2001							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	0.0	0.0	0.0	1.8	7.2	7.6	16.6
Central-E	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESB	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northeast	2.5	0.0	0.0	0.1	0.1	0.0	2.7
North	7.3	0.0	0.0	0.1	2.1	0.2	9.6
South	7.9	0.0	0.0	0.0	0.2	1.4	9.5
Total	17.7	0.0	0.0	1.9	9.6	9.2	38.5
2006							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	0.0	0.0	0.0	2.5	9.7	10.6	22.8
Central-E	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESB	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northeast	4.1	0.0	0.0	0.2	0.1	0.0	4.5
North	9.7	0.0	0.0	0.1	2.8	0.2	12.8
South	11.0	0.0	0.0	0.0	0.3	2.0	13.3
Total	24.9	0.0	0.0	2.8	12.8	12.9	53.3

Table 2.3 (Continued)

2011							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	0.0	0.0	0.0	3.5	12.9	14.6	31.0
Central-E	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESB	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northeast	6.6	0.0	0.0	0.3	0.2	0.0	7.1
North	13.0	0.0	0.0	0.1	3.6	0.3	17.0
South	15.1	0.0	0.0	0.0	0.4	3.0	18.4
Total	34.7	0.0	0.0	3.9	17.1	17.9	73.5

Ratio 2001/1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	N.A.	N.A.	N.A.	2.72	2.51	2.83	2.67
Central-E	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
ESB	3.41	N.A.	N.A.	N.A.	3.41	N.A.	3.41
Northeast	3.85	N.A.	N.A.	2.04	3.45	N.A.	3.70
North	2.31	N.A.	N.A.	2.68	2.43	2.07	2.33
South	2.66	N.A.	N.A.	N.A.	3.41	2.93	2.71
Total	2.61	N.A.	N.A.	2.67	2.51	2.83	2.64

Ratio 2011/1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	N.A.	N.A.	N.A.	5.31	4.47	5.43	4.97
Central-E	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
ESB	7.55	N.A.	N.A.	N.A.	7.55	N.A.	7.55
Northeast	10.10	N.A.	N.A.	5.42	8.24	N.A.	9.69
North	4.11	N.A.	N.A.	5.49	4.20	3.23	4.12
South	5.08	N.A.	N.A.	N.A.	7.55	6.17	5.27
Total	5.11	N.A.	N.A.	5.32	4.48	5.49	5.04

Table 2.3 (Continued)

Average Annual Growth 1990 to 2001 (Percent)

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	N.A.	N.A.	N.A.	9.5	8.7	9.9	9.3
Central-E	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
ESB	11.8	N.A.	N.A.	N.A.	11.8	N.A.	11.8
Northeast	13.0	N.A.	N.A.	6.7	11.9	N.A.	12.6
North	7.9	N.A.	N.A.	9.4	8.4	6.9	8.0
South	9.3	N.A.	N.A.	N.A.	11.8	10.3	9.5
Total	9.1	N.A.	N.A.	9.3	8.7	9.9	9.2

Average Annual Growth 2001 to 2011 (Percent)

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	N.A.	N.A.	N.A.	6.9	5.9	6.7	6.4
Central-E	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
ESB	8.3	N.A.	N.A.	N.A.	8.3	N.A.	8.3
Northeast	10.1	N.A.	N.A.	10.2	9.1	N.A.	10.1
North	5.9	N.A.	N.A.	7.4	5.6	4.5	5.9
South	6.7	N.A.	N.A.	N.A.	8.3	7.7	6.9
Total	7.0	N.A.	N.A.	7.1	5.9	6.9	6.7

Table 2.4
Land Person Trip Matrix 1990 To 2011 ('000 Persons/Day)

1990							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	399.8	205.8	101.2	39.6	30.7	18.9	796.0
Central-E	203.9	138.6	37.8	22.0	45.4	14.2	461.9
ESB	91.0	36.2	59.5	11.0	18.3	2.0	218.0
Northeast	35.2	25.1	12.2	164.1	28.0	7.5	272.0
North	46.0	41.1	6.3	28.6	135.6	4.0	261.5
South	21.1	12.3	5.3	8.7	3.3	250.2	300.9
Total	797.0	459.1	222.3	273.8	261.3	296.8	2310.4
1996							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	713.6	334.9	213.2	47.2	37.8	34.1	1380.9
Central-E	332.9	208.1	75.5	25.6	53.0	23.4	718.5
ESB	195.9	79.7	151.1	16.0	27.1	4.3	474.0
Northeast	41.5	29.8	17.0	179.4	30.6	9.1	307.5
North	54.2	48.3	8.9	31.3	148.3	5.2	296.1
South	31.6	18.8	9.9	9.7	3.8	370.0	443.9
Total	1369.7	719.6	475.6	309.2	300.6	446.2	3620.8
2001							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	1110.2	484.9	355.2	55.3	43.7	51.4	2100.7
Central-E	486.6	285.5	126.2	29.4	59.7	34.7	1022.1
ESB	342.4	136.0	283.0	21.2	34.8	7.4	824.8
Northeast	48.7	33.8	21.7	193.2	32.9	10.9	341.3
North	67.8	56.1	11.8	33.8	160.5	7.0	336.9
South	43.5	24.6	14.9	10.4	4.1	503.5	601.1
Total	2099.2	1020.9	812.7	343.3	335.8	614.9	5226.9
2006							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	1653.8	672.4	543.8	63.1	54.2	66.4	3053.6
Central-E	670.3	368.5	187.1	33.3	69.5	42.9	1371.5
ESB	510.9	195.0	433.8	24.3	41.4	9.7	1214.9
Northeast	56.0	37.7	26.0	208.0	35.6	11.8	375.1
North	81.6	63.3	14.5	36.6	176.2	7.9	380.1
South	64.3	34.1	21.6	12.3	5.4	684.4	822.1
Total	3036.9	1370.9	1226.8	377.6	382.2	823.0	7217.4

Table 2.4 (Continued)

2011							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	2378.4	927.1	768.2	73.8	66.2	89.9	4303.8
Central-E	922.6	491.1	261.9	37.7	82.2	55.7	1851.3
ESB	740.5	279.6	617.7	28.9	47.8	13.2	1727.8
Northeast	65.3	44.0	30.5	224.3	38.8	13.3	416.1
North	102.7	76.1	17.7	39.6	201.4	10.1	447.6
South	88.6	45.9	28.7	13.7	6.9	953.7	1137.4
Total	4298.1	1863.9	1724.7	418.0	443.3	1135.9	9883.9

Ratio 2001/1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	2.78	2.36	3.51	1.40	1.42	2.72	2.64
Central-E	2.39	2.06	3.34	1.34	1.32	2.44	2.21
ESB	3.76	3.76	4.75	1.93	1.90	3.70	3.78
Northeast	1.38	1.35	1.79	1.18	1.18	1.45	1.25
North	1.47	1.36	1.86	1.18	1.18	1.76	1.29
South	2.06	2.01	2.80	1.20	1.25	2.01	2.00
Total	2.63	2.22	3.66	1.25	1.29	2.07	2.26

Ratio 2011/1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	5.95	4.51	7.59	1.87	2.16	4.75	5.41
Central-E	4.52	3.54	6.93	1.72	1.81	3.92	4.01
ESB	8.13	7.73	10.38	2.63	2.61	6.61	7.92
Northeast	1.86	1.75	2.51	1.37	1.39	1.77	1.53
North	2.23	1.85	2.80	1.39	1.49	2.53	1.71
South	4.20	3.74	5.39	1.58	2.06	3.81	3.78
Total	5.39	4.06	7.76	1.53	1.70	3.83	4.28

Table 2.4 (Continued)

Average Annual Growth 1990 To 2001 (Percent)

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	9.73	8.10	12.09	3.09	3.26	9.51	9.22
Central-E	8.23	6.79	11.58	2.68	2.53	8.45	7.49
ESB	12.80	12.80	15.23	6.16	6.01	12.63	12.86
Northeast	3.00	2.74	5.41	1.50	1.49	3.46	2.08
North	3.59	2.86	5.80	1.54	1.55	5.27	2.33
South	6.81	6.54	9.81	1.70	2.03	6.56	6.49
Total	9.20	7.54	12.51	2.08	2.31	6.85	7.70

Average Annual Growth 2001 To 2011 (Percent)

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	7.92	6.70	8.02	2.93	4.25	5.75	7.44
Central-E	6.61	5.57	7.58	2.54	3.24	4.86	6.12
ESB	8.02	7.47	8.12	3.16	3.22	5.98	7.67
Northeast	2.98	2.65	3.45	1.50	1.65	1.98	2.00
North	4.24	3.10	4.18	1.60	2.30	3.71	2.88
South	7.36	6.42	6.78	2.76	5.17	6.60	6.58
Total	7.43	6.20	7.81	1.99	2.82	6.33	6.58

2.1.2 Land Person Trips

Subtracting the projection of air person trip from total person trip, the projected land person trip O-D matrices are obtained. This is given in Table 2.4. As air transport accounts for a very small proportion of total person trips, the growth of land person trips is similar to that for total person trips. By 2001, total land person trips are expected to increase by 2.26 times compared to 1990, and by 2011 the increase is expected to be 4.28 times. It can be seen that tremendous growths are expected for travel around the BMR and nearby regions. Inter-provincial travel within the BMR is expected to increase to about 2.4 million person trips per day by 2011, which is more than all the inter-provincial person trips for the whole country in 1990. The most dramatic growth occurs for travel between the BMR and the Eastern Seaboard corridor (ESB). By 2011, the number of person trips between the BMR and ESB is expected to reach about 750,000 person trips per day, which is about 1.9 times the total inter-provincial person trips within the BMR in 1990. Also, inter-provincial trips within ESB itself is expected to show very high growth, reaching over 600,000 person trips per day by 2011, which is about 50% more than the total inter-provincial movement within the BMR in 1990. It is clear that huge growth in transport infrastructure for travel between the BMR and ESB will be required in addition to the various projects that have already been planned to cope with such a large expected increase in person trips (to which, of course, one has to add demand from freight movement).

Person movement between the BMR and the non-ESB provinces in the Central region (Central-E) are also expected to increase significantly, reaching over 920,000 person trips per day by 2011. Thus, trips around the BMR and surrounding provinces are where large increases are expected. This is in line with the expected future development pattern, where, in spite of the desire by almost all governments to shift development into outlying provinces, achieving this aim has proven almost impossible.

For other parts of the country, inter-provincial person trips within the Southern region is also expected to increase to very high levels, reaching almost 1 million person trips per day by 2011. Movement between the Central-E region and the Northern Region is also expected to reach about 80,000 person trips per day by 2011.

This picture of the growth in person trips is in line with the view than the transport sector grows in line with the overall growth in the economy. By 2011, if the economic growth scenarios of about 7-8 percent per annum is realized, then overall economic activity in Thailand would have increased by over 4 times the current level, and it is expected that the transport sector will also grow by about the same factor. While it is possible that person movements may reach a point where growth becomes much slower than overall economic growth, this point appears to be quite far in the future for Thailand, given that the level of the Thai economy is still at an early industrialization stage. The expected growth in person trips by about 4.3 folds should not be too far off the mark. The pattern of this growth also appears reasonable, given the expected future trend of regional development, with the BMR and ESB together with some other provinces in the Central-E region likely to continue to be the most dynamic areas of the country.

2.1.3 Rail Person Trips

From the projected growth in land person trips, we start with the basic scenario for rail person trip, which is to assume a fixed share in land person trips for the railway. The shares in 1990 are given in Table 2.5. (This is, in fact, an aggregation from an 16 X 16 regional matrix upon which the analysis is based as described in Chapter 3, so that the fixed shares assumed are based on the 16 X 16 O-D matrix and not on the aggregated matrix in Table 2.5).

Table 2.5
Share of Rail in Land Person Trips 1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	24.46%	13.86%	2.40%	43.55%	28.78%	60.81%	20.90%
Central-E	13.81%	16.73%	2.73%	9.36%	4.77%	10.89%	12.59%
ESB	3.20%	2.60%	0.27%	1.76%	0.36%	0.32%	1.96%
Northeast	47.99%	8.08%	1.69%	22.49%	0.05%	0.20%	20.60%
North	20.44%	5.47%	1.19%	0.05%	16.10%	0.12%	12.84%
South	54.22%	12.59%	0.14%	0.22%	0.15%	22.52%	23.05%
Total	20.90%	12.74%	1.76%	20.60%	12.60%	23.39%	16.78%

Applying fixed 1990 shares to the land person trips matrices, the projected growth in rail person trips is obtained in Table 2.6. With the assumed fixed shares, total rail person trips are expected to increase by 3.87 times by 2011 compared to 1990, slightly lower than the overall growth of total land person trips. Total rail person trips are expected to increase at an average rate of 6.88 percent per annum between 1990 and

2001, and by 6.42 percent per annum between 2001 and 2011. In terms of the number of person trips, this is expected to increase from about 388,000 person trips per day in 1990 to about 1.5 million person trips per day in 2011. Much of this growth occurs in inter-provincial travel within the BMR, which is expected to increase from about 97,800 person trips per day in 1990 to about 581,700 person trips per day by 2011 (which is about 1.5 times the total person trips per day on the whole of the present day rail system). Ignoring inter-BMR movements, much of which should be served by various Mass Transits systems by 2011, rail person trips elsewhere are expected to increase from about 290,000 person trips per day in 1990 to about 920,000 person trips per day by 2011, or an increase of about 3.17 times.

While the increase in rail person trips in this fixed share case may appear large if current state of rail operations are taken into account, it seems to be within the capability of the SRT. The main growth occurs for inter-BMR travel, which as suggested above should be mostly provided for by various mass transit systems. If one assumes, roughly, that 2/3 of the inter-BMR travel in 2011 will be so served, then SRT commuter trains will account for the remaining 1/3, or about 174,500 person trips per day. Adding this to the non inter-BMR trips gets a total rail person trip of about 1.1 million person

trips per day in 2011. This is equivalent to an average annual growth rate of almost exactly 5 percent per annum between 1990 and 2011. This seems to be within the feasible range. For example, between 1970 and 1980, rail passenger growth was on average 4.4% per annum. It is between 1980 and 1990 that the growth rates fell tremendously to only 1.4% per annum (although passenger km. increased faster, at 2.7% per annum). With recommended "re-positioning" of the SRT along a number of dimensions (to be discussed in Chapter 6), it seems realistically possible that growth in rail passenger service can revert back to at least the level in the 1970s, which would correspond roughly to this fixed share case.

Some feature of this fixed shares case does not appear to be very satisfactory, in terms of the SRT serving the future transportation needs of the nation. If one examines the O-D growth patterns in land person trips, with the shares of the railway, then it can be seen that the SRT has rather low shares for land O-D trips that are expected to increase at very high rates in the future. As already indicated above, very large growth, both in terms of growth rates and in terms of absolute numbers, in land person trips are expected for areas surrounding the BMR, particularly BMR-ESB travel. For this latter O-D pair, the rail share in 1990 was tiny; about 3 percent. With assumed fixed shares, this means that the contribution of the SRT to serve the rapid trip growth expected for BMR-ESB

Table 2.6
Rail Person Trip Matrix 1990 to 2011 ('000 Persons/Day)
Fixed Rail Share As In 1990

1990							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	97.8	28.5	2.4	17.2	8.8	11.5	166.3
Central-E	28.2	23.2	1.0	2.1	2.2	1.5	58.2
ESB	2.9	0.9	0.2	0.2	0.1	0.0	4.3
Northeast	16.9	2.0	0.2	36.9	0.0	0.0	56.0
North	9.4	2.2	0.1	0.0	21.8	0.0	33.6
South	11.4	1.5	0.0	0.0	0.0	56.3	69.4
Total	166.6	58.5	3.9	56.4	32.9	69.4	387.7
1996							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	174.5	46.4	5.1	20.6	10.8	20.4	277.9
Central-E	45.0	34.5	2.0	2.3	2.5	2.5	88.8
ESB	6.3	2.0	0.4	0.3	0.1	0.0	9.1
Northeast	19.8	2.3	0.3	40.3	0.0	0.0	62.8
North	11.0	2.6	0.1	0.0	23.8	0.0	37.6
South	17.6	2.3	0.0	0.0	0.0	82.8	102.8
Total	274.3	90.2	7.9	63.6	37.3	105.7	579.1
2001							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	271.5	67.2	8.5	24.3	12.5	30.2	414.2
Central-E	65.2	46.8	3.2	2.5	2.8	3.6	124.1
ESB	11.0	3.4	0.8	0.4	0.1	0.0	15.6
Northeast	23.0	2.6	0.3	43.4	0.0	0.0	69.4
North	13.9	3.1	0.1	0.0	25.7	0.0	42.8
South	24.4	3.0	0.0	0.0	0.0	112.4	139.9
Total	408.9	126.0	13.0	70.6	41.2	146.2	806.0
2006							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	404.5	93.3	13.1	27.4	15.4	39.2	592.9
Central-E	89.8	60.1	4.6	2.7	3.2	4.4	165.0
ESB	16.4	4.7	1.2	0.4	0.1	0.0	22.8
Northeast	26.9	2.8	0.4	46.8	0.0	0.0	76.9
North	16.8	3.5	0.2	0.0	28.1	0.0	48.6
South	34.6	4.1	0.0	0.0	0.0	152.4	191.2
Total	588.9	168.5	19.4	77.4	47.0	196.2	1097.4

Table 2.6 (Continued)

2011							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	581.7	131.0	18.4	32.4	18.8	52.3	834.7
Central-E	125.7	80.8	6.2	3.1	3.8	5.8	225.4
ESB	23.7	6.6	1.7	0.5	0.2	0.0	32.7
Northeast	31.9	3.2	0.5	50.4	0.0	0.0	86.2
North	21.3	4.3	0.2	0.0	31.7	0.0	57.5
South	46.7	5.5	0.0	0.0	0.0	213.3	265.6
Total	831.2	231.4	27.0	86.5	54.5	271.5	1502.0

Ratio 2001/1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	2.78	2.36	3.51	1.41	1.42	2.62	2.49
Central-E	2.31	2.02	3.11	1.22	1.30	2.34	2.13
ESB	3.76	3.57	4.75	1.94	1.90	3.83	3.65
Northeast	1.36	1.26	1.70	1.18	1.18	1.47	1.24
North	1.47	1.36	1.70	1.18	1.18	1.69	1.28
South	2.13	1.96	2.53	1.19	1.21	1.99	2.02
Total	2.45	2.15	3.32	1.25	1.25	2.11	2.08

Ratio 2011/1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	5.95	4.59	7.59	1.88	2.12	4.54	5.02
Central-E	4.47	3.48	6.02	1.51	1.77	3.71	3.88
ESB	8.13	6.96	10.38	2.61	2.60	6.81	7.62
Northeast	1.89	1.59	2.42	1.37	1.39	1.84	1.54
North	2.27	1.89	2.40	1.38	1.45	2.36	1.71
South	4.08	3.55	5.66	1.51	1.99	3.79	3.83
Total	4.99	3.96	6.91	1.53	1.66	3.91	3.87

Table 2.6 (Continued)

Average Annual Growth Rate 1990 To 2001 (Percent)

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	9.73	8.10	12.09	3.16	3.22	9.14	8.65
Central-E	7.93	6.59	10.86	1.84	2.41	8.03	7.13
ESB	12.80	12.27	15.23	6.19	5.99	12.98	12.48
Northeast	2.86	2.09	4.94	1.50	1.51	3.57	1.96
North	3.60	2.86	4.94	1.52	1.51	4.91	2.24
South	7.13	6.33	8.82	1.58	1.74	6.48	6.58
Total	8.51	7.23	11.54	2.07	2.07	7.00	6.88

Average Annual Growth Rate 2001 To 2011 (Percent)

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	7.92	6.91	8.02	2.93	4.12	5.67	7.26
Central-E	6.80	5.62	6.83	2.12	3.15	4.74	6.15
ESB	8.02	6.91	8.12	3.04	3.19	5.93	7.66
Northeast	3.33	2.41	3.58	1.50	1.67	2.26	2.18
North	4.40	3.32	3.49	1.57	2.11	3.37	2.99
South	6.71	6.08	8.36	2.43	5.10	6.62	6.62
Total	7.35	6.27	7.60	2.04	2.83	6.38	6.42

travel will not significantly ease the pressure on the other land modes. The same is true for BMR-Central-E travel, although the rail share for this O-D pair is larger, at about 14 percent. And as indicated above, with much more negative externalities for road compared to rail travel, these externalities (pollution, congestion etc.) will increase rapidly in the areas within and surrounding the BMR. Because of this, another scenario should be looked at where rail will have increased role in land transportation in the future.

2.2 Non-Rail Targets and Resulting Rail Person Trips

In the fixed rail shares case above, one can subtract the projection of rail person trips from that of total land person trips to arrive at road person trips (personal cars and buses). This is given in Table 2.7. This shows tremendous increase for areas within and surrounding the BMR. Within the BMR, inter-provincial person trip is projected to increase 5.9 times by 2011, from about 302,000 person trips per day in 1990 to a huge 1.8 million person trips per day in 2011.[8] Under this scenario, for BMR-ESB travel, the growth is expected to be about 12-13% per annum between 1990 and 2001, and about 8% per annum between 2001 and 2011. The number of person trips for BMR-ESB travel is expected to increase from about 100,000 person trips per day in 1990 to around 710-750,000 person trips per day in 2011. This would be about 2.4 times the inter-provincial person trips within the BMR in 1990. The amount of congestion that this would lead to, even with all the planned new road infrastructure is difficult to contemplate, even not taking into account other negative effects such as pollution, fuel consumption, and road accidents.

In this part, an alternative analysis is presented. This starts with some simple assumptions about how much can the road be expected to realistically absorb, without leading to unacceptable levels of the negative externalities as discussed earlier. The remaining will then have to be the role of the railway.

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8. Much of this would be due to large growth in population residing in the surrounding provinces 20 years hence, due to the usual city development pattern, where inner city areas become less and less residential due to very high land prices. Commuting from outside the city to work in the city would therefore increase tremendously.

Table 2.7
Non-Rail Land Person Trip Matrix 1990 To 2011 ('000 Persons/Day)
Under Fixed Rail Share

1990							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	302.0	177.2	98.8	22.3	21.9	7.4	629.7
Central-E	175.8	115.4	36.8	19.9	43.2	12.7	403.8
ESB	88.1	35.2	59.4	10.8	18.3	2.0	213.7
Northeast	18.3	23.1	12.0	127.2	28.0	7.5	216.0
North	36.6	38.9	6.3	28.5	113.7	4.0	227.9
South	9.7	10.7	5.3	8.6	3.3	193.8	231.5
Total	630.5	400.6	218.4	217.4	228.4	227.4	1922.6

1996							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	539.1	288.5	208.1	26.6	27.0	13.8	1103.0
Central-E	287.8	173.6	73.5	23.3	50.5	20.9	629.6
ESB	189.6	77.7	150.7	15.7	27.0	4.3	464.9
Northeast	21.7	27.5	16.7	139.0	30.6	9.1	244.7
North	43.1	45.6	8.8	31.3	124.5	5.2	258.5
South	14.0	16.4	9.9	9.7	3.8	287.2	341.1
Total	1095.4	629.4	467.7	245.6	263.3	340.5	3041.8

2001							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	838.6	417.7	346.7	31.0	31.1	21.3	1686.5
Central-E	421.4	238.7	123.0	26.9	56.9	31.1	898.0
ESB	331.5	132.6	282.2	20.8	34.7	7.4	809.2
Northeast	25.7	31.3	21.4	149.7	32.9	10.9	271.9
North	53.9	53.0	11.6	33.8	134.8	7.0	294.1
South	19.1	21.6	14.9	10.4	4.1	391.1	461.3
Total	1690.3	894.9	799.7	272.6	294.6	468.7	4420.9

2006							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	1249.3	579.1	530.7	35.7	38.7	27.1	2460.7
Central-E	580.5	308.4	182.5	30.5	66.2	38.4	1206.6
ESB	491.5	190.3	432.6	23.9	41.2	9.6	1192.1
Northeast	29.1	34.9	25.6	161.2	35.6	11.8	298.2
North	64.8	59.8	14.3	36.6	148.1	7.9	331.5
South	29.8	30.0	21.6	12.2	5.4	532.0	630.9
Total	2448.0	1202.4	1207.3	300.2	335.3	626.8	6120.0

Table 2.7 (Continued)

2011							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	1796.7	796.1	749.8	41.5	47.5	37.6	3469.1
Central-E	796.9	410.3	255.7	34.6	78.3	50.0	1625.9
ESB	716.8	273.1	616.0	28.4	47.7	13.2	1695.1
Northeast	33.4	40.7	30.0	173.8	38.8	13.3	330.0
North	81.3	71.8	17.5	39.6	169.7	10.1	390.1
South	41.8	40.4	28.6	13.7	6.8	740.4	871.8
Total	3466.9	1632.5	1697.6	331.6	388.8	864.5	8381.9

Ratio 2001/1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	2.78	2.36	3.51	1.39	1.42	2.87	2.68
Central-E	2.40	2.07	3.34	1.35	1.32	2.45	2.22
ESB	3.76	3.77	4.75	1.93	1.90	3.70	3.79
Northeast	1.40	1.35	1.79	1.18	1.18	1.45	1.26
North	1.47	1.36	1.86	1.18	1.18	1.76	1.29
South	1.98	2.01	2.80	1.20	1.25	2.02	1.99
Total	2.68	2.23	3.66	1.25	1.29	2.06	2.30

Ratio 2011/1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	5.95	4.49	7.59	1.86	2.17	5.07	5.51
Central-E	4.53	3.55	6.96	1.74	1.81	3.95	4.03
ESB	8.13	7.75	10.38	2.63	2.61	6.61	7.93
Northeast	1.83	1.76	2.51	1.37	1.39	1.77	1.53
North	2.22	1.85	2.80	1.39	1.49	2.53	1.71
South	4.33	3.77	5.39	1.58	2.06	3.82	3.77
Total	5.50	4.08	7.77	1.53	1.70	3.80	4.36

Table 2.7 (Continued)

Average Annual Growth 1990 To 2001 (Percent)

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	9.7	8.1	12.1	3.0	3.3	10.0	9.4
Central-E	8.3	6.8	11.6	2.8	2.5	8.5	7.5
ESB	12.8	12.8	15.2	6.2	6.0	12.6	12.9
Northeast	3.1	2.8	5.4	1.5	1.5	3.5	2.1
North	3.6	2.9	5.8	1.5	1.6	5.3	2.3
South	6.4	6.6	9.8	1.7	2.0	6.6	6.5
Total	9.4	7.6	12.5	2.1	2.3	6.8	7.9

Average Annual Growth 2001 To 2011 (Percent)

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	7.9	6.7	8.0	2.9	4.3	5.9	7.5
Central-E	6.6	5.6	7.6	2.6	3.2	4.9	6.1
ESB	8.0	7.5	8.1	3.2	3.2	6.0	7.7
Northeast	2.7	2.7	3.4	1.5	1.7	2.0	2.0
North	4.2	3.1	4.2	1.6	2.3	3.7	2.9
South	8.1	6.5	6.8	2.8	5.2	6.6	6.6
Total	7.4	6.2	7.8	2.0	2.8	6.3	6.6

2.2.1 Non-Rail Targets

Table 2.8 shows some rough targets for non-rail land transport growth. Targets are set for the maximum average growth in person trips between 1990 and 2011, and hence implied ratio of person trips in 2011 compared to 1990. The main assumptions are:

- Target Non-Rail Land Person Trip Matrix 1990 to 2011 ('000 Persons/Day).
- Inter-Regional Road Network Trips Increase at most 5% per annum (2.78 times).
- Inter-Regional Road Network Trips BMR-Surrounding Central Regions at most 7% per annum (4.14 times).
- Intra-Regional Road Network Trips Increase at most 8% per annum (5.03 times).
- Central-ESB at 8% per annum.
- Movement to South at 8% per annum (Low current demand).
- BMR-ESB at 9.5% per annum (6.72 times).
- Intra-ESB at 11% per annum (8.95 times).

Starting from the fixed rail shares case, if the implied growth in non-rail person trips is lower than the various limits, then the non-rail person trips in 2011 are not changed. However, if the implied non-rail person trips in the fixed rail shares case exceed the above targets, then a cap is put on the non-rail person trips.

These non-rail targets are in fact quite generous concerning the ability of the road system to absorb. For routes which are already highly congested, such as the BMR-ESB routes, it would imply new road constructions at a rate nearly equal to the target rates to prevent unrealistic congestion scenarios, which in the BMR-ESB case is a very high 9.5% growth per annum.

Even with the above non-rail targets, congestion on the nation's road are very unlikely to improve. This can be seen from Table 2.9, which shows the past growth of the road stock (under DOH jurisdiction). It can be seen that between 1980-90, the stock of national highways only increased about 2-3% annually, while the stock for provincial highways increased by about 9.1% per annum between 1980 and 1985, with the rate declining to less than 5% per annum between 1985-90. That the growth of road stock is not increasing that rapidly is not surprising. With an ever increasing length of road stock (about 45,500 km. of national and provincial highways in 1990), each percentage increase

Table 2.8
Target Non-Rail Land Person Trip Matrix 1990 to 2011 ('000 Persons/Day)
Inter-Regional Road Network Trips Increase at most 5% per annum (2.78 times)
Inter-Regional Road Network Trips BMR-Surrounding Central Regions at most 7% per annum (4.14 times)
Intra-Regional Road Network Trips Increase at most 8% per annum (5.03 times)
Central-ESB at 8% per annum
Movement to South at 8% per annum (Low current demand)
BMR-ESB at 9.5% per annum (6.72 times)
Intra-ESB at 11% per annum (8.95 times)

Ratio 2011/1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	5.03	4.14	6.73	1.86	2.17	5.03	4.84
Central-E	4.14	3.55	5.03	1.74	1.81	3.95	3.68
ESB	6.73	5.03	8.95	2.63	2.61	5.03	6.49
Northeast	1.83	1.76	2.51	1.37	1.39	1.77	1.53
North	2.22	1.85	2.79	1.39	1.49	2.53	1.71
South	4.33	3.77	5.03	1.58	2.06	3.82	3.76
Total	4.75	3.68	6.66	1.53	1.70	3.79	3.91

1990							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	302.0	177.2	98.8	22.3	21.9	7.4	629.7
Central-E	175.8	115.4	36.8	19.9	43.2	12.7	403.8
ESB	88.1	35.2	59.4	10.8	18.3	2.0	213.7
Northeast	18.3	23.1	12.0	127.2	28.0	7.5	216.0
North	36.6	38.9	6.3	28.5	113.7	4.0	227.9
South	9.7	10.7	5.3	8.6	3.3	193.8	231.5
Total	630.5	400.6	218.4	217.4	228.4	227.4	1922.6
2011							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	1520.3	733.9	664.4	41.5	47.5	37.4	3045.0
Central-E	727.8	410.3	185.0	34.6	78.3	50.0	1486.2
ESB	592.6	177.3	531.2	28.4	47.7	10.0	1387.2
Northeast	33.4	40.7	30.0	173.8	38.8	13.3	330.0
North	81.3	71.8	17.4	39.6	169.7	10.1	389.9
South	41.8	40.4	26.8	13.7	6.8	740.4	870.0
Total	2997.3	1474.5	1454.8	331.6	388.8	861.1	7508.2

Table 2.9
Route Length of Highway 1965-1990 (DOH Jurisdiction Only)
(In Kms. on 30 September)

Year	National	Provincial	Total
1965	9482	2794	12276
1970	10041	5892	15933
1975	12658	7439	20097
1980	13893	14257	28150
1985	15218	22017	37235
1990	17486	27959	45445

Average Growth

1965-70	1.15%	16.09%	5.35%
1970-75	4.74%	4.77%	4.75%
1975-80	1.88%	13.89%	6.97%
1980-85	1.84%	9.08%	5.75%
1985-90	2.82%	4.89%	4.07%

Source: Department of Highways.

implies ever greater absolute length of road to build, and hence greater budget and time required. If the above non-rail targets are examined with Table 2.9 in mind, it should be obvious that even in the this target scenario, average congestion is most likely to increase, and severe congestion around the BMR and ESB region can only be avoided with an accelerated pace of road building in these regions.

2.2.2 Implied Rail Person Trips

Subtracting the non-rail target person trip matrix from the 2011 total land person trip matrix yields the implied rail person trip matrix for 2011 in Table 2.10. It can be seen that the role of rail in person movement for areas surrounding the BMR goes up significantly compared to the fixed share case. For the BMR-ESB trips, rail contribution reaches over 100,000 person trips per day in either direction, a level of volume that may make some form of High Speed Rail economically viable, particularly as demand for inter-provincial travel within the ESB region also increases to about 87,000 person trips per day.

For the Central-E region, rail contribution increases to about 194,000 person trips per day, implying much needed improvement and capacity expansion of the commuter lines extending out from Bangkok. Rail travel between ESB and Central-E also increases tremendously, to about 76-100,000 person trips per day. This would required substantial new investment in integration of the rail system surrounding the BMR area so that rail trips can be made within in the area without all having to come to Bangkok as the center. Finally, with this scenario, the implied share of rail in land person trips increases by about 50% by 2011, to 24.04% compared to 16.78% in 1990 (Table 2.11).

2.3 Conclusions

It seems clear that and adequate person transportation system for the future should involve an increase in the role of the railway. The future spatial development pattern in Thailand, as all available indicators point to, suggests an extension of the BMR conglomerate further out to the neighboring provinces, with the ESB corridor and some upper central provinces as the main growth pole. This is reflected in the NESDB's concept of the Extended Bangkok Metropolitan Region (EBMR). The urban network is expected to expand outward from the BMR. With this development, comes the need for an integrated and expanded transportation system. With current congestion in the BMR area, there is a real need for expanded role for the railway in this integrated transportation system for the area. Without such an expanded role, the negative externalities associated with road transport are likely to grow to almost unacceptable proportions, and may in fact significantly affect the productive efficiency of the economy. What all the above data and analyses suggest is that; first, a strategy to at least maintain the railway's overall share at the 1990 level should be regarded as essential, and at the same time serious efforts should be made to significantly increase the railway's share, particularly for areas in and around the BMR and ESB regions. This will, of course, involve much needed adjustment within the SRT itself and in its relationship with the government (Chapter 6). However, it will also need clear ideas on the part of the government about the desired direction of overall transportation patterns in the country and accompanying transportation policy, and appropriate measures on road transport which may need real political courage to implement.

Table 2.10
Rail Trip Matrix Under Target Non-Rail ('000 Persons/Day)

1990							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	97.8	28.5	2.4	17.2	8.8	11.5	166.3
Central-E	28.2	23.2	1.0	2.1	2.2	1.5	58.2
ESB	2.9	0.9	0.2	0.2	0.1	0.0	4.3
Northeast	16.9	2.0	0.2	36.9	0.0	0.0	56.0
North	9.4	2.2	0.1	0.0	21.8	0.0	33.6
South	11.4	1.5	0.0	0.0	0.0	56.3	69.4
Total	166.6	58.5	3.9	56.4	32.9	69.4	387.7
2011							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	858.1	193.2	103.8	32.4	18.8	52.6	1258.8
Central-E	194.8	80.8	76.9	3.1	3.8	5.8	365.1
ESB	147.9	102.3	86.4	0.5	0.2	3.2	340.6
Northeast	31.9	3.2	0.5	50.4	0.0	0.0	86.2
North	21.3	4.3	0.3	0.0	31.7	0.0	57.6
South	46.7	5.5	1.9	0.0	0.0	213.3	267.5
Total	1300.8	389.3	269.8	86.5	54.5	274.8	2375.7

Ratio 2011/1990

	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	8.77	6.77	42.69	1.88	2.12	4.57	7.57
Central-E	6.92	3.48	74.63	1.51	1.77	3.71	6.28
ESB	50.76	108.63	537.04	2.61	2.60	497.70	79.51
Northeast	1.89	1.59	2.42	1.37	1.39	1.84	1.54
North	2.27	1.89	3.96	1.38	1.45	2.36	1.72
South	4.08	3.55	257.65	1.51	1.99	3.79	3.86
Total	7.81	6.66	69.01	1.53	1.66	3.96	6.13

Table 2.11
Share Of Rail In Land Trip (1990 and 2011) Under Target Non-Rail
(Percent)

1990							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	24.46	13.86	2.40	43.55	28.78	60.81	20.90
Central-E	13.81	16.73	2.73	9.36	4.77	10.89	12.59
ESB	3.20	2.60	0.27	1.76	0.36	0.32	1.96
Northeast	47.99	8.08	1.69	22.49	0.05	0.20	20.60
North	20.44	5.47	1.19	0.05	16.10	0.12	12.84
South	54.22	12.59	0.14	0.22	0.15	22.52	23.05
Total	20.90	12.74	1.76	20.60	12.60	23.39	16.78
2011							
	BMR	Central-E	ESB	Northeast	North	South	Total
BMR	36.08	20.84	13.51	43.85	28.32	58.46	29.25
Central-E	21.11	16.46	29.35	8.21	4.67	10.32	19.72
ESB	19.98	36.59	14.00	1.74	0.36	24.10	19.71
Northeast	48.89	7.36	1.63	22.49	0.05	0.21	20.70
North	20.78	5.59	1.68	0.05	15.74	0.11	12.87
South	52.75	11.93	6.75	0.21	0.15	22.36	23.51
Total	30.26	20.89	15.64	20.68	12.29	24.19	24.04

3. POSSIBLE FUTURE FREIGHT TRANSPORTATION DEMAND BY RAIL

It has become clear from the analysis in Chapter 3 that the demand for freight transportation in the country will be growing at rapid rates in the future. This is particularly true for commodities like cement, containers and oil products where the demand in terms of tonnage will grow at about 15.5%, 10.5% and 8.4% per year between 1991 to 2011, respectively. On the other hand, the growth in transport demand for rice will be less strong, but the volume of rice to be transported in the future will continue to be significant. Furthermore, there are also new business opportunities in freight transportation arising from increasing use of household appliances and motor vehicles in upcountry provinces. There are also opportunities in the demand for bulk commodities, one of which is imported coal to be used in cement or power plants. These commodities could potentially be transported by rail.

The main objective of this section is to specify the amount of freight by type of major freights that could potentially be served by rail between now and the year 2011. These include oil products, rice, cement, containers, electrical appliances, motor vehicles and coal. In our judgment, the volume of rail freight demand presented in this chapter are well within SRT's potential and capability, given that the various constraints in the organization are resolved.

3.1 Petroleum Products

According to Figure 3.1, rail transportation of oil products in 1991 amounted to 1,650 million litres. These products were shipped directly from the central terminal in Chong Non Sri to oil depots in the North and Northeast, and to direct customers in the Central region. The share of rail transportation of oil products to these three regions was 37% in 1991. There has been only a few rail transportation of oil products to the South because rail could not compete with barge in term of transport cost. The volume of rail transportation of oil products has been fairly steady over the past few years despite the fact that the demand for oil products in the North, Northeast and Central have been rising over the period. The lack of growth in the rail oil transportation business has not been because of the lack of interest from oil companies in shipping oil by rail. Rather, poor business growth has been the result of SRT's owned internal problems and among them are the shortages of locomotives and rail tank cars, heavy traffic on single track affecting turn around times, old and small payloads of tank cars etc.. These and many other problems of the SRT are pointed out in other sections of this study, including the recommendations of how to resolve them.

Given that the above mentioned problems are eventually resolved, there are no reasons why the SRT should not be able to gain an increasing share of oil transportation. This is particularly true for the North and Northeast routes which are inland routes.

3.1.1 Rail Freight Demand of Oil in 2001

Figure 3.2 shows the forecast of oil product transportation in Thailand in the year 2001. By the end of this century, both FPT and THAPP oil pipelines would have long been in operation. The THAPP pipeline will deliver the oil from refineries in the East to various depots in the Central region. First, about 8,385 million litres of oil will be delivered by THAPP to Lam Luk Ka depot which is now being built to serve customers in the eastern side of Bangkok. Further to the north of Lam Luk Ka is Saraburi depot where THAPP line ends. Saraburi depot is meant to serve customers in the Central, North and Northeast. To the west of Lam Luk Ka depot lies BAFS terminal which serves jet fuel to airlines at Don Muang.

The second and shorter pipeline runs from Bangchak refinery in Phra Kanong to a large terminal in Bang Pa In. The purpose of the Bang Pa In depot is similar to the one in Saraburi. However, customers in the West will also be able to pick up the oil from the Bang Pa In depot.

Judging from the oil transportation system which are being built, the role of SRT in transporting oil will probably be limited to the locations between Saraburi and Bang Pa In terminals and depots in the North and Northeast regions. This is due to the relative costs between oil pipelines and rail where pipelines are expected to have lower transportation costs than rail. It will also not be economical to transport oil to the south by rail since barge will continue to have strong cost advantage over rail in the future. However, rail will continue to have some business in delivering fuel oil in the Central region as both pipelines are not designed to carry fuel oil. Fuel oil will be transported by conventional means, that is by barge from refineries to terminals in Bangkok, and then by rail or truck to factories in the Central area.

According to Figure 3.2, oil demand in the North, Northeast and Central regions will grow from 4,489 million litre in 1991 to 8,354 million litres in 2001. This is equal to about 6.4% growth rate per year. Given a conservative estimate that rail oil transportation is to maintain its market share in 1991, then the rail oil transportation volume in 2001 will be 3,018 million litres compared to the 1,650 million litres volume in 1991. This is equal to about 7-8 trips of rail delivery a day compared to about 4-5 trips a day at present. However, rail oil transportation services in the future will originate from Saraburi or Bang Pa In, not from Bangkok. This could mean that the turn around time of rail service could improve because delivery distances to customers will be shortened while the services will not be subject to Bangkok rush hour curfew as at present.

In a less conservative case, it is assumed that the share of rail service can gradually expand from 37% in 1991 to 50% in 2001. In this case, the volume of oil to be delivered by rail to the North, Northeast and Central will be increased from 1,650 million litres in 1991 to 4,177 million litres in 2001. This amounts to an increase of 2,527 million litres per year in rail volume by the year 2001. This is equal to about 11 trips of rail deliveries a day. The number of trip here is estimated on the basis of 1 million litres of oil products per trip which is the current SRT's capacity. This capacity could be increased in the future with higher payload tank cars and more powerful locomotives. Thus, the number of trips may not be quite as high as mentioned above (see Figure 3.3).

In an aggressive service case, it is assumed that rail deliveries could be as high as 80% of total bulk oil shipments to the three regions. This is not an unrealistic case, because the volume shown in Figure 3.4 only includes bulk shipments of oil products. It excludes the volume of oil transported from local oil depots to end users, which will probably be done by trucks. Under the aggressive case, rail oil transportation volume in 2001 could be as high as 6,683 million litres, or about 18 trips per day. This will be about 4 times the number of trips being provided by rail today.

The aggressive service case will involve major commitments on both the part of the SRT and that of the oil companies. This will include investment in new oil tank cars, locomotives, track improvement, operation improvement, and oil depot expansion. SRT is also considering new technology in transporting the oil, whereby roll on-roll off tankers could be used instead of the conventional tankers. This could result in improved services by rail because the shipment could bypass the use of local depots.

3.1.2 Rail Freight Demand of Oil in 2011

In the longer term, the total oil demand in the North, Northeast and Central regions are expected to increased to 15,227 million litres in 2011. This is about 10,000

Figure 3.1
Distribution of Oil Products in 1991 (Million Litres)

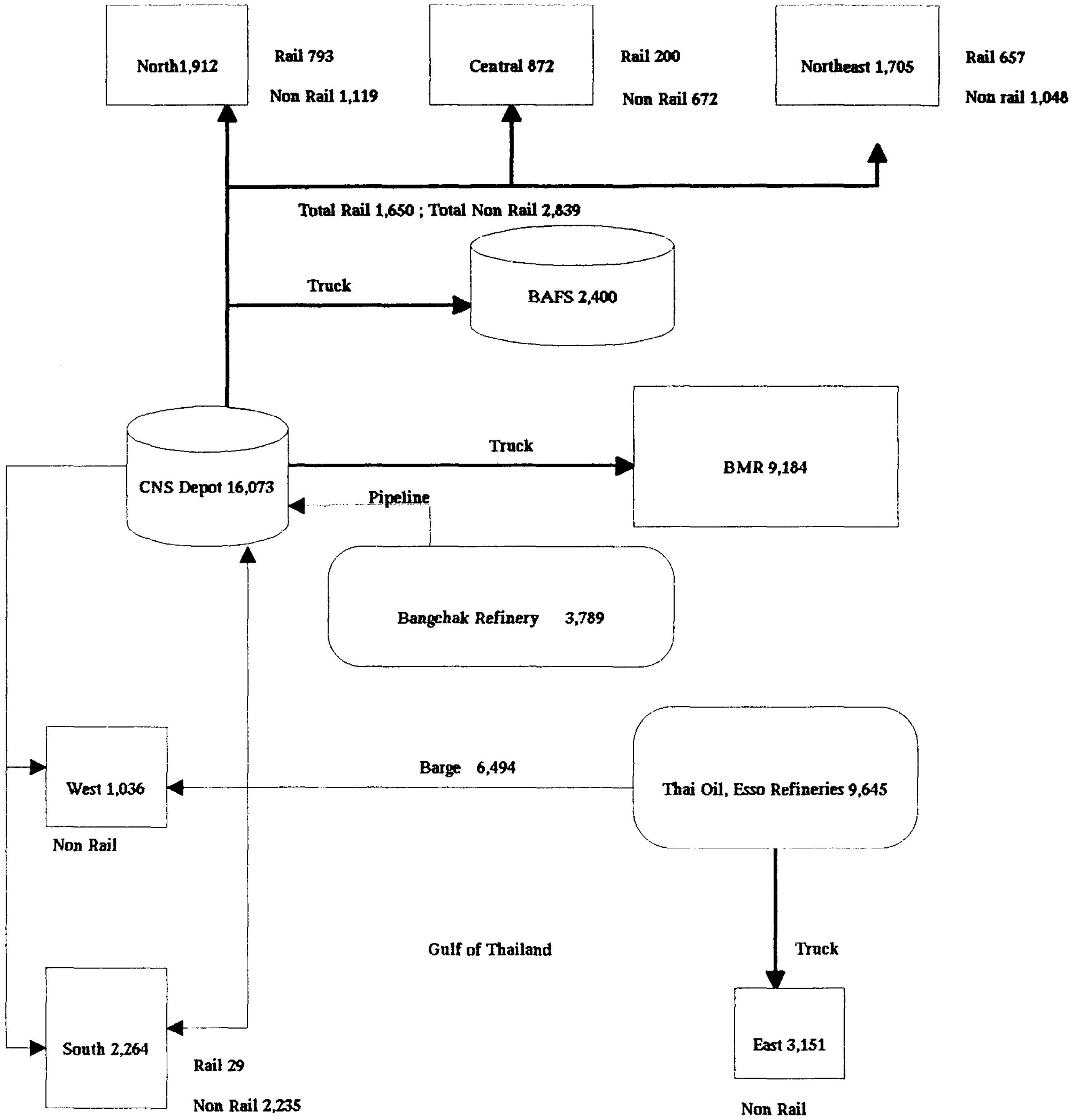


Figure 3.2
Distribution of Oil Products in 2001 (Million Litres)

Base case : volume of rail = share of 1991

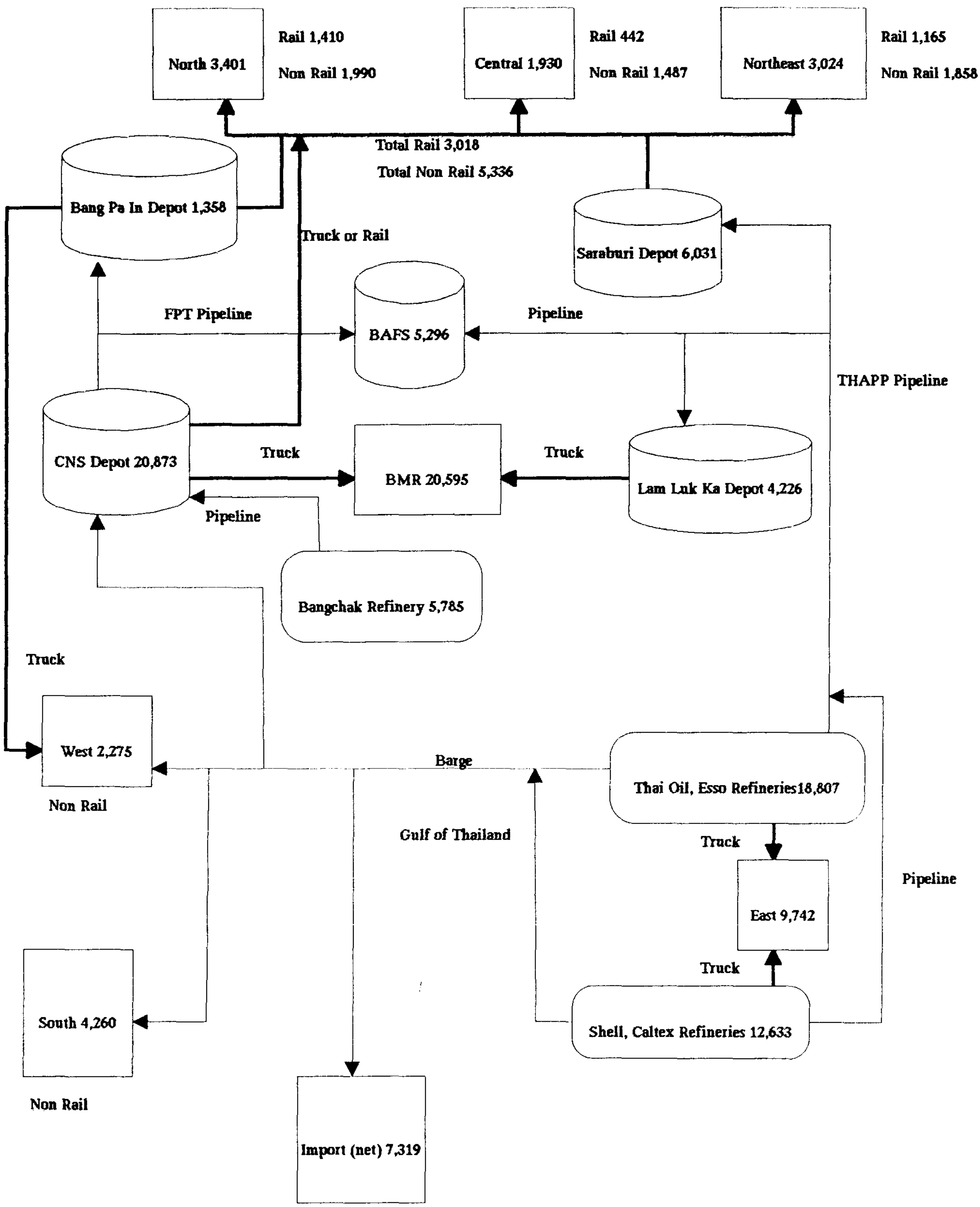


Figure 3.3
Distribution of Oil Products in 2001 (Million Litres)
volume of rail = 50% share

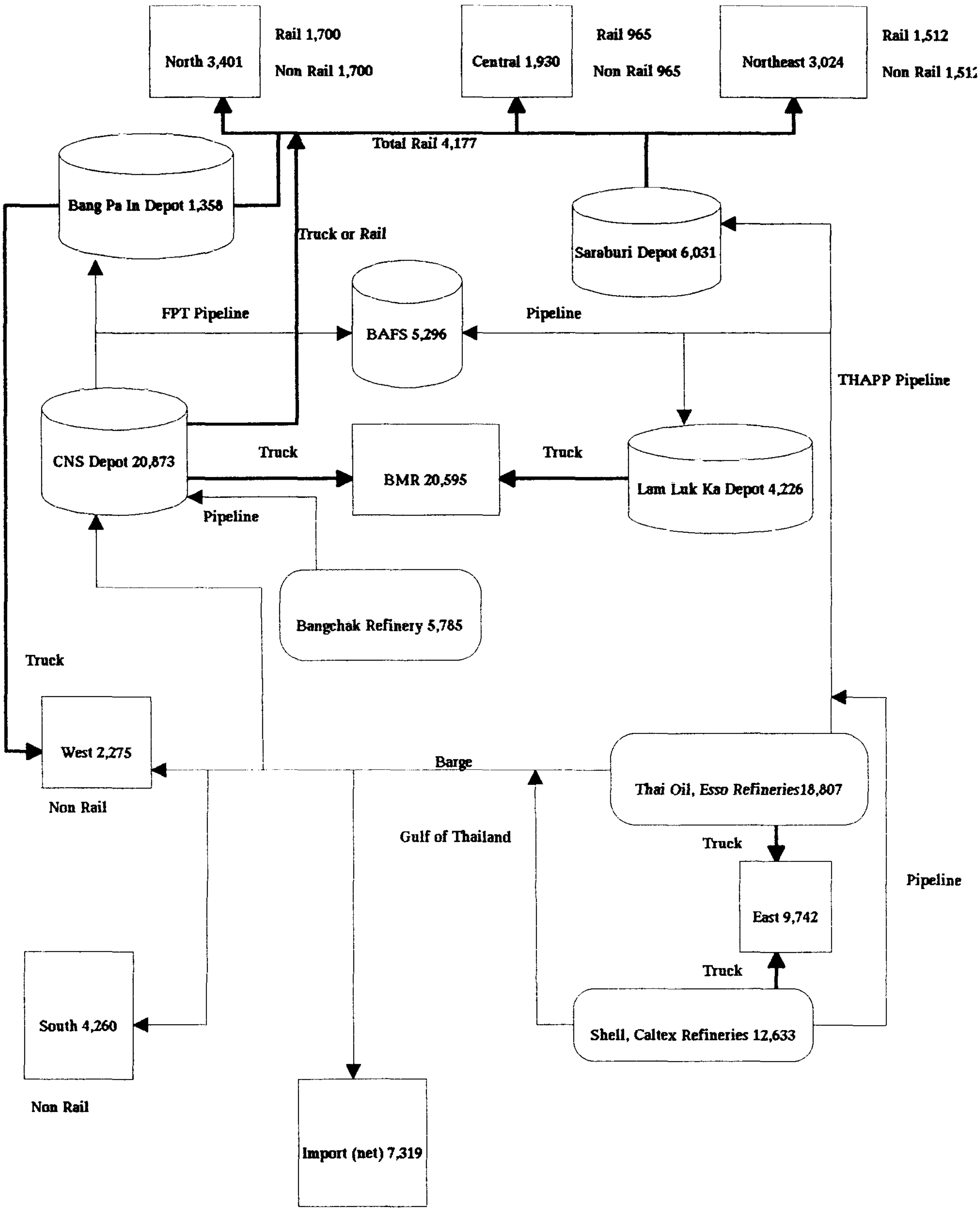


Figure 3.4
Distribution of Oil Products in 2001 (Million Litres)
volume of rail = 80 % share

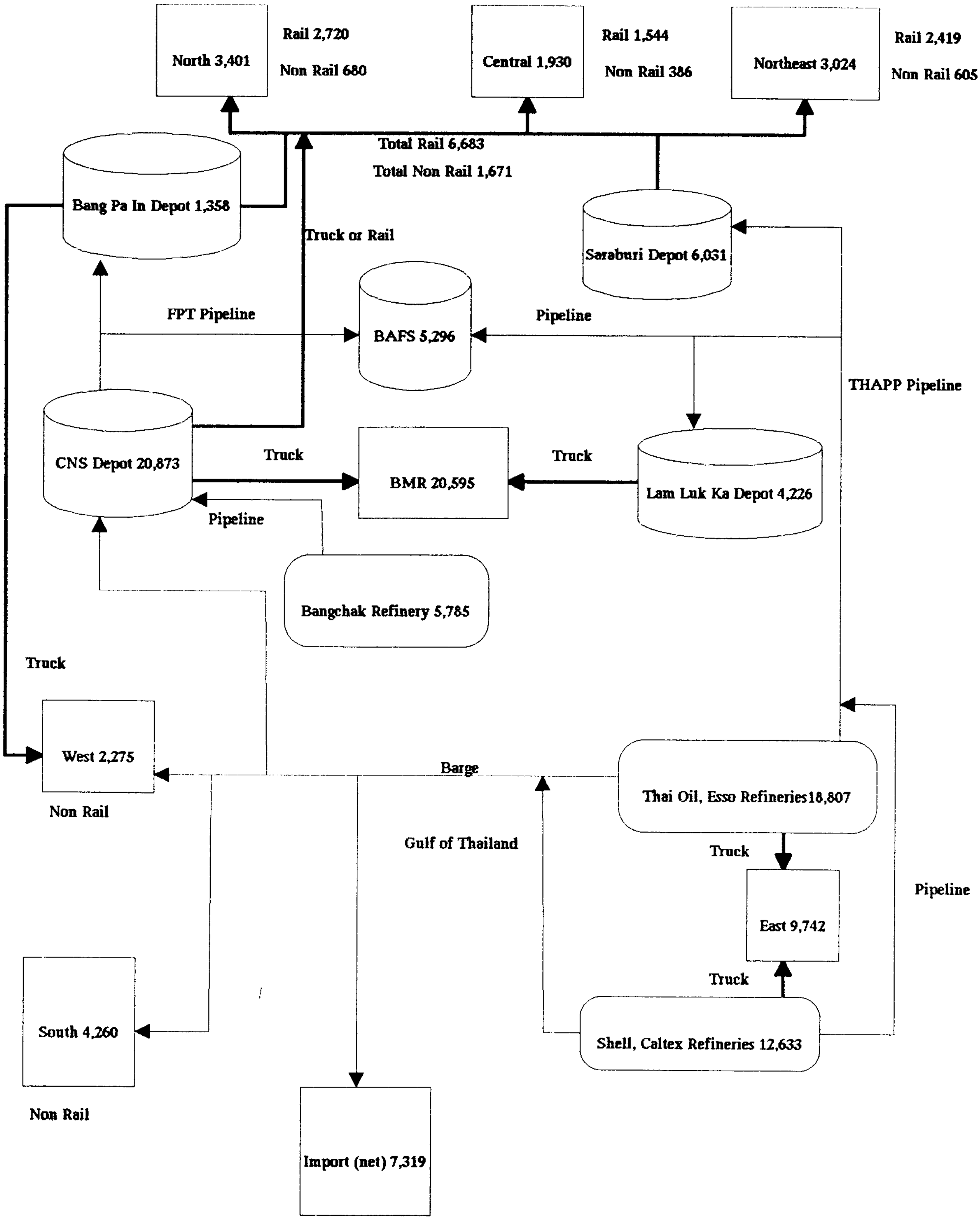


Figure 3.5

Distribution of Oil Products in 2011 (Million Litres)

Base Case : Volume of Rail = Share of 1991

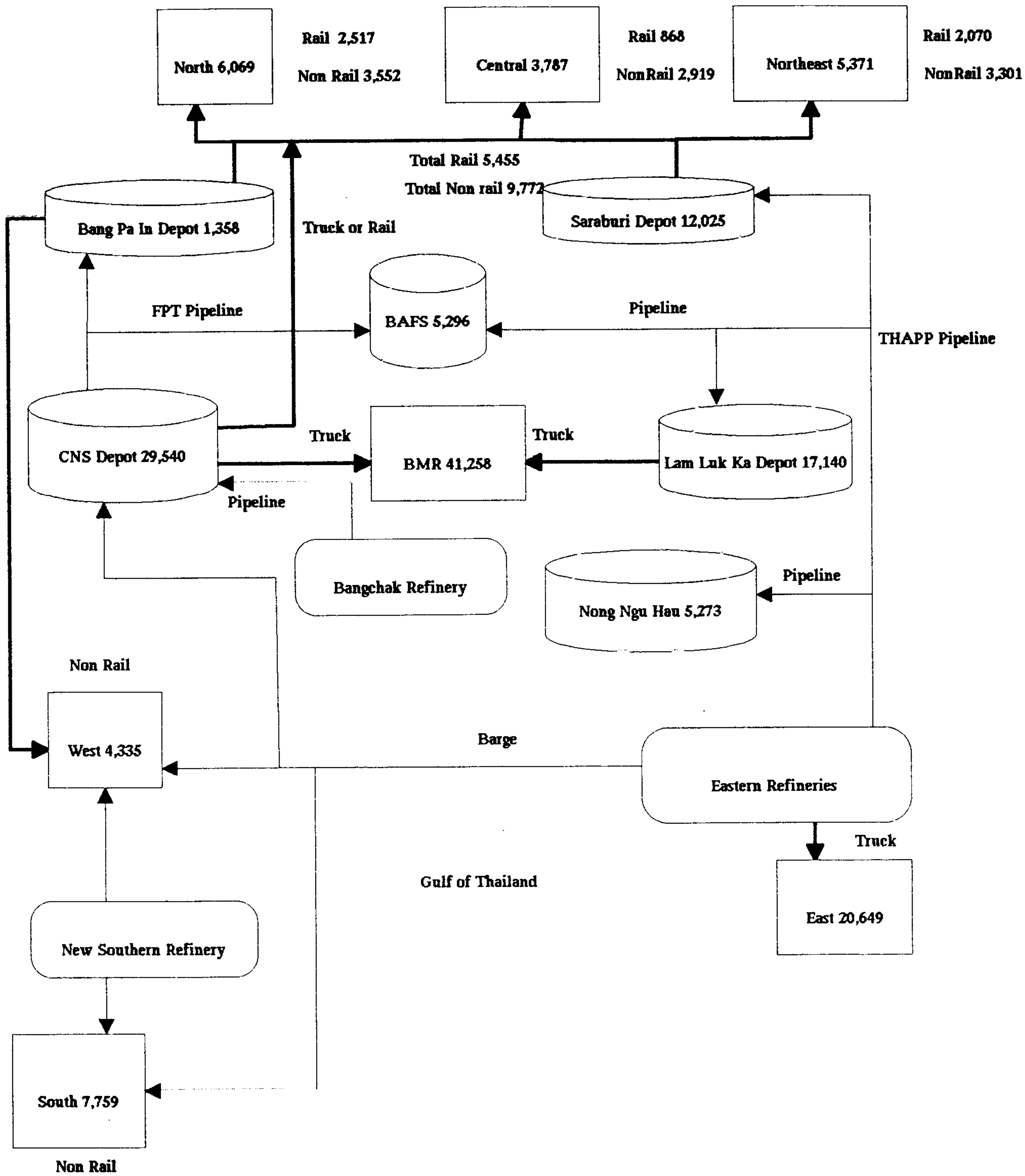


Figure 3.6

Distribution of Oil Products in 2011 (Million Litres)

Volume of Rail = 50 % Share

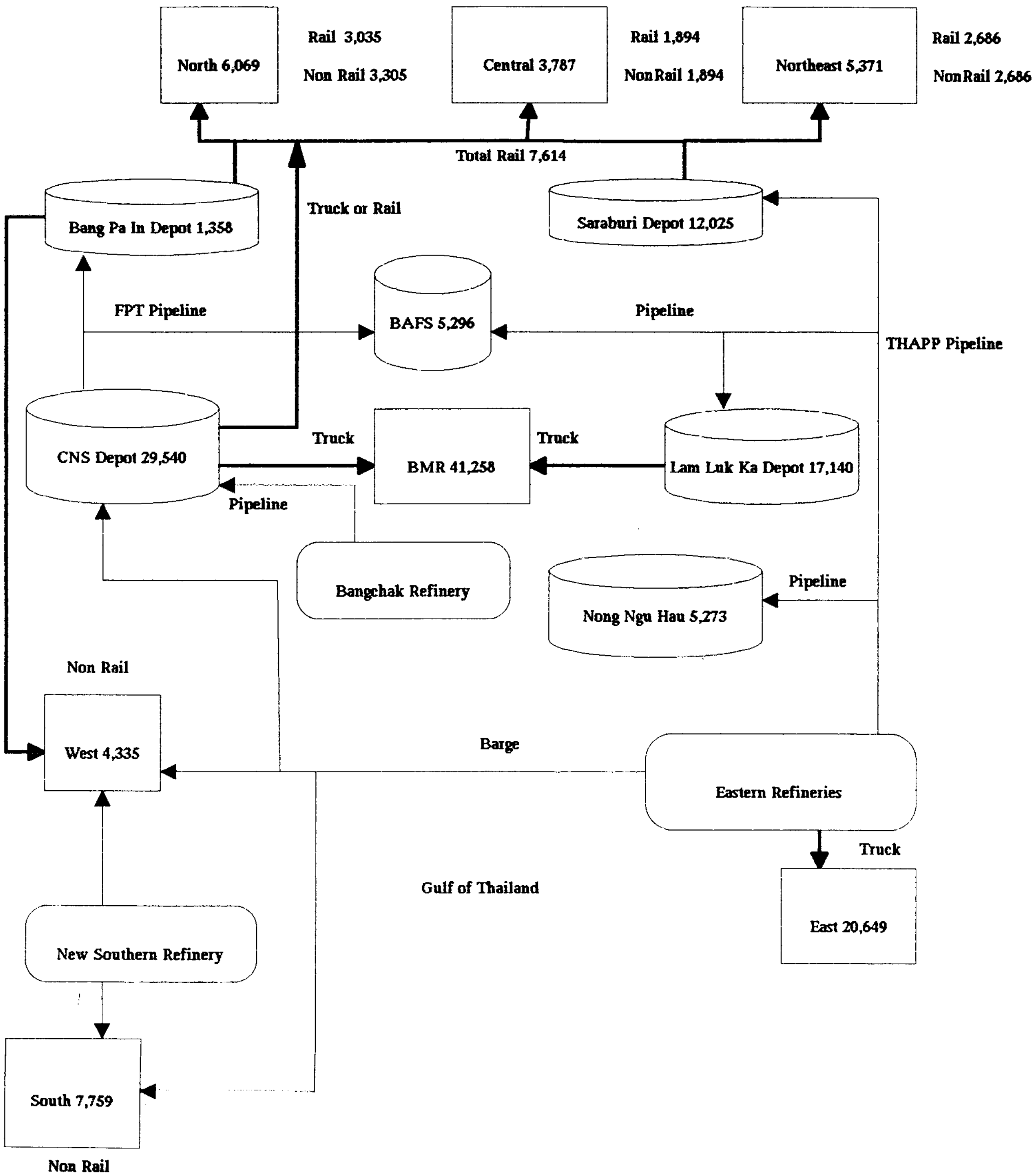
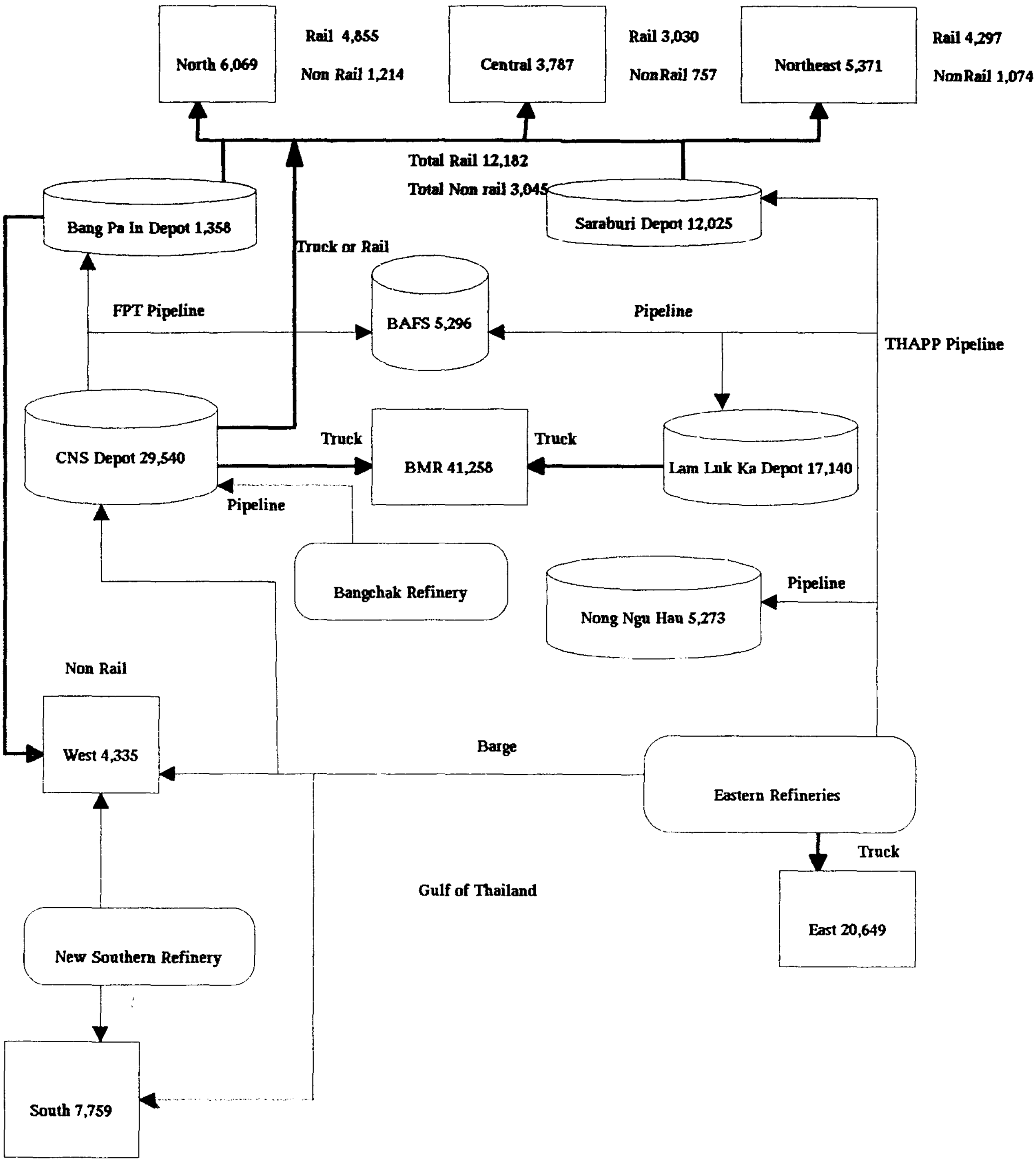


Figure 3.7

Distribution of Oil Products in 2011 (Million Litres)

Volume of Rail = 80 % Share



million litres higher than the current demand (See Figure 3.5). The role of rail shipment will probably continue to be the same as its existing role, which is to serve consumers in the North, Northeast and part of the Central region. Although there has been some suggestions that the oil pipeline should be extended from the Central to the North and Northeast, there has been no concrete long term plan about these pipelines. The economics of the pipeline depends very much on the size and steadiness of oil volume through the pipeline. Furthermore, the construction of extended pipelines may also require additional investments for expansion of the existing pipeline capacity.

Without the extended pipeline to the North and Northeast, the volume of oil that could potentially be transported by rail are 5,455 million litres in 2011, given that rail could maintain its 1991 share of 37%. This is a conservative estimate as the number of rail trips will be increased by only 3-4 times from the existing number of trips, given that the volume of shipment per trip remains unchanged.

In a less modest case, the share of rail services could be increased to 50% of total demand. This will result in the volume of rail oil transportation rising to 7,614 million litres per year by 2011. In terms of the number of trips, the number of shipment will be increased from 4-5 per day at present to 20 per day by 2011. (See Figure 3.6)

In the aggressive case where the share of rail services is increased to as high as 80% of the total demand in the North and Northeast, the volume of rail shipment will be 12,182 million litres per year by 2011. This is roughly 7 times the volume of shipments compared to today's volume of 1,650 million litres per year. Concerning the number of trips, the aggressive service case will require 33 shipments per day given the assumed capacity of one million litres per shipment (Figure 3.7).

Thus, it is quite clear that even with the conservative estimate, the rail oil transportation volume in the future will be significant. By keeping the existing share, the rail volume will increase to several times today's volume. On the other hand, if SRT decides to go for more aggressive service strategies, rail oil shipment could potentially exceed 10 billions litres per year by 2011.

3.2 Rice Transportation

Section 5.2 in Chapter 3 provides an estimate of rice production and demand by region. The differences between the production and demand determine the amount of rice to be transported into or out of a particular region. In general, there will be surpluses of rice in the producing regions of the North, Northeast and Central. On the other hand, the South, which has traditionally been the net "importer" of rice, will continue to do so throughout the forecasting period. Furthermore, although the production of paddy in Thailand will be growing by about 1.4% per year, domestic demand in the country will also grow at about the same rate resulting in the net surplus of rice remaining fairly constant in the future years.

The objective of this section is to provide estimates of rice shipment by rail and other modes in the year 2001 and 2011. The basic assumption in the estimates is that the share of rail shipment of rice will remain constant throughout the forecast years. This is a plausible assumption given the constraints that most rice mills are much more easily accessible by trucks than by rail. However, rail shipment will continue to be significant in the future particularly from the North and Northeast to the South where the transport distances are long.

3.2.1 Rice Transportation by Mode in 1991

As mentioned in the preceding chapter, both domestic and foreign demand for Thai rice was 12.5 million tons in 1991. However, when excluding the amount consumed by farmers which was about 4.2 million tons, the amount of rice to be transported between regions amounted to 8.5 million tons.

According to Table 3.1, total rice shipment by rail in 1991 was only about 0.34 million tons, or only 4% of the total rice being transported. Hence, the rest of the shipments, which were about 8.2 million tons, were transported by truck, including a small amount by barge.

On a regional basis, rail shipment of rice from the Northeast was the most significant. The volume being shipped from this region amounted to 0.22 million tons, or 66% of the total rice shipment by rail in Thailand. About 0.14 million tons (or 60%) of these were shipped to the South, while the rest were transported to the Central region and Bangkok.

As for the North, the shipment of rice by rail amounted to 0.07 million tons. This accounted for 20% of the total rice shipment by rail. Like in the Northeast, about 0.04 million tons (or 64%) of rice shipment from the North was distributed to the South, while about 0.02 million tons were sent to the Central and Bangkok. The rest, only about 4 thousand tons, were transported within the region.

The shipment of rice from the Central and Bangkok to the South by rail was also significant. According to Table 3.1, the total shipment to the South was 36 thousand tons in 1991.

Rail was also being used for local rice distribution. As indicated in Table 3.1, of the 11 thousand tons of rice distributed by rail from the South, up to 10 thousand tons were for local shipment. The rest, about a thousand tons, were shipped to the Central and Bangkok.

However, compared to the amount of rice shipment by truck, rice transportation by rail was relatively low in all regions, even in the Northeast where the volume of rice movement by rail was most significant. In other words, of the 2.7 million tons total rice shipment from the Northeast, about 2.4 million ton, or 92% were shipped by truck.

In the North, the truck's share was up to 97%. This amounted to 1.8 million tons of shipment by truck from the total shipment of 1.9 million tons. As for the Central and Bangkok, the share of truck was highest, amounting to 99%. About 3.6 million tons of 3.7 million tons total shipment were shipped by truck. In the South, the share of truck was 94%, which amounted to 0.18 million tons of rice being transported by truck.

3.2.2 Rice Transportation by Mode in 2001

Based on the constant 1991 share criterion, the total rice shipment by rail in 2001 will be rising to 0.57 million tons (See Table 3.2). The rest of the shipments, which is expected to be about 10.9 million tons, will be shipped by truck.

On the regional distribution, the figures in Table 3.2 indicate that rice transportation in the North will be 3.03 million tons which include both local and regional trade. It is expected that only about 0.1 million tons of rice will be shipped by rail. Rice shipment by rail from the North to the South will be 0.04 million tons while about 5 thousand tons will be transported by rail within the region.

Rail is also expected to be significantly used for rice shipment from the Northeast to the South. According to Table 3.2, 0.2 million tons of rice will be transported by rail to the South, while about 0.19 million tons will be transported by rail to the Central region and Bangkok. In total, there will be about 0.39 million tons of rice being shipped from the Northeast to other regions in 2001.

Table 3.1
Total Rice Movement by Region by Mode in 1991

Unit: ,000 Tons

From	North		Northeast		Central &		South		Total	
To					Bangkok					
North	Rail	4		-		-		-	Rail	4
	Truck	863							Truck	863
	Total	867							Total	867
Northeast		-	Rail	-	Rail	1		-	Rail	1
			Truck	976	Truck	-			Truck	976
			Total	976	Total	1			Total	977
Central &	Rail	20	Rail	87	Rail	-	Rail	1	Rail	108
Bangkok	Truck	1,017	Truck	1,463	Truck	3,196	Truck	149	Truck	5,825
	Total	1,037	Total	1,550	Total	3,196	Total	150	Total	5,933
South	Rail	42	Rail	136	Rail	36	Rail	10	Rail	224
	Truck	-	Truck	-	Truck	460	Truck	34	Truck	494
	Total	42	Total	136	Total	496	Total	44	Total	718
Total	Rail	66	Rail	223	Rail	37	Rail	11	Rail	337
	Truck	1,880	Truck	2,439	Truck	3,656	Truck	183	Truck	8,158
	Total	1,946	Total	2,662	Total	3,693	Total	194	Total	8,495

Note:Rice movement by truck from the North and from the Northeast to Bangkok includes very small volume of barge movement. The volumes include stock at the beginning of the year, most of which were in the Central and Bangkok.

Table 3.2
Total Rice Movement by Region by Mode in 2001

Unit: ,000 Tons

From	North		Northeast		Central &		South		Total	
To					Bangkok					
North	Rail	5		-		-		-	Rail	5
	Truck	1,102							Truck	1,102
	Total	1,107							Total	1,107
Northeast		-	Rail	-	Rail	1		-	Rail	1
			Truck	1,272	Truck	-			Truck	1,272
			Total	1,272	Total	1			Total	1,273
Central &	Rail	36	Rail	191	Rail	-	Rail	1	Rail	228
Bangkok	Truck	1,823	Truck	3,211	Truck	2,567	Truck	215	Truck	7,816
	Total	1,859	Total	3,402	Total	2,567	Total	216	Total	8,044
South	Rail	62	Rail	202	Rail	53	Rail	15	Rail	332
	Truck	-	Truck	-	Truck	683	Truck	49	Truck	732
	Total	62	Total	202	Total	736	Total	64	Total	1,064
Total	Rail	103	Rail	393	Rail	54	Rail	16	Rail	566
	Truck	2,925	Truck	4,483	Truck	3,250	Truck	264	Truck	10,922
	Total	3,028	Total	4,876	Total	3,304	Total	280	Total	11,488

Note: All figures exclude stock movements. Assuming constant 1991 share.

Table 3.3
Total Rice Movement by Region by Mode 2011

Unit: ,000 Tons

From	North		Northeast		Central &		South		Total	
To					Bangkok					
North	Rail	7		-		-		-	Rail	7
	Truck	1,533							Truck	1,533
	Total	1,540							Total	1,540
Northeast		-	Rail	-	Rail	2		-	Rail	2
			Truck	1,951	Truck	-			Truck	1,951
			Total	1,951	Total	2			Total	1,953
Central &	Rail	36	Rail	198	Rail	-	Rail	2	Rail	236
Bangkok	Truck	1,828	Truck	3,334	Truck	2,909	Truck	251	Truck	8,322
	Total	1,864	Total	3,532	Total	2,909	Total	253	Total	3,558
South	Rail	82	Rail	265	Rail	71	Rail	17	Rail	435
	Truck	-	Truck	-	Truck	910	Truck	57	Truck	967
	Total	82	Total	265	Total	981	Total	74	Total	1,402
Total	Rail	125	Rail	463	Rail	73	Rail	19	Rail	680
	Truck	3,361	Truck	5,285	Truck	3,819	Truck	308	Truck	12,773
	Total	3,486	Total	5,748	Total	3,892	Total	327	Total	13,453

Note: All figures exclude stock movements. Assuming constant 1991 share.

On the other hand, the role of rail freight service for rice shipment from the Central to the other regions will continue to be quite small. As shown in Table 3.2, only about 0.054 million tons of rice will be transported by rail to other regions, particularly the South, while about 3.2 million tons will be shipped by truck.

Rail is also used to ship only a small amount of rice in the South for both local and regional trade. As indicated in Table 3.2, while there will be 0.28 million tons of rice being transported, only 0.016 million tons will be shipped by rail. Note that, of the total amount of rice shipment by rail, over 90% of the shipment will be within the region.

3.2.3 Rice Transportation by Mode in 2011

According to Table 3.3, the total rice shipment by rail in 2011 will increase to 0.68 million tons. The volume will continue to be relatively small compared to the country's demand, which is expected to be 13.5 million tons.

In the North, the amount of rice to be locally and regionally distributed by rail service will increase to 0.125 million tons in 2011. The rest, which is about 3.5 million tons, is excepted to be transported by truck.

In the Northeast, the total amount of rice shipment is expected to be 5.7 million tons. This can be classified into rail transport of 0.463 million tons and truck transport of 5.3 million tons. Of the 0.463 million tons rice shipment by rail, 0.265 million tons will be shipped to the South, and the rest to the Central region.

The amount of rice to be distributed from the Central and Bangkok and the South by rail will be small. The volume will only be about 0.073 million tons for the former in 2011. However, this is still greater than that of the latter, which is expected to be only 0.019 million tons.

3.3 Rail Transportation of Cement

Unlike rice, the potential for shipment of cement by rail is very large. Being bulk commodity by nature, rail shipment of cement is most suitable both over the short and long distances. Furthermore, most cement plants in Thailand have already had direct rail access at the plants, and the markets for cement are well defined. With improvement in rail transportation efficiency, the potential for gaining cement shipment business is very strong. This is particularly true for bulk or powder cement, most of which will be used in large construction projects in Bangkok and the Central region.

This section provides estimates of rail shipment by mode of transportation for the year 2001 and 2011. Estimates are made for both bagged and bulk cement under various scenarios of constant 1991 share, and 80% share of rail bulk cement shipment to Bangkok.

It is expected that locations of future cement plants will be similar to that of the present. That is the majority of the plants, both old and new, will be in the Saraburi area. Saraburi is probably the most suitable site to build cement plants because the province has abundant limestone resource which is the key ingredient in cement making. Saraburi also has natural gas pipeline, and has easy access to lignite resources in the North. Furthermore, the province is close to Bangkok which is the biggest user of cement. It also situates on the gateway to the Northeast.

However, cement plants currently in other locations will continue to operate in the future. Most of these plants will also expand their capacity to meet local demand.

3.3.1 Cement Transportation by Mode in 1991

The total demand for cement in 1991 was about 22.7 million tons. This could be classified into 11.1 million tons of bulk cement and 11.5 million tons of bagged cement. The common mode of cement shipment are rail, truck and barge.

Bulk Cement

According to Table 3.4, the total demand for bulk cement in Thailand was 11.1 million tons. About 1.4 million tons, or 13% were shipped by rail, while up to 9.4 million tons, or about 84% were transported by truck. The rest which were only about 0.28 million tons were supplied by barge.

Regionally, rail service was most significant in transporting bulk cement to Bangkok from various sources of supply. The shipment amounted to 1.3 million tons, or 91% of the total bulk cement shipment by rail in 1991. Most of the bulk cement shipped by rail to Bangkok came from the cement plants in Saraburi. It accounted for 90% of the total bulk cement transportation by rail to Bangkok.

Rail was also used for bulk cement distribution within the Southern area. However, the volume being transported was only about 0.132 million tons.

Compared to truck, bulk cement shipment by rail was still relatively small even in Bangkok, as records show that rail was used to transport only 1.3 million tons, or 18% of the 7.2 million tons of bulk cement demanded in the city. In other words, up to about 5.6 million tons of bulk cement transported to Bangkok were supplied by truck. In addition, a small amount of bulk cement used in Bangkok of about 0.29 million tons was shipped by barge from the cement plants in Petchaburi. The share of barge in total bulk cement shipment to Bangkok was 4%.

Bagged Cement

Compared to truck, bagged cement shipment by rail was much less popular. As shown in Table 3.5, of the 11.5 million tons total bagged cement demanded in Thailand in 1991, only 0.967 million tons, or 8% were shipped by rail. The rest, which was about 10.6 million tons, was transported by truck.

As for the role of rail service in bagged cement shipment in each region, it was found that rail is not significantly used in the South. Total shipment by rail in 1991 was only about 0.34 million tons, which accounted for 25% of the 1.3 million tons of bagged cement demanded in the South. Bagged cement shipped by rail to the South came mainly from two sources, Saraburi and Thungsong. About 0.127 million tons came from plants in Saraburi, while 0.206 million tons came from Thungsong. The two plants accounted for 38% and 61% of the bagged cement shipment by rail to the South, respectively.

As for the Northeast and Central, bagged cement shipment by rail amounted to 0.21 and 0.25 million tons, respectively. Thus, truck still plays a dominant role in bagged cement shipment, especially in the Central region and Bangkok, where the share of truck was about 93% and 95% respectively. Rail shipment of bagged cement in the North was 0.02 million tons in 1991.

Total Cement Shipment

According to Table 3.6, 2.4 million tons of cement were shipped by rail in 1991. Rail transportation accounted for 11% of the total cement demanded in Thailand which was 22.7 million tons. The rest was supplied by truck, with only a small quantity of 0.29 million tons of barge shipment.

The amount of cement shipment by rail to Bangkok was most significant compared to other regions. Rail shipment to Bangkok amounted to 1.5 million tons, or about 61% of the total cement shipment by rail. Almost 90% of cement transported by rail to Bangkok were from cement plants in Saraburi. However, compared to truck, the share of cement shipment by rail was only 14% of the total cement demand in Bangkok. Truck also have significant role in cement shipment in all other regions of the country. The shares of truck in total cement shipment were 99%, 92% and 72% in the North, Northeast and South, respectively.

3.3.2 Cement Transportation by Mode in 2001

According to our forecast, domestic demand for cement in Thailand will increase to 53.6 million tons in 2001. About 27.3 million tons of the demand will be in bulk form and 26.3 million tons in bagged form. The amount of cement shipment by various modes will be calculated on the basis of two assumptions; constant 1991 share, and 80% bulk cement shipment by rail from Saraburi to Bangkok

Scenario 1: Constant 1991 Share

Bulk Cement

As presented in Table 3.7, there will be 27.3 million tons total shipment of bulk cement locally and regionally in 2001. Assuming constant 1991 share, rail is expected to ship about 4.4 million tons of cement. Up to about 4.2 million tons of rail shipment will be transported to Bangkok, and 3.7 million tons of which are cement from plants in Saraburi.

Also assuming constant 1991 share, rail shipment of bulk cement in the South will be 0.17 million tons. On the other hand, truck still plays a dominant role by transporting 0.47 million tons of cement in 2001. No bulk cement shipment by rail are expected under this scenario.

Bagged Cement

According Table 3.8, the total bagged cement shipment by rail will increase from 0.97 million tons in 1991 to 2.2 million tons in 2001. The rest, which are about 24.1 million tons will be shipped by truck.

Regionally, bagged cement shipment by rail in the Central will rise to 0.821 million tons, which is highest compared to other regions. On the other hand, the cement shipment by rail in the South will be only about 0.48 million tons. In the Northeast and Bangkok the shipment will be about 0.4 million tons each. In addition, a small amount of cement of about 0.05 million tons are expected to be transported by rail in the North.

Total Cement

As shown in Table 3.9, total cement shipment by rail is expected to rise from 2.4 million tons in 1991 to 6.6 million tons in 2001, given that rail service could maintain its present share. However, truck shipment will also increase to 46.1 million tons, while the shipment by barge will rise to 0.92 million tons in 2001.

Rail cement shipment still plays a significant role in the Bangkok. The amount of cement shipment by rail to Bangkok will increase from 1.4 million tons in 1991 to 4.7 million tons in 2001. This is followed by the volume of rail shipment in the Central region, which will be about 0.82 million tons, and in the South of about 0.65 million tons.

Scenario 2: 80% Bulk Rail Shipment Between Saraburi-Bangkok

According to Table 3.10, assuming 80% share of bulk cement shipment by rail from plants in Saraburi to Bangkok, the amount shipped by rail will rise to 13 million tons in 2001 from 1.1 million tons in 1991. This will also result in the rail share in the total bulk cement increasing from 13% in 1991 to 50% in 2001.

As shown in Table 3.11, the total cement shipment by rail will increase to 15.9 million tons. Its share in the total cement shipment will be 30% compared to 10% in 1991.

Most cement demand in Bangkok are in the form of bulk or powder cement. This makes it most suitable for shipment by rail from the supplying plants in Saraburi. Most cement companies already have silos for bulk cement at Bang Sue railway junction, thus the facilities for bulk cement shipment are already in place. However, there are still many obstacles to increase the volume of rail shipment of cement to Bangkok. These obstacles are of the same nature as that of other rail freights. That is there are not enough locomotives, insufficient freight cars, busy traffic, etc.. The obstacles make the cement companies turn to trucks for bulk cement delivery.

However, assuming that these obstacles could be resolved in the future, there is no reason why rail could not gain the bulk of powder cement shipment to Bangkok. Cement shipment, like that of oil, could be planned in advance with fixed time table. The volume of shipment are high and steady. These are the kind of commodities most suitable for rail shipment. The relatively short distance between Saraburi and Bangkok are not a problem for rail here. Thus, our assumption of 80% share of bulk rail shipment from Saraburi to Bangkok is not an unrealistic one.

3.3.3 Cement Transportation by Mode in 2011

By 2011, the demand for cement in Thailand is expected to be 111 million tons. It could be divided into 56.8 million tons of bulk cement and 54.2 million tons of bagged cement.

Scenario 1: Constant 1991 share

Bulk Cement

Bulk Cement shipment by rail will rise to 9.1 million tons in 2011 (Table 3.12). Nevertheless, the shipment by truck is also expected to increase to 45.8 million tons, while that by barge will increase slightly to 1.9 million tons.

Rail will be used to transport a significant amount of cement to Bangkok. The total rail volume is expected to be 8.7 million tons. Cement shipped by rail from plants in Saraburi will be 7.8 million tons. However rail volume to Bangkok will be relatively small compared to the shipment by truck which will be to 26.9 million tons.

Bagged Cement

Only about 4.6 million tons of bagged cement is expected to be shipped by rail in 2011 (Table 3.13). The amount will be dominated by the shipment to the Central region and Bangkok, which will be 1.7 and 1 million tons, respectively.

Compared to truck, it is found in Table 3.13 that the share of rail in bagged cement shipment is relatively small. That is, the shipment by truck will be as high as 49.6 million tons in 2011.

Table 3.4
Bulk Cement Movement by Region by Mode in 1991

Unit: ,000 Tons

From / To	Nakhonsawan (J)		Saraburi (S, SC, U)		Bangkok		Petchaburi (J)		Thungsong (S)		Total	
North	Rail	-	Rail	-	Rail	1		-		-	Rail	-
	Truck	53	Truck	355	Truck	26					Truck	434
	Total	53	Total	355	Total	26					Total	434
Northeast		-	Rail	-	Rail	-		-		-	Rail	-
			Truck	763	Truck	23					Truck	786
			Total	763	Total	23					Total	786
Central	Rail	-	Rail	-	Rail	-	Rail	-	Rail	-	Rail	-
	Truck	20	Truck	1,900	Truck	374	Truck	35	Truck	15	Truck	2,344
	Total	20	Total	1,900	Total	374	Total	35	Total	15	Total	2,344
Bangkok	Rail	121	Rail	1,179	Rail	-	Rail	13	Rail	-	Rail	1,313
	Truck	19	Truck	3,938	Truck	1,554	Truck	14	Truck	72	Truck	5,597
							Barge	288			Barge	288
	Total	140	Total	5,117	Total	1,554	Total	315	Total	72	Total	7,198
South		-	Rail	-		-	Rail	-	Rail	132	Rail	132
			Truck	118			Truck	79	Truck	44	Truck	241
			Total	118			Total	79	Total	176	Total	373
Total	Rail	121	Rail	1,179	Rail	-	Rail	13	Rail	132	Rail	1,445
	Truck	92	Truck	7,074	Truck	1,977	Truck	128	Truck	131	Truck	9,402
							Barge	288			Barge	288
	Total	213	Total	8,253	Total	1,977	Total	429	Toal	263	Total	11,135

Note: J = Jalaprathan Cement Co. Ltd.
S = Siam Cement Co. Ltd.
SC = Siam City Cement Co. Ltd.
U = Universal White Cement Co. Ltd.

Table 3.5
Bagged Cement Movement by Region by Mode in 1991

Unit: ,000 Tons

From / To	Nakhonsawan (J)		Saraburi (S, SC, U)		Bangkok		Petchaburi (J)		Thungsong (S)		Total	
North	Rail	19	Rail	6	Rail	1		-		-	Rail	26
	Truck	178	Truck	1,335	Truck	95					Truck	1,608
	Total	197	Total	1,341	Total	96					Total	1,634
Northeast		-	Rail	207	Rail	2		-		-	Rail	209
			Truck	1,574	Truck	51					Truck	1,625
			Total	1,781	Total	53					Total	1,834
Central	Rail	-	Rail	229	Rail	-	Rail	8	Rail	8	Rail	245
	Truck	30	Truck	2,744	Truck	585	Truck	47	Truck	15	Truck	3,421
	Total	30	Total	2,973	Total	585	Total	55	Total	23	Total	3,666
Bangkok	Rail	26	Rail	109	Rail	-	Rail	10	Rail	7	Rail	152
	Truck	34	Truck	2,084	Truck	666	Truck	125	Truck	24	Truck	2,933
							Barge	-			Barge	-
	Total	60	Total	2,193	Total	666	Total	135	Total	31	Total	3,085
South		-	Rail	127		-	Rail	2	Rail	206	Rail	335
			Truck	290			Truck	279	Truck	417	Truck	986
			Total	417			Total	281	Total	623	Total	1,321
Total	Rail	45	Rail	678	Rail	3	Rail	20	Rail	221	Rail	967
	Truck	242	Truck	8,027	Truck	1,397	Truck	451	Truck	456	Truck	10,573
							Barge	-			Barge	-
	Total	287	Total	8,705	Total	1,400	Total	471	Toal	677	Total	11,540

Note: J = Jalaprathan Cement Co. Ltd.
S = Siam Cement Co. Ltd.
SC = Siam City Cement Co. Ltd.
U = Universal White Cement Co. Ltd.

Table 3.6
Total Cement Movement by Region by Mode in 1991

Unit: ,000 Tons

From / To	Nakhonsawan (J)		Saraburi (S, SC, U)		Bangkok		Petchaburi (J)		Thungsong (S)		Total	
North	Rail	19	Rail	6	Rail	1		-		-	Rail	26
	Truck	231	Truck	1,690	Truck	121					Truck	2,042
	Total	250	Total	1,696	Total	122					Total	2,068
Northeast		-	Rail	207	Rail	2		-		-	Rail	209
			Truck	2,337	Truck	74					Truck	2,411
			Total	2,544	Total	76					Total	2,620
Central	Rail	-	Rail	229	Rail	-	Rail	8	Rail	8	Rail	245
	Truck	50	Truck	4,644	Truck	959	Truck	82	Truck	30	Truck	5,765
	Total	50	Total	4,873	Total	959	Total	90	Total	38	Total	6,010
Bangkok	Rail	147	Rail	1,288	Rail	-	Rail	23	Rail	7	Rail	1,465
	Truck	53	Truck	6,022	Truck	2,220	Truck	139	Truck	96	Truck	8,530
							Barge	288			Barge	288
	Total	200	Total	7,310	Total	2,220	Total	450	Total	103	Total	10,283
South		-	Rail	127		-	Rail	2	Rail	338	Rail	467
			Truck	408			Truck	358	Truck	461	Truck	1,227
			Total	535			Total	360	Total	799	Total	1,694
Total	Rail	166	Rail	1,857	Rail	3	Rail	33	Rail	353	Rail	2,412
	Truck	334	Truck	15,101	Truck	3,374	Truck	579	Truck	587	Truck	19,975
							Barge	288			Barge	288
	Total	500	Total	16,958	Total	3,377	Total	900	Toal	940	Total	22,675

Note: J = Jalaprathan Cement Co. Ltd.
S = Siam Cement Co. Ltd.
SC = Siam City Cement Co. Ltd.
U = Universal White Cement Co. Ltd.

Table 3.7
Bulk Cement Movement by Region by Mode in 2001

Unit: ,000 Tons

From / To	Nakhonsawan		Saraburi		Petchaburi		Thungsong		Total	
North	Rail	-	Rail	-					Rail	-
	Truck	102	Truck	698		-		-	Truck	800
	Total	102	Total	698					Total	800
Northeast			Rail	-					Rail	-
		-	Truck	1,454		-		-	Truck	1,454
			Total	1,454					Total	1,454
Central	Rail	-	Rail	-	Rail	-	Rail	-	Rail	-
	Truck	63	Truck	6,142	Truck	113	Truck	48	Truck	6,366
	Total	63	Total	6,142	Total	113	Total	48	Total	6,366
Bangkok	Rail	384	Rail	3,756	Rail	40	Rail	-	Rail	4,180
	Truck	63	Truck	12,576	Truck	50	Truck	231	Truck	12,920
					Barge	915			Barge	915
	Total	447	Total	16,332	Total	1,005	Total	231	Total	18,015
South			Rail	-	Rail	-	Rail	173	Rail	173
		-	Truck	193	Truck	220	Truck	57	Truck	470
			Total	193	Total	220	Total	230	Total	643
Total	Rail	384	Rail	3,756	Rail	40	Rail	173	Rail	4,353
	Truck	228	Truck	21,063	Truck	383	Truck	336	Truck	22,010
					Barge	915			Barge	915
	Total	612	Total	24,819	Total	1,338	Toal	509	Total	27,278

Note : Assuming constant 1991 share.

Table 3.8

Bagged Cement Movement by Region by Mode in 2001

Unit: ,000 Tons

From / To	Nakhonsawan		Saraburi		Petchaburi		Thungsong		Total	
North	Rail	39	Rail	10					Rail	49
	Truck	349	Truck	2,614		-		-	Truck	2,963
	Total	388	Total	2,624					Total	3,012
Northeast			Rail	407					Rail	407
		-	Truck	2,984		-		-	Truck	2,984
			Total	3,391					Total	3,391
Central	Rail	-	Rail	768	Rail	27	Rail	26	Rail	821
	Truck	99	Truck	8,838	Truck	151	Truck	48	Truck	9,136
	Total	99	Total	9,606	Total	178	Total	74	Total	9,957
Bangkok	Rail	82	Rail	350	Rail	30	Rail	23	Rail	485
	Truck	109	Truck	6,650	Truck	401	Truck	76	Truck	7,236
					Barge	-			Barge	-
	Total	191	Total	7,000	Total	431	Total	99	Total	7,721
South			Rail	205	Rail	5	Rail	269	Rail	479
		-	Truck	479	Truck	775	Truck	546	Truck	1,800
			Total	684	Total	780	Total	815	Total	2,279
Total	Rail	121	Rail	1,740	Rail	62	Rail	318	Rail	2,241
	Truck	557	Truck	21,565	Truck	1,327	Truck	670	Truck	24,119
					Barge	-			Barge	-
	Total	678	Total	23,305	Total	1,389	Toal	988	Total	26,360

Note : Assuming constant 1991 share.

Table 3.9

Total Cement Movement by Region by Mode in 2001

Unit: ,000 Tons

From / To	Nakhonsawan		Saraburi		Petchaburi		Thungsong		Total	
North	Rail	39	Rail	10					Rail	49
	Truck	451	Truck	3,312		-		-	Truck	3,763
	Total	490	Total	3,322					Total	3,812
Northeast			Rail	407					Rail	407
		-	Truck	4,438		-		-	Truck	4,438
			Total	4,845					Total	4,845
Central	Rail	0	Rail	768	Rail	27	Rail	26	Rail	821
	Truck	162	Truck	14,980	Truck	264	Truck	96	Truck	15,502
	Total	162	Total	15,748	Total	291	Total	122	Total	16,323
Bangkok	Rail	466	Rail	4,106	Rail	70	Rail	23	Rail	4,665
	Truck	172	Truck	19,226	Truck	451	Truck	307	Truck	20,156
					Barge	915			Barge	915
	Total	638	Total	23,332	Total	1,436	Total	330	Total	25,736
South			Rail	205	Rail	5	Rail	442	Rail	652
		-	Truck	672	Truck	995	Truck	603	Truck	2,270
			Total	877	Total	1,000	Total	1,045	Total	2,922
Total	Rail	505	Rail	5,496	Rail	102	Rail	491	Rail	6,594
	Truck	785	Truck	42,628	Truck	1,710	Truck	1,006	Truck	46,129
					Barge	915			Barge	915
	Total	1,290	Total	48,124	Total	2,727	Toal	1,497	Total	53,638

Note : Assuming constant 1991 share.

Table 3.10
Bulk Cement Movement by Region by Mode in 2001

Unit: ,000 Tons

From / To	Nakhonsawan		Saraburi		Petchaburi		Thungsong		Total	
North	Rail	-	Rail	-					Rail	-
	Truck	102	Truck	698		-		-	Truck	800
	Total	102	Total	698					Total	800
Northeast			Rail	-					Rail	-
		-	Truck	1,454		-		-	Truck	1,454
			Total	1,454					Total	1,454
Central	Rail	-	Rail	-	Rail	-	Rail	-	Rail	-
	Truck	63	Truck	6,142	Truck	113	Truck	48	Truck	6,366
	Total	63	Total	6,142	Total	113	Total	48	Total	6,366
Bangkok	Rail	384	Rail	13,066	Rail	40	Rail	-	Rail	13,490
	Truck	63	Truck	3,266	Truck	50	Truck	231	Truck	3,610
					Barge	915			Barge	915
	Total	447	Total	16,332	Total	1,005	Total	231	Total	18,015
South			Rail	-	Rail	-	Rail	173	Rail	173
		-	Truck	193	Truck	220	Truck	57	Truck	470
			Total	193	Total	220	Total	230	Total	643
Total	Rail	384	Rail	13,066	Rail	40	Rail	173	Rail	13,663
	Truck	228	Truck	11,753	Truck	383	Truck	336	Truck	12,700
					Barge	915			Barge	915
	Total	612	Total	24,819	Total	1,338	Toal	509	Total	27,278

Note: Constant 1991 share except Saraburi-Bangkok assuming 80% bulk by rail.

Table 3.11
Total Cement Movement by Region by Mode in 2001

Unit: ,000 Tons

From / To	Nakhonsawan		Saraburi		Petchaburi		Thungsong		Total	
North	Rail	39	Rail	10					Rail	49
	Truck	451	Truck	3,312		-		-	Truck	3,763
	Total	490	Total	3,322					Total	3,812
Northeast			Rail	407					Rail	407
		-	Truck	4,438		-		-	Truck	4,438
			Total	4,845					Total	4,845
Central	Rail	0	Rail	768	Rail	27	Rail	26	Rail	821
	Truck	162	Truck	14,980	Truck	264	Truck	96	Truck	15,502
	Total	162	Total	15,748	Total	291	Total	122	Total	16,323
Bangkok	Rail	466	Rail	13,416	Rail	70	Rail	23	Rail	13,975
	Truck	172	Truck	9,916	Truck	451	Truck	307	Truck	10,846
					Barge	915			Barge	915
	Total	638	Total	23,332	Total	1,436	Total	330	Total	25,736
South			Rail	205	Rail	5	Rail	442	Rail	652
		-	Truck	672	Truck	995	Truck	603	Truck	2,270
			Total	877	Total	1,000	Total	1,045	Total	2,922
Total	Rail	505	Rail	14,806	Rail	102	Rail	491	Rail	15,904
	Truck	785	Truck	33,318	Truck	1,710	Truck	1,006	Truck	36,819
					Barge	915			Barge	915
	Total	1,290	Total	48,124	Total	2,727	Toal	1,497	Total	53,638

Note: Constant 1991 share except Saraburi-Bangkok assuming 80% bulk by rail.

Table 3.12
Bulk Cement Movement by Region by Mode in 2011

Unit: ,000 Tons

From / To	Nakhonsawan		Saraburi		Petchaburi		Thungsong		Total	
North	Rail	-	Rail	-					Rail	-
	Truck	200	Truck	1,352		-		-	Truck	1,552
	Total	200	Total	1,352					Total	1,552
Northeast			Rail	-					Rail	-
		-	Truck	2,874		-		-	Truck	2,874
			Total	2,874					Total	2,874
Central	Rail	-	Rail	-	Rail	-	Rail	-	Rail	-
	Truck	133	Truck	12,968	Truck	239	Truck	100	Truck	13,440
	Total	133	Total	12,968	Total	239	Total	100	Total	13,440
Bangkok	Rail	802	Rail	7,843	Rail	84	Rail	-	Rail	8,729
	Truck	130	Truck	26,255	Truck	105	Truck	482	Truck	26,972
					Barge	1,909			Barge	1,909
	Total	932	Total	34,098	Total	2,098	Total	482	Total	37,610
South			Rail	-	Rail	-	Rail	357	Rail	357
		-	Truck	349	Truck	455	Truck	119	Truck	923
			Total	349	Total	455	Total	476	Total	1,280
Total	Rail	802	Rail	7,843	Rail	84	Rail	357	Rail	9,086
	Truck	463	Truck	43,798	Truck	799	Truck	701	Truck	45,761
					Barge	1,909			Barge	1,909
	Total	1,265	Total	51,641	Total	2,792	Toal	1,058	Total	56,756

Note : Assuming constant 1991 share.

Table 3.13

Bagged Cement Movement by Region by Mode in 2011

Unit: ,000 Tons

From / To	Nakhonsawan		Saraburi		Petchaburi		Thungsong		Total	
North	Rail	75	Rail	20					Rail	95
	Truck	675	Truck	5,069		-		-	Truck	5,744
	Total	750	Total	5,089					Total	5,839
Northeast			Rail	805					Rail	805
		-	Truck	5,901		-		-	Truck	5,901
			Total	6,706					Total	6,706
Central	Rail	-	Rail	1,623	Rail	56	Rail	55	Rail	1,734
	Truck	208	Truck	18,659	Truck	318	Truck	103	Truck	19,288
	Total	208	Total	20,282	Total	374	Total	158	Total	21,022
Bangkok	Rail	172	Rail	731	Rail	63	Rail	47	Rail	1,013
	Truck	228	Truck	13,882	Truck	837	Truck	159	Truck	15,106
					Barge	-			Barge	-
	Total	400	Total	14,613	Total	900	Total	206	Total	16,119
South			Rail	371	Rail	11	Rail	556	Rail	938
		-	Truck	867	Truck	1,602	Truck	1,130	Truck	3,599
			Total	1,238	Total	1,613	Total	1,686	Total	4,537
Total	Rail	247	Rail	3,550	Rail	130	Rail	658	Rail	4,585
	Truck	1,111	Truck	44,378	Truck	2,757	Truck	1,392	Truck	49,638
					Barge	-			Barge	-
	Total	1,358	Total	47,928	Total	2,887	Toal	2,050	Total	54,223

Note : Assuming constant 1991 share.

Table 3.14

Total Cement Movement by Region by Mode in 2011

Unit: ,000 Tons

From / To	Nakhonsawan		Saraburi		Petchaburi		Thungsong		Total	
North	Rail	75	Rail	20					Rail	95
	Truck	875	Truck	6,421		-		-	Truck	7,296
	Total	950	Total	6,441					Total	7,391
Northeast			Rail	805					Rail	805
		-	Truck	8,775		-		-	Truck	8,775
			Total	9,580					Total	9,580
Central	Rail	-	Rail	1,623	Rail	56	Rail	55	Rail	1,734
	Truck	341	Truck	31,627	Truck	557	Truck	203	Truck	32,728
	Total	341	Total	33,250	Total	613	Total	258	Total	34,462
Bangkok	Rail	974	Rail	8,574	Rail	147	Rail	47	Rail	9,742
	Truck	358	Truck	40,137	Truck	942	Truck	641	Truck	42,078
					Barge	1,909			Barge	1,909
	Total	1,332	Total	48,711	Total	2,998	Total	688	Total	53,729
South			Rail	371	Rail	11	Rail	913	Rail	1,295
		-	Truck	1,216	Truck	2,057	Truck	1,249	Truck	4,522
			Total	1,587	Total	2,068	Total	2,162	Total	5,817
Total	Rail	1,049	Rail	11,393	Rail	214	Rail	1,015	Rail	13,671
	Truck	1,574	Truck	88,176	Truck	3,556	Truck	2,093	Truck	95,399
					Barge	1,909			Barge	1,909
	Total	2,623	Total	99,569	Total	5,679	Toal	3,108	Total	110,979

Note: Assuming constant 1991 share.

Table 3.15
Bulk Cement Movement by Region by Mode in 2011

Unit: ,000 Tons

From / To	Nakhonsawan		Saraburi		Petchaburi		Thungsong		Total	
North	Rail	-	Rail	-					Rail	-
	Truck	200	Truck	1,352		-		-	Truck	1,552
	Total	200	Total	1,352					Total	1,552
Northeast			Rail	-					Rail	-
		-	Truck	2,874		-		-	Truck	2,874
			Total	2,874					Total	2,874
Central	Rail	-	Rail	-	Rail	-	Rail	-	Rail	-
	Truck	133	Truck	12,968	Truck	239	Truck	100	Truck	13,440
	Total	133	Total	12,968	Total	239	Total	100	Total	13,440
Bangkok	Rail	802	Rail	27,278	Rail	84	Rail	-	Rail	28,164
	Truck	130	Truck	6,820	Truck	105	Truck	482	Truck	7,537
					Barge	1,909			Barge	1,909
	Total	932	Total	34,098	Total	2,098	Total	482	Total	37,610
South			Rail	-	Rail	-	Rail	357	Rail	357
		-	Truck	349	Truck	455	Truck	119	Truck	923
			Total	349	Total	455	Total	476	Total	1,280
Total	Rail	802	Rail	27,278	Rail	84	Rail	357	Rail	28,521
	Truck	463	Truck	24,363	Truck	799	Truck	701	Truck	26,326
					Barge	1,909			Barge	1,909
	Total	1,265	Total	51,641	Total	2,792	Toal	1,058	Total	56,756

Note: Constant 1991 share except Saraburi-Bangkok assuming 80% bulk by rail.

Table 3.16

Total Cement Movement by Region by Mode in 2011

Unit: ,000 Tons

From / To	Nakhonsawan		Saraburi		Petchaburi		Thungsong		Total	
North	Rail	75	Rail	20					Rail	95
	Truck	875	Truck	6,421		-		-	Truck	7,296
	Total	950	Total	6,441					Total	7,391
Northeast			Rail	805					Rail	805
		-	Truck	8,775		-		-	Truck	8,775
			Total	9,580					Total	9,580
Central	Rail	-	Rail	1,623	Rail	56	Rail	55	Rail	1,734
	Truck	341	Truck	31,627	Truck	557	Truck	203	Truck	32,728
	Total	341	Total	33,250	Total	613	Total	258	Total	34,462
Bangkok	Rail	974	Rail	28,009	Rail	147	Rail	47	Rail	29,177
	Truck	358	Truck	20,702	Truck	942	Truck	641	Truck	22,643
					Barge	1,909			Barge	1,909
	Total	1,332	Total	48,711	Total	2,998	Total	688	Total	53,729
South			Rail	371	Rail	11	Rail	913	Rail	1,295
		-	Truck	1,216	Truck	2,057	Truck	1,249	Truck	4,522
			Total	1,587	Total	2,068	Total	2,162	Total	5,817
Total	Rail	1,049	Rail	30,828	Rail	214	Rail	1,015	Rail	33,106
	Truck	1,574	Truck	68,741	Truck	3,556	Truck	2,093	Truck	75,964
					Barge	1,909			Barge	1,909
	Total	2,623	Total	99,569	Total	5,679	Toal	3,108	Total	110,979

Note: Constant 1991 share except Saraburi-Bangkok assuming 80% bulk by rail.

Total Cement

According to Table 3.14, total cement shipment by rail in 2011 will be 13.7 million tons, and by truck 95.4 million tons. Barge will also be used to ship about 2 million tons.

In Bangkok, where rail plays a significant role, the cement shipment by rail will be 9.7 million tons. Up to 8.6 million tons will be transported from plants in Saraburi. Rail will also transport a small amount of cement in the Central and the South. The volume will be about 1.7 and 1.3 million tons, respectively.

Scenario 2: 80% Bulk Rail Shipment between Saraburi-Bangkok

Based on this assumption, the bulk cement shipment by rail from Saraburi to Bangkok is expected to be 27.2 million tons, as indicated in Table 3.15. Accordingly, the total bulk cement shipment by rail will be 28.5 million tons, compared to 26.3 million tons by truck (Table 3.15). As a result of high volume of bulk rail shipment to Bangkok, total rail shipment of both bagged and bulk cement will increase from 2.4 million tons in 1991 to 33.1 million tons in 2011 (Table 3.16). This is a thirteen fold increase in 20 years time. This amount of shipment is achievable given that major improvement and restructuring are undertaken in the rail operation system as mentioned earlier.

3.4 Rail Shipment of Containers

Although rail shipment of containers is relatively small at present, the future growth potential of rail shipment of containers is enormous. The future volume of container movements between Bangkok and Laem Chabang, where most of the future growth will be, will reach 3 million tons by 2001 and 15 million tons by 2011. This is equal to 300,000 TEU in 2001 and 1.5 million TEU in 2011. Like oil and cement, containers are suitable for rail shipment because of their bulkiness, high volume and fixed schedule nature. In this regard, the study believes rail should take a leading role in container shipment, particularly between Bangkok and Laem Chabang port. We think the target of 50% share of rail by 2001 and 75% share by 2011 are not unrealistic, given that rail operating system be streamlined.

3.4.1 Container Transportation by Rail in 1987

As mentioned in the preceding chapter, there were 6.2 million tons of container cargoes being shipped in Thailand in 1987. All of them were handled at the Bangkok Port.

According to Table 3.17, the total rail shipment of containers in 1987 amounted to only 0.15 million tons, or about 2.4% of the total containers shipments to and from the Bangkok Port. The rest which were about 6 million tons were transported by trucks.

Regionally, it was found that container shipment from the North and South to the Bangkok Port were shipped partly by rail. It amounted to 0.065 and 0.086 million tons, respectively.

On the other hand, shipments of containerized cargoes from the Northeast, Central, and East to the Bangkok Port were exclusively by truck. However, truck shipment's volume was highest in the Bangkok area where about 2.3 million tons of containers were moved. This was followed by 1.9 million tons shipment from Central, 0.6 million tons from the South, 0.5 million tons from the Northeast, 0.4 million tons from the North and 0.37 million tons from the East.

3.4.2 Container Transportation in 2001: Constant 1987 Share Except Transportation to and from Laem Chabang Port Assuming 50% Rail Share

By 2001, the overall container volume in various ports in Thailand is expected to be 32 million tons. About 16.4 million tons will be handled at the Bangkok Port, 14.4 million tons at Laem Chabang Port and 1.2 million tons in the Southern Port.

Based on the above assumptions, the total container shipment by rail is expected to be 7.54 million tons. This will account for 24% of the total container shipment in Thailand. Thus, there will be 24.5 million tons of containers being shipped by trucks.

The container shipment by rail from and to Bangkok Port will increase from 0.15 million tons in 1987 to 0.36 million tons in 2001. The shipment from the North and the South will be 0.2 million tons each. Hence, the rest of the total container shipment from and to Bangkok Port which are about 16 million tons will be shipped by truck.

Table 3.17
Container Movement by Region by Mode in 1987

Unit: ,000 Tons

From / To	North		Northeast		Central		Bangkok		East		South		Total	
Bangkok Port	Rail	65	Rail	-	Rail	-	Rail	-	Rail	-	Rail	86	Rail	151
	Truck	435	Truck	492	Truck	1,871	Truck	2,275	Truck	371	Truck	623	Truck	6,067
	Total	500	Total	492	Total	1,871	Total	2,275	Total	371	Total	709	Total	6,218

Table 3.18
Container Movement by Region by Mode in 2001

Unit: Million Tons

From / To	North		Northeast		Central		Bangkok		East		South		Total	
Bangkok Port	Rail	0.21			Rail	-	Rail	-			Rail	0.15	Rail	0.36
	Truck	1.42	-		Truck	6.11	Truck	7.43	-		Truck	1.08	Truck	16.04
	Total	1.63			Total	6.11	Total	7.43			Total	1.23	Total	16.40
Laem Chabang Port	Rail	0.26	Rail	0.92	Rail	3.10	Rail	1.52	Rail	1.38			Rail	7.18
	Truck	0.27	Truck	0.93	Truck	3.11	Truck	1.52	Truck	1.39	-		Truck	7.22
	Total	0.53	Total	1.85	Total	6.21	Total	3.04	Total	2.77			Total	14.40
Southern Port											Rail	-	Rail	-
	-		-		-		-		-		Truck	1.20	Truck	1.20
											Total	1.20	Total	1.20
Total	Rail	0.47	Rail	0.92	Rail	3.10	Rail	1.52	Rail	1.38	Rail	0.15	Rail	7.54
	Truck	1.69	Truck	0.93	Truck	9.22	Truck	8.95	Truck	1.39	Truck	2.28	Truck	24.46
	Total	2.16	Total	1.85	Total	12.32	Total	10.47	Total	2.77	Total	2.43	Total	32.00

Note : Constant 1987 share except transportation to and from Laem Chabang Port assuming 50% rail.

Table 3.19

Container Movement by Region by Mode in 2011

Unit: Million Tons

From / To	North		Northeast		Central		Bangkok		East		South		Total	
Bangkok Port	Rail	0.21			Rail	-	Rail	-			Rail	0.15	Rail	0.36
	Truck	1.42	-		Truck	6.11	Truck	7.43	-		Truck	1.08	Truck	16.04
	Total	1.63			Total	6.11	Total	7.43			Total	1.23	Total	16.40
Laem Chabang Port	Rail	2.27	Rail	2.99	Rail	15.34	Rail	11.36	Rail	4.49	Rail	1.07	Rail	37.52
	Truck	0.75	Truck	0.99	Truck	5.11	Truck	3.79	Truck	1.49	Truck	0.35	Truck	12.48
	Total	3.02	Total	3.98	Total	20.45	Total	15.15	Total	5.98	Total	1.42	Total	50.00
Southern Port											Rail	-	Rail	-
	-		-		-		-		-		Truck	1.39	Truck	1.39
											Total	1.39	Total	1.39
Total	Rail	2.48	Rail	2.99	Rail	15.34	Rail	11.36	Rail	4.49	Rail	1.22	Rail	37.88
	Truck	2.17	Truck	0.99	Truck	11.22	Truck	11.22	Truck	1.49	Truck	2.82	Truck	29.91
	Total	4.65	Total	3.98	Total	26.56	Total	22.58	Total	5.98	Total	4.04	Total	67.79

Note : Constant 1987 share except transportation to and from Laem Chabang Port assuming 75% rail.

By 2001, Laem Chabang Port is expected to handle about 14.4 million tons of containers. According to the 50% rail transport share assumption, the total shipment by rail will be 7.2 million tons, as shown in Table 3.18. About 43% of the shipment, or 3.1 million tons, are cargoes from the Central region. That from Bangkok and the East will be about 1.5 million tons each. As for the North and the Northeast, the amount are expected to be only about 0.3 and 0.9 million tons, respectively.

However, rail service is not significantly used for container movement from and to the Southern Port. This port, indeed, mainly serves only cargoes within the region. It will handle about 1.2 million tons of containers, all are transported by truck.

3.4.3 Container Transportation in 2011: Constant 1987 share except transportation to and from Laem Chabang Port Assuming 75% Rail Share

Since the maximum handling capacity of the Bangkok Port is expected to be 16.4 million tons as mentioned in Chapter 3, any additional containerized cargoes will have to be handled at the Laem Chabang Port. According to the estimated containerized cargoes in Chapter 3, there will be about 50 million tons of containers being handled at the Laem Chabang Port in 2011.

According to Table 3.19, the total containerized cargoes shipment by rail from and to Laem Chabang Port will be about 37.5 million tons in 2011 under the 75% rail share criterion. This is equivalent to about 3.75 million TEU of containers.

Of the total containerized cargoes shipment by rail from and to Laem Chabang Port, about 71% will be from the Central region and Bangkok. The volume will amount to 15.3 and 11.4 million tons, respectively. The rest of containerized cargoes will be from the East, Northeast, North and the South with volumes of 4.5, 3.0, 2.3 and 1.1 million tons, respectively.

In addition, the Southern Port is expected to handle about 1.4 million tons of containerized cargoes; all are shipped by trucks.

In total, there will be about 37.9 million tons of containerized cargoes being shipped by rail in 2011. This amounts to 56% of the total containerized cargoes shipment in Thailand. The rest which are about 30 million tons will be transported by trucks.

3.5 Rail Transportation of Electrical Appliance

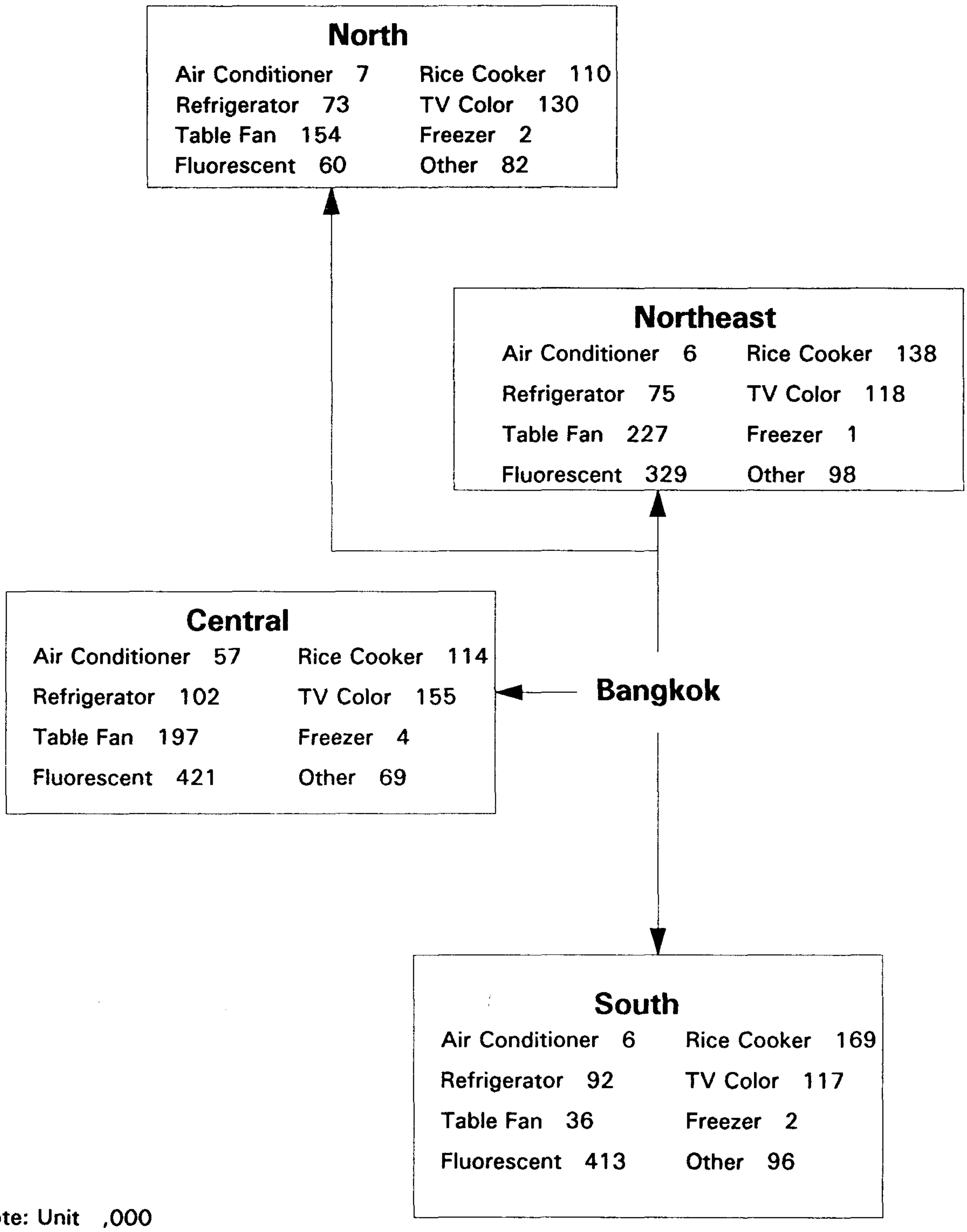
In addition to the four bulk commodities mentioned earlier, there are several other kinds of freight which could potentially be transported by rail. An important type of freight, which has been growing rapidly in volume, is electrical appliances such as television sets, refrigerators, air-conditioners, light bulbs, fans and others. In 1992, over half a million sets each of television and table fans, and 1.2 million fluorescent light bulbs were sent from Bangkok to up country provinces, all by truck. Thousands of other appliances were also shipped by trucks from Bangkok to other regions of the country. These appliances were packed into large trucks in the center of Bangkok before traveling to customers in all areas of the country (see Figure 3.8).

Figure 3.9 shows the quantity of appliances to be transported from Bangkok to other regions in 2001. The number of television sets demanded in the Northeast each year will grow from 118,000 sets in 1992 to 304,000 sets in 2001. By 2001, about 110,000 refrigerators, 288,000 rice cookers, 689,000 fans, and 456,000 light bulbs will be transported each year to the Northeast to meet growing demand in that region. Similarly, consumers in the North will require 226,000 television sets, 216,000 rice cookers, 110,000 refrigerators and so on. This is also true for consumers in the Central and the South (see Figure 3.9).

By 2011, the annual demand for electrical appliances will be enormous. According to Figure 3.10, each region will require over a million fans, several million light bulbs, and hundreds of thousands of each of the other household appliances annually. In addition, a large quantity of spare parts for these appliance will also be transported by manufacturers to service their customers.

Thus, there is no doubt about the potential for freight transportation of these appliances. However, for the SRT to capture a significant part of the transportation market for these appliances may involve changes in the way the appliance manufactures distribute their merchandises. Currently, the distribution is done by sales agents who prefer truck to rail because they can deliver goods to consumers' door steps. However, with the rapidly growing volume of these appliances, it may become more economical for manufacturers to set up their regional distribution centers in the regions, which could also be used as their service centers. In this way, rail service could penetrate this truck dominated business by providing reliable shipment of these appliances from manufacturers in Bangkok to distribution centers in the regions. However, this may require some initiative from the SRT to discuss this long term business opportunity with appliance

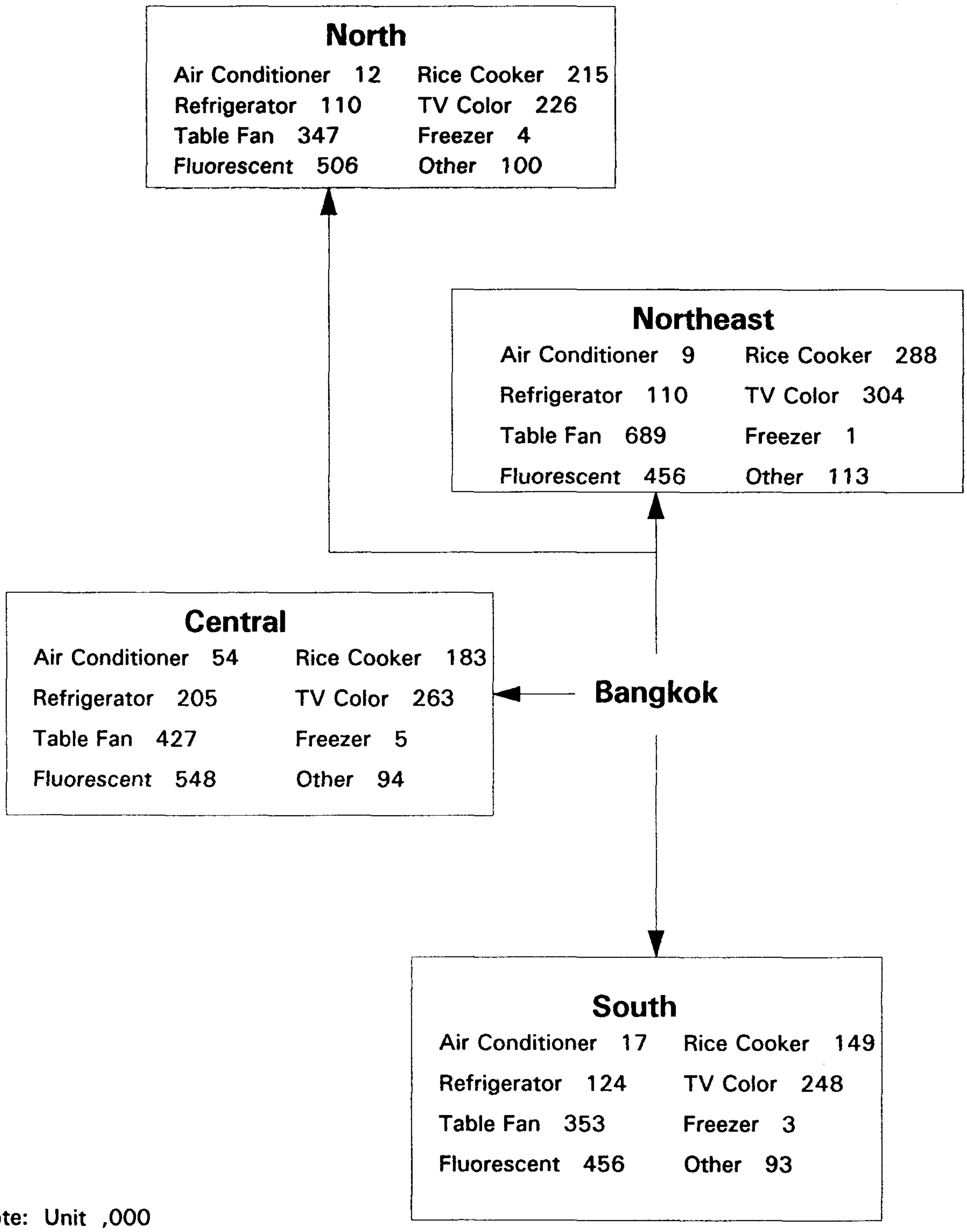
Figure 3.8
Distribution of Major Appliances in 1992



Note: Unit ,000

Source: Load Forecast Sub-committee

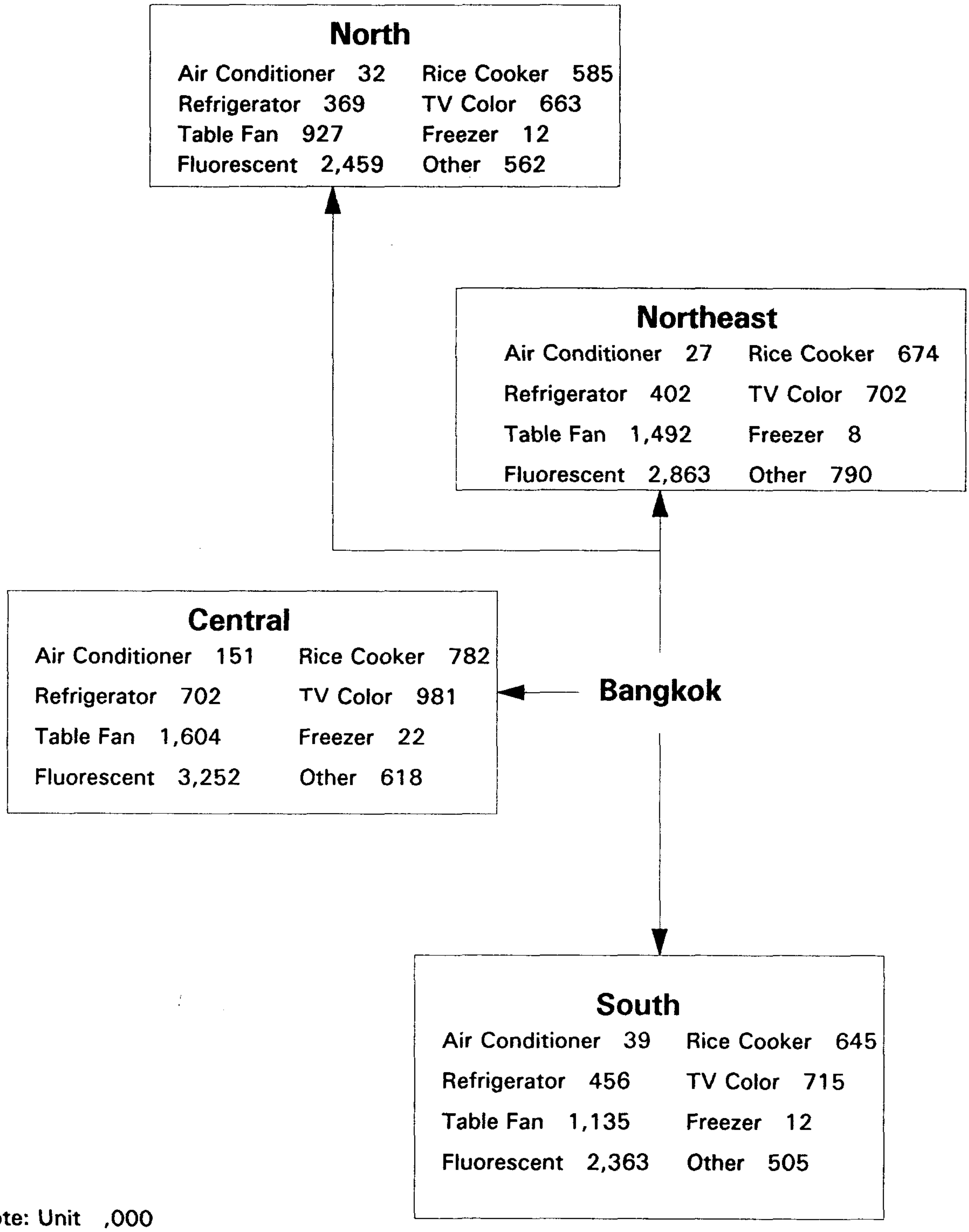
Figure 3.9
Distribution of Major Appliances in 2001



Note: Unit ,000

Source: Load Forecast Sub-committee

Figure 3.10
Distribution of Major Appliances in 2011



Note: Unit ,000

Source: Load Forecast Sub-committee

manufacturers. This is in addition to a prior streamlining of its own organization. Most of all, these appliance should be sent via containers for safety, convenience, and economy.

3.6 Rail Shipment of Motor Vehicles

In addition to electrical appliances mentioned in Section 3.5 there is a strong potential for the shipment of motor vehicles from manufacturers in Bangkok to consumers in up country regions. The development of the regional economy over the years has resulted in higher consumer and business incomes, and, consequently, higher purchasing power for household items and motor vehicles. In the Northeast, the demand for motorcycles now reaches 110,325 units per year. The demand for pick-up trucks and passenger cars are about 24,460 and 2,173 units a year, respectively (see Figure 3.11). The demand for motor vehicles in the North are slightly higher, and the South slightly lower compared to the Northeast.

However, the important point here is about the future growth of these motor vehicles demand. By 2001, annual demand for these motor vehicles will roughly double from today's level in all regions of the country. Over half a million motorcycles will be demanded each year in the North and Northeast, and over one hundred thousand pick-up trucks will be sold per year by 2001. A total of over 800,000 motorcycles, 200,000 pick-up trucks and nearly 40,000 passenger cars will be shipped to all regions of the country by 2001 (see Figure 3.12). The regional demand for these vehicles will continue to grow in the long term, where about 1.5 million motorcycles and hundreds of thousands of pick-up trucks and passenger cars will be demanded by regional consumers in 2011 (see Figure 3.13).

Currently, all of these vehicles are being shipped by trucks to consumers in the regions. Some of the cars are being driven individually to dealers in the provinces. These are the most uneconomical way of vehicle deliveries, but they are being done here in Thailand. However, in order for rail to penetrate into this market, the suggestions as mentioned in Section 3.5 for household appliances should be considered.

3.7 Rail Shipment of Coal and Lignite

In addition to oil, the other potential sources of energy that could be transported by rail are coal and lignite. There are several prospects of coal and lignite transport by rail. First, lignite is currently being used by cement plants and other factories at about 3 million tons per year. Cement plants in Saraburi alone consume about 2.5 million tons

Figure 3.11
Distribution of New Vehicles in 1991

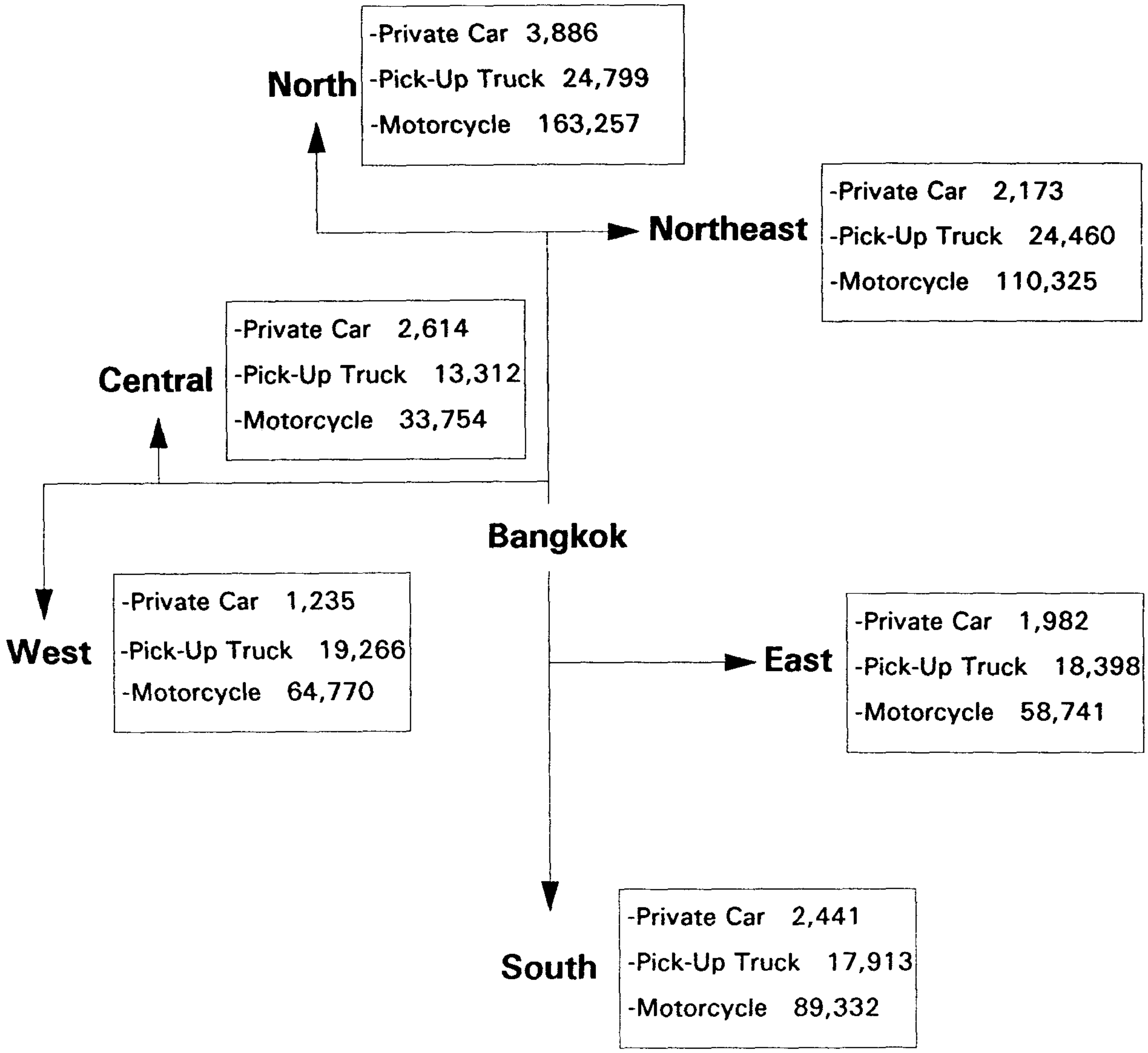


Figure 3.12
Distribution of New Vehicles in 2001

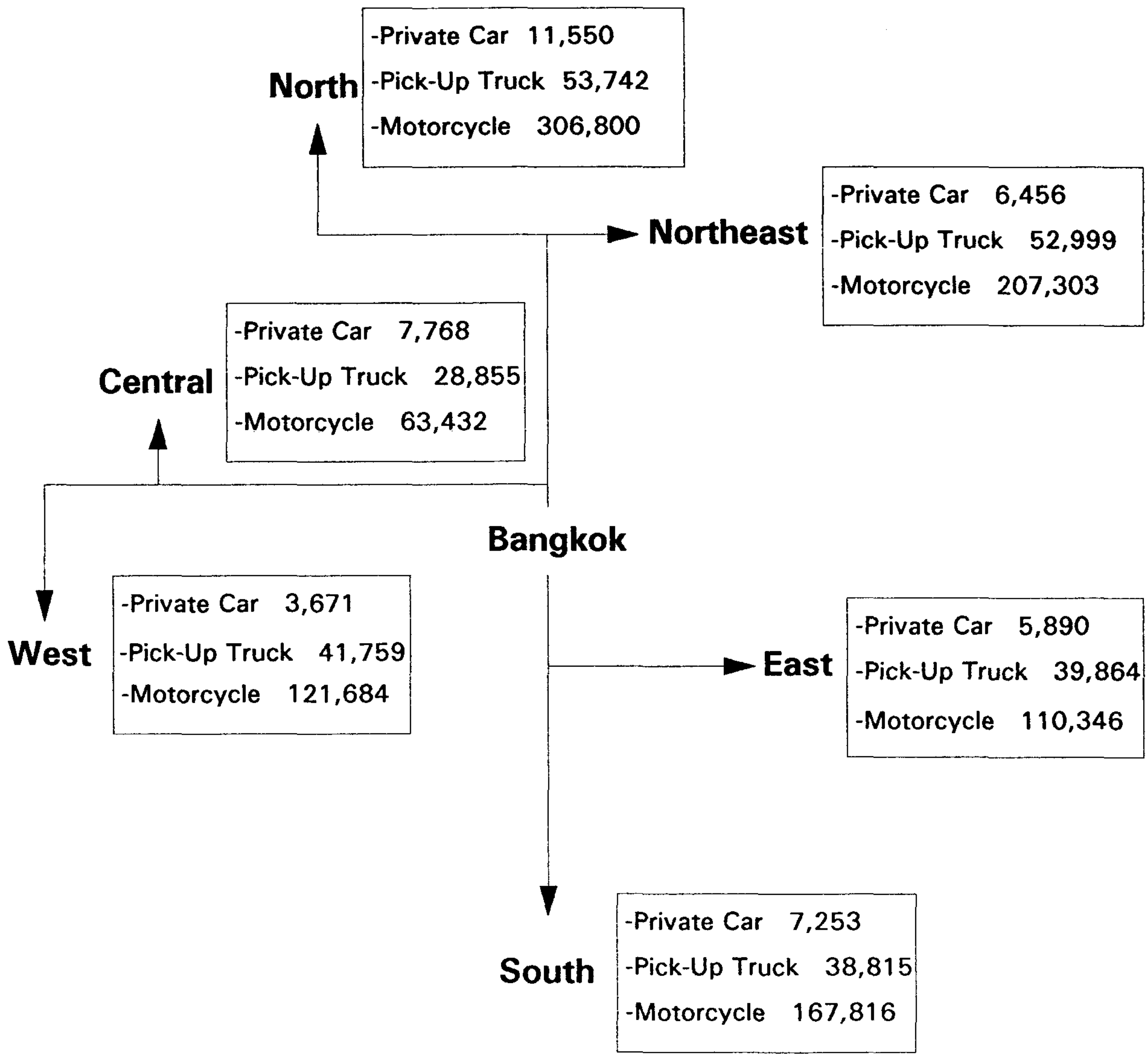
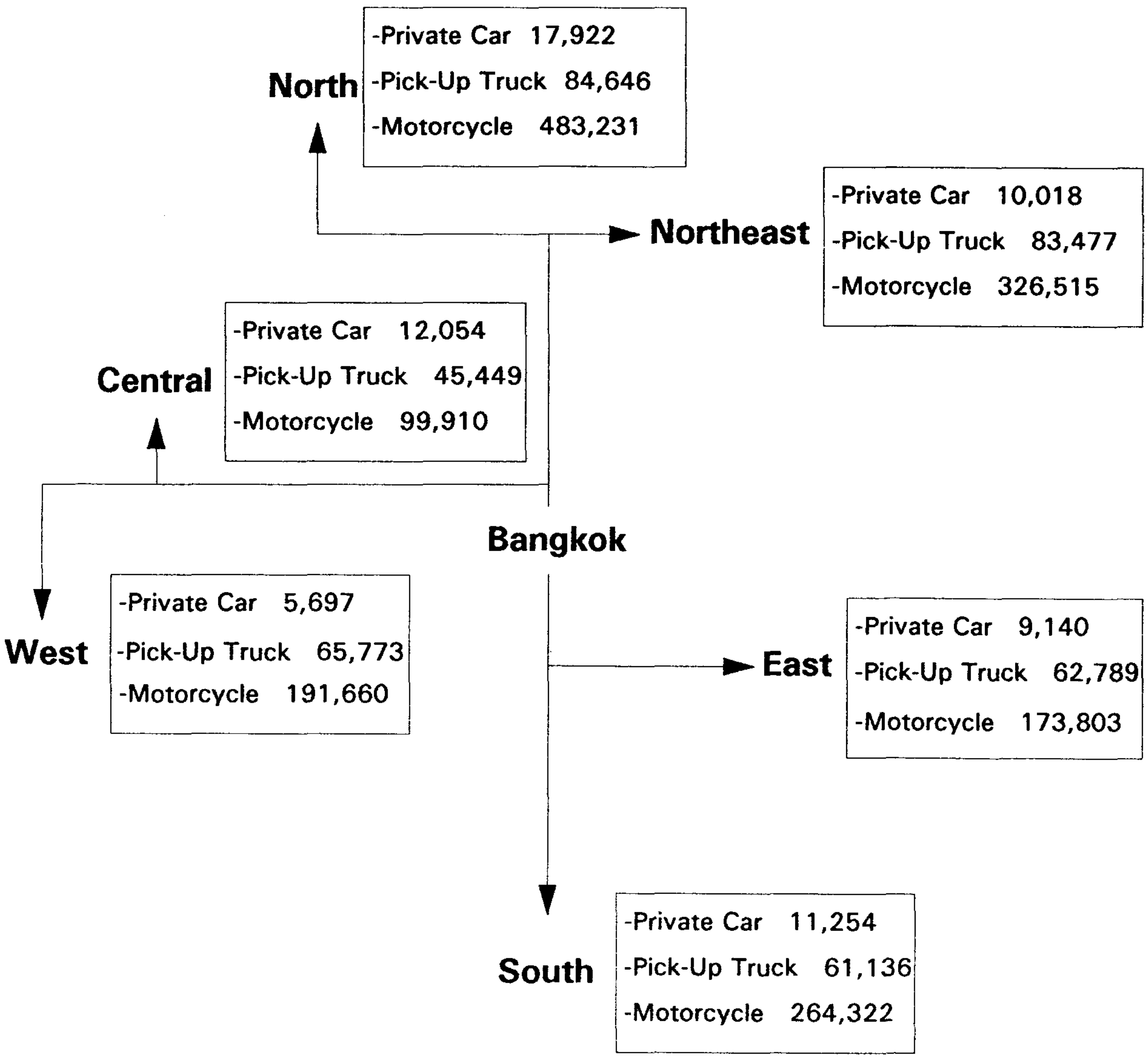


Figure 3.13
Distribution of New Vehicles in 2011



per year. The lignite comes from private mines in Lampang province, and are being transported by truck from the mine sites directly to consumers in Saraburi and other provinces. These mines are mostly small with a combined potential reserve of about 300 million tons, and economically recoverable reserves of about 100 million tons.

In the future, the production of these mines will be raised to about 5 million tons a year, making the reserve to production ratio (or mine's life) about 20 years. However, there are prospects of discovering more lignite from these mines, and that could extend their life further.

Currently, Ban Pu Mine, the owner of the largest private lignite reserves in the country, are discussing with SRT about the prospect of transporting lignite from Ban Pu mines to Saraburi. Rail could transport about 1,000 tons of lignite per trip using the existing equipment. This means that to carry 3 million tons a year of lignite the SRT must operate about 8 train-trips per day.

The problem of lignite transportation is with the location of the mines. Most of the mines are small and are located deep in the mountain ranges. In this regard, rail must employ new technology, like roll-on, roll-off freight cars that could be hauled straight to the mine sites to eliminate double handling costs. Furthermore, the railroad tracks between Sila-at station and Lampang have very steep grades. The tracks were constructed in the early days of SRT's operations, and were not well engineered according to modern day's standard. This makes it difficult and costly to transport heavy freight, as the SRT must use twin locomotives for that segment of the trip. To increase the prospect of lignite transporting (as well as other freight), that rail road section (about 154 kms.) must be rerouted or reconstructed.

The second prospect of rail coal freight transportation is to transport imported coal from Laem Chabang to cement plants in Saraburi. There is a prospect for 2 million tons a year of imported coal to be used in these plants to supplement other sources of fuel. This is a good opportunity for rail service because coal is a bulky product most suitable for rail shipment. In addition, rail could also take advantage of the new railway line linking Laem Chabang with the North and Northeast via Kang Koy junction. This should make rail service highly competitive with truck. Ban Pu mine is studying this prospect with the SRT.

Ban Pu is also studying the prospect of carrying imported coal by rail to EGAT's power plants in Lampang. Imported coal has low sulfur, and thus could be used to burn with high sulfur lignite. However, it is still too early to make any evaluation of this prospect.

3.8 Rail Shipment of Other Freights

There are many ideas being proposed to expand rail freight services of the SRT. One idea is to use rail to transport heavy construction materials like crushed rock, or gravel, to be used in major construction projects in Bangkok. According to the SRT, a large project like Hopewell needs a special kind of crushed granite for concrete making. This kind of granite could be found in the South, and could potentially be transported by rail.

There are also suggestions to transport the 2 million tons per year of garbage in Bangkok to land fills in upcountry provinces. However, the obstacles to this kind of projects are with the finding of locations for land fills because of the environmental concerns.

4. NON-RAIL ACTIVITIES

To conclude this Chapter, some brief remarks are made on non-rail activities of the SRT.

In order to maximize revenue potential, the SRT should take advantage of a recent Government decision allowing it to joint venture with other companies in other lines of business. Priority should be given to the development of SRT properties, or businesses that complement railway services. A brief strategy for SRT real estate development can be found in Section 4.5 of Chapter 6, which includes the recommendation that priority should be given to land development that would enhance railway revenues (e.g. industrial estates alongside railway lines).

Examples of non-real estate businesses that could complement railway services include the followings:

- Hotel ownership and/or management, where the hotel is in a major passenger center close to a railway station. The SRT would allow reservations to be made at these hotels through its Seat Ticketing and Reservation System.

- Trucking companies, whose primary role is to serve as feeder operations to the railway system (especially for containers).
- Ship feeder operations, especially container feeder operations to Singapore.
- Bussing companies, whose services complement SRT train schedules, with origin points at railway stations.
- Planned excess telecommunications services, where the SRT is developing new services of its own.

During the course of this study, we were unable to identify any specific such opportunity available today. It is recommended that someone in the SRT organization be given the responsibility to continually assess such opportunities. In developing any such business, the following principles should be met:

- The new business should be managed by professionals in that line of business.
- The reporting structure of the new business is such that it does not disrupt normal railway management.
- The accounting for the new business does not cloud SRT's railway operations accounting.

APPENDIX TO CHAPTER 4
Road User Charges and Import Duties

A1. ROAD USER CHARGES

A part of the SRT Study requires that a comparative examination be made of road user charges for various types of vehicles in comparison to those of other countries. The availability of information from other countries has proved difficult to collect. However, some information was available and this has been presented later in this section. It should be noted here also that this data is difficult to compare directly with road user charges in Thailand. A comparison has been made but this should not be taken as a definitive statement of road user charges in general. The examination that is made here is limited to heavy vehicles, i.e. trucks. Before this examination is made, a brief introduction to road user charges and the principals involved is made.

A1.1 Road User Charging Principles

As far as possible road user charges should be related to the nature of the cost. Use-related road costs should, therefore, be covered by use-related charges. The road user would then pay the marginal social cost for the use of the road network. Non use-related costs should, as far as practicable, be recovered by methods that do not affect the utilization of vehicles.

Road costs can also be classified according to the extent to which they can be attributed to specific vehicle types. Each vehicle type should be charged as per attributable costs. Non attributable costs should be recovered in ways that impose the fewest distortions and which appear reasonable and equitable. Variable road maintenance costs on paved roads, for instance, result from the damage caused by heavy vehicles. Heavy vehicles rather than light vehicles should thus be responsible for these costs. It is these costs that are examined in the next section of this report. It should be noted at this point that in 1985 it was stated in the Transport Sector Review of Thailand by the World Bank that road user charges on national and provincial roads were close to 70 per cent of all expenditures. However, the major under-coverage of infrastructure costs was caused by heavy vehicles (both 6 and 10 wheel trucks). It was also estimated that the amount of taxes required to cover marginal costs for heavy trucks would increase trucking costs by between 2.5 per cent to 5.0 per cent.

A1.2 Previous Studies

In 1982 a Road User Taxation Study was undertaken by B.C.E.O.M. consultants. This study analyzed the system of taxation on road users in Thailand which consists primarily of:

- Customs duties and business taxes on imported and locally assembled vehicles;
- Vehicle registration and annual license fees;
- Motor fuel taxes (import duties, excise taxes, business and municipal taxes).

The study concluded that when individual categories of road user are considered:

- Light vehicles and heavy buses bear the marginal road costs that they cause through taxes, while heavy 6 wheel and 10 wheel trucks do not;
- Only passenger cars, light buses and light trucks have contributed to Department of Highways expenditures beyond their marginal costs.

The vehicle taxes on heavy goods vehicles that were in force at the time of the study (which have been in effect since 1979) and have not been changed since are shown in Table A.1.

Table A.1
Vehicle Taxes on Trucks

Weight of Vehicle in Kgs.	Vehicle used in fixed route transport	Vehicle used in non-fixed route transport	Vehicle used in private transport
	Baht	Baht	Baht
4,001 kgs. to 4,500 kgs.	2,100	3,150	2,800
4,501 kgs. to 5,000 kgs.	2,300	3,450	3,000
5,001 kgs. to 6,000 kgs.	2,500	3,750	3,200
6,001 kgs. to 7,000 kgs.	2,700	4,050	3,400
7,001 kgs. upward	2,900	4,350	3,600

It was proposed in the 1982 study that taxes on heavy trucks should be increased, and two policy options should be considered by the Government as follows:

(i) Marginal pricing policy: vehicles should be charged only with the marginal infrastructure costs that they cause (marginal costs of highway patrol, marginal cost of pavement maintenance, costs of pavement strengthening and overlays). With this policy, the annual tax on typical heavy trucks would need to be increased as follows:

- 12-ton GVW, 6 wheel truck; from about Baht 3,000 to Baht 14,132 or Baht 18,352 depending on annual kilometerage;
- 21-ton GVW, 10 wheel truck; from Baht 3,600 to Baht 14,679 or Baht 15,025 depending on annual kilometerage.

(ii) Tootal DOH cost recovery policy: a "neutral" tax is added to the above taxes to achieve yearly equilibrium between tax receipts and DOH expenditures. Under this policy both heavy trucks and buses should bear additional annual taxes, as follows:

- 12-ton GVW, 6 wheel truck; from about Baht 3,000 to Baht 22,312 or Baht 29,632 depending on annual kilometerage;
- 21-ton GVW, 10 wheel truck; from Baht 3,600 to Baht 27,530 or Baht 28,280 depending on annual kilometerage;
- 10-ton GVW, 6 wheel bus; from Baht 2,900 to Baht 9,816 or Baht 11,772 depending on annual kilometerage.

The taxes described above were obtained from the 1982 study which were calculated in 1980 prices.

In 1986, the Economic Division of the Ministry of Transport and Communications updated the 1982 study for the period 1980 to 1984. The results showed that the total tax received from the road sector as well as the over-taxation component grew considerably faster than the Department of Highways budget.

As these increases proposed in the 1982 study are large, the Ministry of Transport and Communications proposed in July 1991 to increase vehicle taxes to the levels shown in Table A.2.

Table A.2
Proposed Scale of Vehicle Taxes on Trucks

Weight of Vehicle in Kilograms	Baht
4,001 to 4,500 kgs.	5,600
4,501 to 5,000 kgs.	6,000
5,001 to 6,000 kgs.	6,500
6,001 to 7,000 kgs.	7,000
7,001 to 8,000 kgs.	8,000
8,001 to 9,000 kgs.	9,000
9,001 to 10,000 kgs.	10,000
10,001 kgs or more	12,000

These proposed increases have however not been accepted by Parliament at the time of writing, although they have been accepted by the Cabinet. The Ministry of Transport and Communications calculated that in order for the 6 wheel and 10 wheel trucks to pay their share of user costs for the damage they do to the road, their license fees should increase to Baht 18,802 and Baht 15,776, respectively. The figures in Table A.2 also only represent the first schedule (Schedule A) proposed by the Ministry of Transport and Communications. Further figures were also proposed, i.e. Schedules B and C which represent the eventual level of vehicle taxes for heavy trucks in the future. These two schedules are shown in Table A.3.

Table A.3
Alternative Scale of Vehicle Taxes on Trucks for the Future

Weight of Vehicle in Kilograms	Baht	Baht
	Schedule B	Schedule C
4,001 to 4,500 kgs.	7,300	9,500
4,501 to 5,000 kgs.	7,800	10,150
5,001 to 6,000 kgs.	8,450	11,000
6,001 to 7,000 kgs.	9,100	11,850
7,001 to 8,000 kgs.	10,400	13,500
8,001 to 9,000 kgs.	11,700	15,200
9,001 to 10,000 kgs.	13,000	16,900
10,001 kgs. or more	15,600	20,300

A comparison of the first schedule, i.e. Schedule A, with the existing costs is shown in Table A.4 for Non-Fixed Route transport only.

Table A.4
Increase in License Fees Proposed for Non-Fixed Route Transport

Weight of Vehicle in Kilograms	Existing Cost Baht	Proposed Cost Baht	Cost Increase Baht	Percentage Increase (%)
4,001 to 4,501 kgs.	3,150	5,600	2,450	77.78
4,501 to 5,000 kgs.	3,450	6,000	2,550	73.91
5,001 to 6,000 kgs.	3,750	6,500	2,750	73.33
6,001 to 7,000 kgs.	4,050	7,000	2,950	72.84
7,001 to 8,000 kgs.	4,350	8,000	3,650	83.91
8,001 to 9,000 kgs.	4,350	9,000	4,650	106.71
9,001 to 10,000 kgs.	4,350	10,000	5,650	129.89
10,001 kgs. or more	4,350	12,000	7,650	175.86

A1.3 Intermodal Competition

Proponents of full recovery of road expenditure through specific taxation of road users emphasize that since railways are normally required to balance revenue and expenditures, including capital investment and operating expenditures, the same principle should be applied to the road sector with a view to promoting efficient intermodal competition. This reasoning is theoretically valid but its practical consequences on modal split should not be overstated.

The 1982 study on Road User Taxation calculated the additional taxes required for 6 wheel and 10 wheel trucks under two different scenarios, i.e. marginal cost pricing policy and total DOH cost recovery policy. These taxes were also calculated on a per vehicle-km. basis. The following results were obtained from this study:

Marginal Cost Pricing Policy:

6 wheel truck (12 ton GVW) -	additional tax per vehicle-km.	38.38 stg
10 wheel truck (21 ton GVW) -	additional tax per vehicle-km.	24.31 stg

Total DOH Cost Recovery Policy:

6 wheel truck (12 ton GVW)	- additional tax per vehicle-km.	66.58 stg
10 wheel truck (21 ton GVW)	- additional tax per vehicle-km.	52.51 stg

The update of the 1982 study by the Economics Division of the Ministry of Transport and Communications recalculated the marginal cost pricing shown above on a per vehicle-km. basis. These recalculated figures for 1986 are shown in Table A.5.

Table A.5
Marginal Road Infrastructure Costs 1986

Gross Vehicle Weight	Highway Patrol Cost (Satang/km.)	Pavement Maintenance Cost (Satang/km.)	Pavement Strengthening Cost (Satang/km.)	Total Cost (Satang/km.)
6 wheel 12 ton truck	0.873	42.528	23.955	67.356
10 wheel 21 ton truck	0.873	39.870	22.458	63.201

It has been estimated from these figures that the financial operating costs of trucks would only increase by between 2.5 per cent to 5.0 per cent if they are charged marginal road cost, and about 5.0 to 10.0 percent if full road cost is charged. This increase should be considered as relatively small, and is therefore unlikely to influence the modal split between road and rail transport to any significant extent. For example, using the above figures, if the operating cost is Baht 10 per vehicle-km. to move a distance of 600 kms. with a load of 12 tons in a 6 wheel truck, then the total cost per ton would be Baht 500. If the tax is increased by 67.356 stg. per vehicle-km., the ton cost over this distance would increase to Baht 533.67. It should be noted that transportation rates are often very different from vehicle operating costs, and are often 2 to 3 times more than the calculated vehicle operating cost. Under these circumstances, in the above example a Baht 33.67 surcharge on truck operating costs is unlikely to affect the modal split in any significant way.

A1.4 Road User Charges in Other Countries

The following section gives data that has been collected from other countries on road user charges. The currency used is that of the country in question. The equivalent in Thai Baht is also given.

Indonesia

In Indonesia, the Government charge road tax and registration fees based on the engine size of the vehicle concerned.

For example, a truck or public transport vehicle with an engine size of 17,000 c.c. has a road tax (yearly) of approximately Rupiahs 383,700 or Baht 5,780. The per capita income in Indonesia in 1990 U.S.$ was approximately $570 whilst the per capita income of Thailand was $1,420, i.e. the per capita income differential is approximately 2.49 lower for Indonesia. This gives a comparable road tax figure of Baht 14,399. As can be seen from Table A.1 Thailand's road taxes vary between Baht 2,900 to Baht 4,350 for a comparable vehicle. The figure of Baht 14,399 however is in line with the amount of road user tax that is proposed in Thailand, i.e. Baht 12,000 to Baht 20,000 (see Tables A.2 and A.3).

Korea

Korea also imposes vehicle taxes by engine size on purchase of the vehicle and also a regular annual tax. The amounts charged are shown in Table A.6.

For a vehicle over 2.0 litres (as are most trucks), the annual auto tax amounts to approximately Baht 74,300, and the license tax amounts to Baht 733. The per capita income differential between Korea and Thailand is 3.80 times higher in Korea. Thus, to compare Thailand with South Korea, the annual auto tax and the license fee above need to be divided by 3.80. This gives an annual auto tax figure of Baht 19,538 and a license fee of Baht 193. The annual auto tax fee of Baht 19,538 is again comparable to the figures proposed by the Ministry of Transport and Communications for the revision of Thailand road user taxes for trucks (see Table A.3).

Table A.6
Road User Charges in Korea

	Below 1.5 Litres	Below 2.0 Litres	Over 2.0 Litres
On Purchase			
Registration Tax	6 per cent	6 per cent	10 per cent
Acquisition Tax	2 per cent	2 per cent	2 per cent
Subway Bond	8 per cent	8 per cent	10 per cent
Regular Tax			
Auto Tax (Quarterly)	Won 73,120	Won 121,680	Won 546,970
License Tax (Yearly)	Won 21,600	Won 21,600	Won 21,600
Insurance (Yearly)	Won 149,150	Won 149,150	Won 149,150

Exchange Rate Won 736.4 = U.S.$ 1

Singapore

The taxes in Singapore for goods vehicles are broken down as shown in Table A.7.

Table A.7
Road User Taxes in Singapore

Engine Capacity	Goods Vehicles (Singapore $)
less than 1,000 c.c.	46
1,001 - 1,600 c.c.	58
1,601 - 2,000 c.c.	69
2,001 - 3,000 c.c.	81
greater than 3,000 c.c.	115

The road tax for company registered vehicles is double that for private registered vehicles. Also diesel driven vehicles have to pay a diesel tax amounting to six times the road tax applicable to the vehicle. For example, a truck with an engine size greater than 3,000 c.c. would have to pay a tax of Singapore $1,380 or approximately Baht 21,400. The per capita income in Singapore is approximately 7.85 times the per capita income in Thailand. This reduces the above figure to a comparable figure of Baht 2,700. This is approximately the existing level of vehicle tax for trucks in Thailand. This suggests that truckers in Singapore are also subsidized to the same extent as Thailand's truckers, all other things remaining equal.

Conclusions

As can be seen from the above data, some of the truck road user charges (Indonesia and Korea) are comparable to the proposals for road user taxation in Thailand. The other figures (Singapore) indicate a level of road user taxation on trucks of the same magnitude as Thailand. As stated previously the comparisons are difficult due to the fact that only an isolated examination is being made of the whole of the road taxation sector of these countries. The comparisons are however indicative of truck taxation levels compared to Thailand.

A.2 IMPORT DUTIES AND CHARGES

The purpose of this section is to investigate the import duties and charges on railway equipment and spare parts, and the impact of these charges on the competitiveness of railway costing.

Customs duties are levied at the rate of 5 per cent of the C.I.F. value at Bangkok on imported railway equipment, and spare parts which cannot be used for any other purposes than railway operations, while all other imported items bear normal customs duties. The 5 per cent rate is much below the normal rate of Thailand customs duties, which was generally between 14 per cent to 20 per cent in the 1980's. The normal rate of customs duties is taken at the same level as that applying to capital goods in the analysis of customs duties charged on trucks and buses, i.e. 12 per cent of C.I.F. values on average during the 1980's, while it was taken at the rate applying to intermediate products and raw materials for chassis and bodies, i.e. 14 per cent on average in the 1980's. By whatever standard, it is gauged that the 5 per cent rate applying to Thailand's railways imports of equipment and spare parts should be considered as relatively small.

CHAPTER 5

BANGKOK COMMUTER NEEDS: A SPECIAL FOCUS

The major objectives of this chapter are:

1) To identify the appropriate role of the SRT commuter train over the next twenty years;
2) To recommend future projects and plans for the SRT commuter train according to the role identified.

The chapter is divided into two parts. The first part analyzes urban development potentials and trends of Bangkok and its metropolitan region. This part provides information on patterns and directions of urban development in the Bangkok Metropolitan Region (BMR) and the extended BMR in the future. The result of the analysis is used to help identify future SRT development projects in the second part.

The second part of the chapter focuses on Bangkok commuter train services. The role of the SRT commuter train over the next twenty year is defined and recommendations on future projects and plans for the SRT commuter train are provided.

1. URBAN DEVELOPMENT POTENTIALS AND TRENDS

Since the implementation of the 5th and 6th National Economic and Social Development Plans (1982-1991), the Bangkok Metropolitan Region (BMR) has expanded rapidly. This expansion has been caused by the rapid growth of the national economy. In recent years, investments from abroad have flowed increasingly into Thailand, particularly into Bangkok and the surrounding areas. This has led to various development projects such as residential housing estates, office buildings, factories, hotels, and golf courses.

The inevitable repercussions are rapid extensions of the inner city districts and horizontal enlargement of the metropolitan suburbs and provincial boundaries. These arbitrary expansions suggest a lack of proper land utilization planning, inadequacies in the provision of infrastructure, and encroachment on previously agricultural lands. Excessive demand for land acquisitions had led to land speculation and astronomical land prices. These complex issues compound the difficulty of implementing a proper metropolis transportation plan that would facilitate rapid changes under fluid economic circumstances.

1.1 National Urban Structure

Urban population is a major indicator related to transport demand. Urban people tend to travel more frequently and at a longer distance than those who live in rural areas. Urban population in each province reflects the overall socioeconomic development for the urban areas.

Table 1.1 and Figure 1.1 show the number of urban population for each province in the nation. As shown in the table, the Bangkok Metropolitan Region (BMR) agglomerates a large portion of urban population. In Bangkok alone, the population in 1990 was 6,161,789, or about one-third of the national urban population. Adding the other five provinces within the BMR (Nontaburi, Pathum Thani, Nakhon Pathom, Samut Prakan, and Samut Sakhon), the proportion would increase to 43 percent. Although this proportion is projected to reduce to 38 percent by the year 2000, it still expresses the dominance of the BMR in the process of the nation's urbanization.

Other significant urban agglomerations include the growth centers defined by the NESDB: Chiang Mai and Phitsanulok in the North; Chon Buri and Rayong in the East; Nakhon Ratchasima, Udon Thani, Khon Kaen, and Ubon Ratchathani in the Northeast; and Songkla, Phuket, and Surat Thani in the South. All these regional centers except Phuket are served by the SRT.

1.2 Socioeconomic Significance of the BMR

Although the significance of the BMR in terms of urbanization tends to decrease, its significance in terms of total population (urban and rural population) tends to be different. As shown in Table 1.2, the total population of the BMA in 1980 was 10.4% of the national population. This proportion rose to 11.0% in 1990 and is projected to rise to 11.2% in 2000 and 2005. The same situation applies to the other 5 provinces within the BMR where the population share went from 4.3% in 1980 to 5.0% in 1990 and is projected to rise to 6.1% in 2005.

Table 1.1
Urban population at provincial level in 1990 and 2000

Region/province	1990	2000
Northern Region		
Chiang Mai *	476,225	717,814
Nakhon Sawan *	310,586	438,254
Chiang Rai	252,559	397,320
Lampang *	205,060	258,650
Phetchabun	202,019	297,534
Phitsanulok *	161,755	206,127
Kamphaeng Phet	147,886	215,716
Sukhothai	134,529	159,304
Phrae *	113,256	148,213
Phayao	99,436	127,182
Lamphun *	94,786	144,737
Uttaradit	85,210	106,160
Tak	85,174	106,168
Phichit *	83,886	95,036
Nan	58,095	78,313
Uthai Thani	38,803	48,813
Mae Hongson	17,339	29,933
Central Region		
BMA *	6,161,789	7,149,299
Samut Prakan	533,868	836,188
Nonthaburi	496,970	772,613
Ratchaburi *	283,447	394,993
Ayutthaya *	254,484	373,277
Pathum Thani *	231,929	400,797
Saraburi *	227,095	340,494
Phetchaburi *	171,853	220,766
Prachuab Khiri Khan *	159,946	207,577
Suphan Buri *	157,504	214,439
Nakhon Pathom *	151,568	247,769
Samut Sakhon *	137,029	201,310
Kanchanaburi *	134,774	200,292

Table 1.1 (Continued)
Urban population at provincial level in 1990 and 2000

Region/province	1990	2000
Lop Buri *	120,275	150,677
Ang Thong	63,863	70,006
Sing Buri	61,725	67,336
Samut Songkhram *	43,923	56,926
Chai Nat	27,390	35,294
Nakhon Nayok	24,524	33,380
Eastern Region		
Chon Buri *	580,443	849,789
Rayong	183,263	335,336
Chachoengsao *	123,774	236,275
Chanthaburi	122,175	190,473
Prachin Buri *	97,867	127,606
Trad	29,061	45,612
Northeastern Region		
Nakhon Ratchasima *	684,808	1,084,017
Udon Thani *	529,888	826,412
Khon Kaen *	382,753	597,454
Ubon Rachathani *	349,976	549,864
Buri Ram *	227,781	363,027
Chaiyaphum	164,157	242,100
Kalasin	152,948	220,060
Nong Khai *	146,712	241,440
Sakon Nakhon	124,438	175,641
Si Sa Ket *	119,738	167,976
Roi Et	111,698	164,764
Surin *	110,263	192,606
Nakhon Phanom	109,351	159,543
Maha Sarakham	85,962	130,522
Loei	67,584	86,790
Yasothon	57,957	85,395
Mukdahan	36,673	54,275

Table 1.1 (Continued)
Urban population at provincial level in 1990 and 2000

Region/province	1990	2000
Southern Region		
Songkhla *	375,342	615,575
Nakhon Si Thammarat *	213,693	297,126
Surat Thani *	205,563	312,116
Narathiwat *	147,062	228,262
Trang *	105,249	156,899
Yala *	103,199	147,259
Pattani	82,407	125,218
Phuket	80,277	130,801
Phatthalung *	50,897	71,191
Chumphon *	48,481	66,121
Phanga	27,773	46,872
Satun	25,521	36,957
Krabi	23,898	44,619
Ranong	21,456	34,809
Thailand	18,123,089	24,989,481

N.B. * Area served by train.
Source: National Urban Development Policy Framework, NESDB (UNDP/TDRI, 1991).

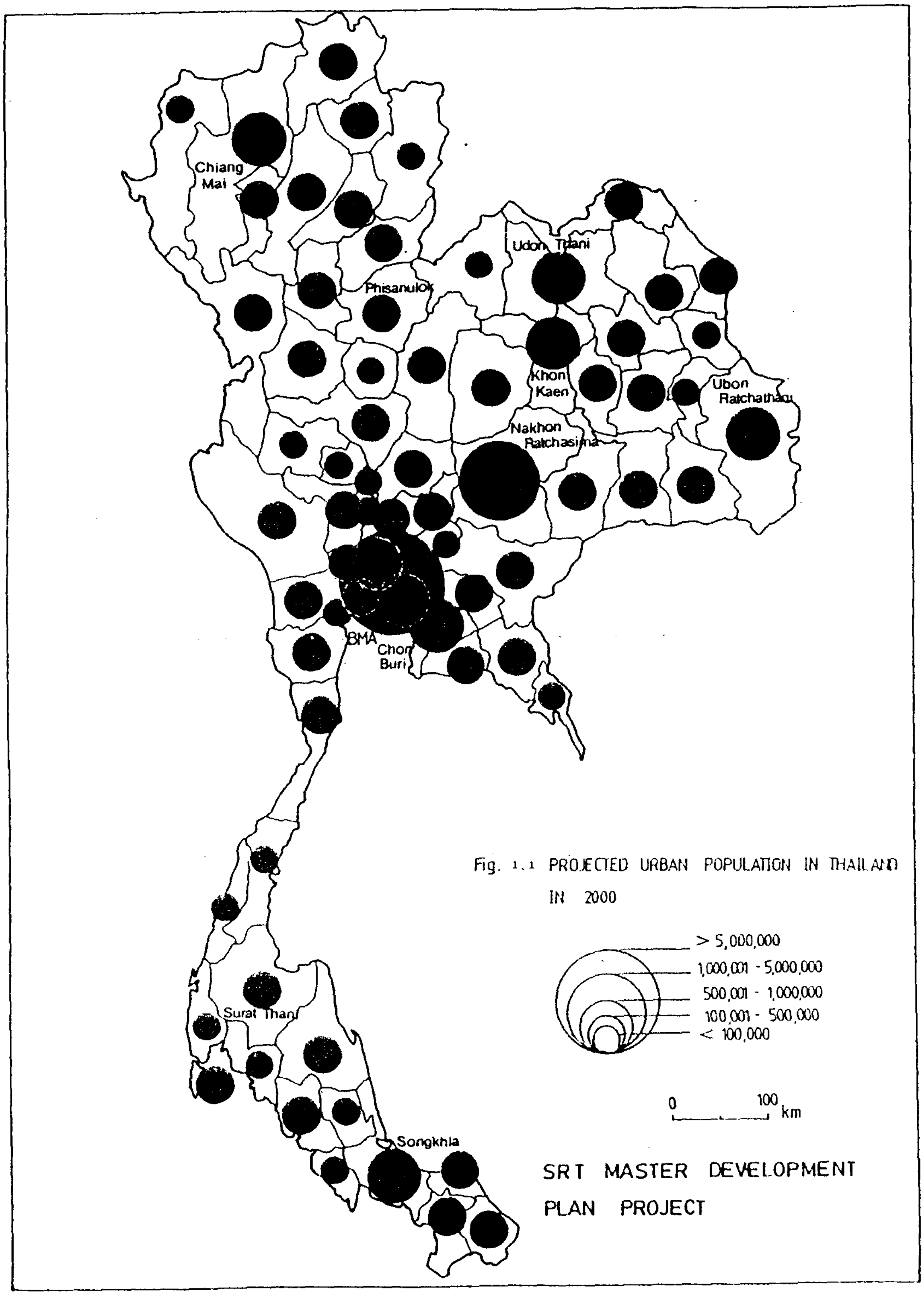


Fig. 1.1 PROJECTED URBAN POPULATION IN THAILAND IN 2000

Table 1.2
Distribution of Population 1980-2005 (As of the 1st of July)

'000 Persons

	1980	1985	1990	1995	2000	2005
BMA	4870	5557	6162	6679	7149	7577
	10.40%	10.80%	11.00%	11.10%	11.20%	11.20%
5 PROVINCES	2025	2416	2808	3220	3655	4107
	4.30%	4.70%	5.00%	5.30%	5.70%	6.10%
CENTRAL	2470	2608	2755	2900	3039	3163
	5.29%	5.06%	4.91%	4.82%	4.74%	4.67%
EAST	2804	3144	3491	3833	4185	4535
	6.00%	6.10%	6.22%	6.37%	6.53%	6.69%
WEST	2814	3055	3254	3433	3609	3775
	6.02%	5.92%	5.80%	5.70%	5.63%	5.57%
NORTHEAST	16433	17982	19321	20507	21641	22681
	35.18%	34.86%	34.45%	34.06%	33.76%	33.46%
NORTH	9427	10154	10804	11364	11845	12244
	20.18%	19.69%	19.26%	18.88%	18.48%	18.06%
SOUTH	5874	6663	7488	8269	8988	9708
	12.57%	12.92%	13.35%	13.73%	14.02%	14.32%
THAILAND	46718	51580	56082	60206	64110	67789
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source : TDRI (1991).

Table 1.3
Value Added and Growth Rates of GDP's at Constant 1972 Price

Value Added (Billion Baht)

	1981	1986	1991	1996	2001	2006	2011
Northeast	49.3	65.4	90.4	120.1	160.3	211.3	284.7
North	42.7	54.5	76.2	101.1	135.6	178.8	242.0
South	30.8	40.6	60.5	83.0	113.8	152.0	207.2
East	22.6	30.4	59.1	108.3	182.8	274.2	387.4
West	18.6	24.3	36.8	55.5	81.0	112.0	154.2
Central	16.9	20.2	32.3	48.2	71.4	100.6	140.2
BMR	137.5	178.0	333.0	504.5	746.7	1064.0	1495.9
Whole Kingdom	318.4	413.5	688.3	1020.8	1491.6	2093.0	2911.7
Ratio of BMR	43.2%	43.2%	48.4%	49.4%	50.1%	50.8%	51.4%

Average Growth Rate

	1981-86	1986-91	1991-96	1996-01	2001-06	2006-11
Northeast	65.4	90.4	120.1	160.3	211.3	284.7
North	54.5	76.2	101.1	135.6	178.8	242.0
South	40.6	60.5	83.0	113.8	152.0	207.2
East	30.4	59.1	108.3	182.8	274.2	387.4
West	24.3	36.8	55.5	81.0	112.0	154.2
Central	20.2	32.3	48.2	71.4	100.6	140.2
BMR	178.0	333.0	504.5	746.7	1064.0	1495.9
Whole Kingdom	413.5	688.3	1020.8	1491.6	2093.0	2911.7

Table 1.4
Projections of Total Employment by Region

	1990	1995	2000
BMA			
Employment ('000)	3,184	3,525	3,771
Share (%)	9.60%	9.80%	9.90%
Average Growth (%)		2.06%	1.36%
5 PROVINCES			
Employment ('000)	1,533	1,815	2,053
Share (%)	4.60%	5.00%	5.40%
Average Growth (%)		3.43%	2.49%
WHOLE KINGDOM			
Employment ('000)	33,016	35,969	38,232
Share (%)	100.00%	100.00%	100.00%
Average Growth (%)		1.73%	1.23%

Source: TDRI, 1991.

In terms of gross domestic product, the significance of the BMR also tends to increase. As shown in Table 1.3, the GDP of the BMR at constant 1972 prices was 43% of the country's GDP in 1981, then rose to 48% in 1991. It is projected to increase to 50% of the nation's GDP in 2001 and 51% in 2011.

The projection of regional employment in Table 1.4 also indicates the expected increase in the BMA's share of employment. In 1990, its share of employment was 9.6% of total employment. This share is projected to increase to 9.9% in 2000. Adding employment in the 5 provinces of the BMR, the employment share of the region is 14.2% in 1990 and is expected to rise to 15.3% in 2000.

The above picture indicates that the BMR will still dominate the nation in terms of socioeconomic development over the next two decades. The regional economic growth of the area is expected to be a little faster than that for the national economy. The population of the BMR will also increase faster than the national average. The demand for transportation, therefore, will increase substantially. Considering the existing inadequacy of road transportation, there is a strong tendency that mass rapid transportation, including the commuter train, will become more important in the process of urban development in the BMR in the future.

1.3 Growth Patterns of Bangkok

The growth process of each part of Bangkok is determined by building control regulations, land prices, location suitability for economic activities, purposes, and the availability of vacant land.

1.3.1 Growth Within Rattanakosin City

Land in Rattanakosin City, the old city of Bangkok, has been used mainly for temples, government offices, educational establishments, and two to four story shophouses. Construction of high-rise buildings is forbidden in this area. Land development in the area has remained static, having already reached its full capacity. Outward migration to escape over-crowding has become a characteristic of this area.

1.3.2 Growth in the Inner City Districts

Inner city districts are defined as densely populated areas with little or no vacant land. Most of the land has already been developed for commercial purposes, living quarters, government offices, educational establishments, temples, and so on. The intensification of land usage is characterized by vertical development in the form of high-rise office and residential buildings, rather than the traditional horizontal development of shophouses. Exorbitant land price is a direct result of the very limited supply of available land. Therefore, only high-income groups can afford to reside in these areas where good infrastructure and facilities are provided.

1.3.3 Growth in the Outer City districts

Land in the outer city districts has been utilized for agricultural purposes such as paddy fields in the eastern suburbs and orchid-rearing, vegetable and fruit gardens in the western suburbs of Bangkok. A portion of these areas has been designated as green-belt zones for agricultural purposes. The preservation objective, however, cannot be strictly maintained. Although legal restraints have been enforced to deter the construction of buildings, exemptions and allowances have been provided in individual cases. To some extent, illegal constructions have occurred. High land prices have contributed to the problem by making returns from agricultural activities very low in comparison to other economic activities. Changes of residential patterns have also affected land utilization. While the traditional Thai pattern of settlements usually spread along the banks of the canals, modern forms of development tend to concentrate along the major communication routes, causing ribbon development. The land beyond the major routes is either being used for agricultural purposes or simply left idle.

1.4 Land Usage in Bangkok

Land development in Bangkok has occurred without proper planning and controls, resulting in a mixture of different usage within relatively small areas. The major categories of urban land utilization can be summarized as follows:

1.4.1 Commercial Areas

Commercial areas tend to concentrate within the inner city districts where communication and accessibility are easy and convenient, thereby consolidating a variety of commodities. The traditional form of building, which still persists, is the shop-house. Two types of commercial buildings can be seen. They include:

- Those used for wholesale purposes or as suppliers of specialized items. These buildings are located in the old city boundaries or the inner city districts.
- Those used for retail purposes that primarily supply the traditional perishable foodstuffs.

1.4.2 Business Areas

The traditional business buildings used to be two to four stories tall. Recently developed high-rise buildings, however, have gradually replaced the traditional buildings. This is due to the very high price of land. Once the land in a particular district is fully developed, the activity will expand into the adjacent area where land is still available.

1.4.3 Residential Areas

Over the last 15 years, traditional living accommodations, such as row houses and detached houses in low density areas, have gradually been replaced by residential housing estate projects. Residential housing estates used to be concentrated in the outer city districts and suburban Bangkok. The recent significant increase in land prices, however, has made housing much more expensive, thereby restricting the potential buyers to only those in the high-income bracket. This has given rise to the development of town houses and residential condominiums. While expensive residential condominiums remain within the city boundaries, cheaper ones tend to be scattered around suburban Bangkok.

1.4.4 Industrial Areas

Industrial areas can be seen in provinces adjacent to Bangkok. Food processing and service industries, however, are located in Bangkok due to their requirements for proximity to the final consumer market. Being labor-intensive and requiring not much working space, many of them are operated in shop-houses that serve as both workplaces and accommodations. These small scale industries, however, are generating pollution. Government efforts should be made to relocate them to mini-factories or industrial condominiums in the outskirts of Bangkok.

1.5 Development Potentials and Land Utilization Trends in Bangkok

A TDRI study entitled "The Framework for the Fourth BMA Development Plan, 1992-1996 (TDRI, 1991)" assessed the development potentials of the BMA districts based on three criteria: changing land use patterns, changes in the population size of individual districts, and the availability of public infrastructure. The results were as follows (see figure 1.2).

1.5.1 Krung Rattanakosin and Related Area

This area covers the major part of Pra Nakhon District and the area located on the opposite bank of the Chao Phraya River, facing Rattanakosin City. This area is an important national and local cultural center as well as an important tourist destination. It is also strategically located in the center of Bangkok with a complete network of infrastructure.

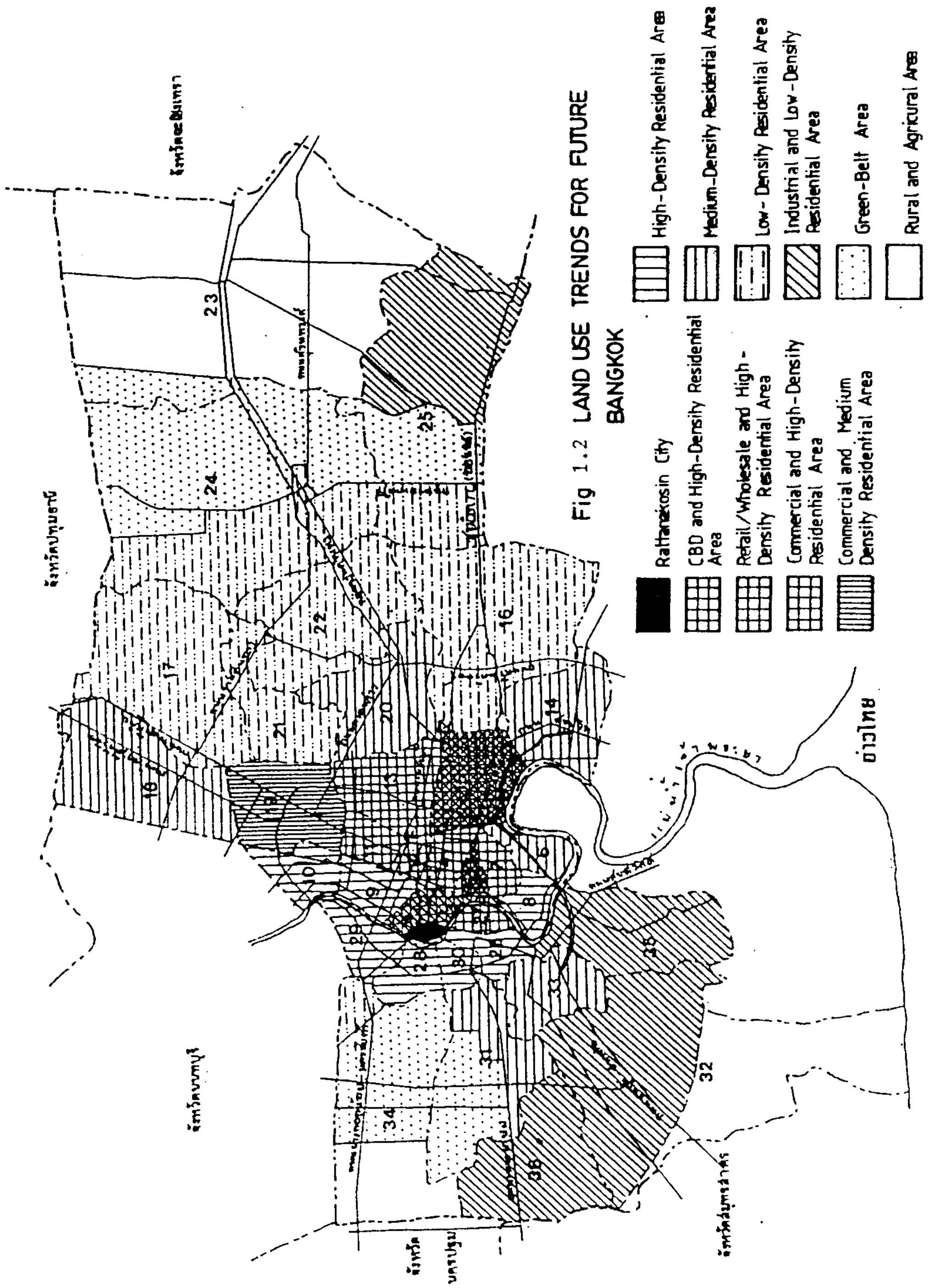


Fig 1.2 LAND USE TRENDS FOR FUTURE BANGKOK

1.5.2 Klong Toei District

This district has a potential of being a new Central Business District (CBD). Several large-scale transportation projects are planned for this district. Urban expansion will be in the form of vertical development.

1.5.3 The Existing CBD Area

This area is surrounded by Surawong, Rama IV, and North Sathorn Roads and the Chao Phraya River. The area will receive the benefit from the currently planned mass transit projects. As a result, it has good prospects for development. Most shop-houses in the area will be replaced by high-rise buildings. It will retain its CBD status along with the new CBD at Klong Toei district.

1.5.4 Other Districts with High Potential for being Major Business Centers

These districts, with favorable locations and will also benefit from the implementation of mass rapid transit systems, are Pathumwan District, part of Huay Kwang District next to Klong Toei, and part of Chatuchak District adjoining Phayathai District. The development trend will be in the vertical form.

1.5.5 Bangkok's Original Business Center

This area, situated between the Ong Aung-Bang Lampoo Canal and the Padung Krung Kasem Canal, has long been the major center for retail and wholesale activities. It is now losing its significance due to traffic congestion and the lack of parking facilities. Most buildings in the area are shop-houses. This poses a problem of large-scale development since there are numerous owners with small land allotments. Therefore, it is anticipated that land use pattern in this area will not change so much in the future.

1.5.6 Other Districts with High Potential for being Secondary Business Centers

These districts include Sathorn, Ratcha Thaewee, Thon Buri and Klong San. Major development will be in the form of shop-houses or shop-houses intertwined with high-rise buildings along both sides of main roads.

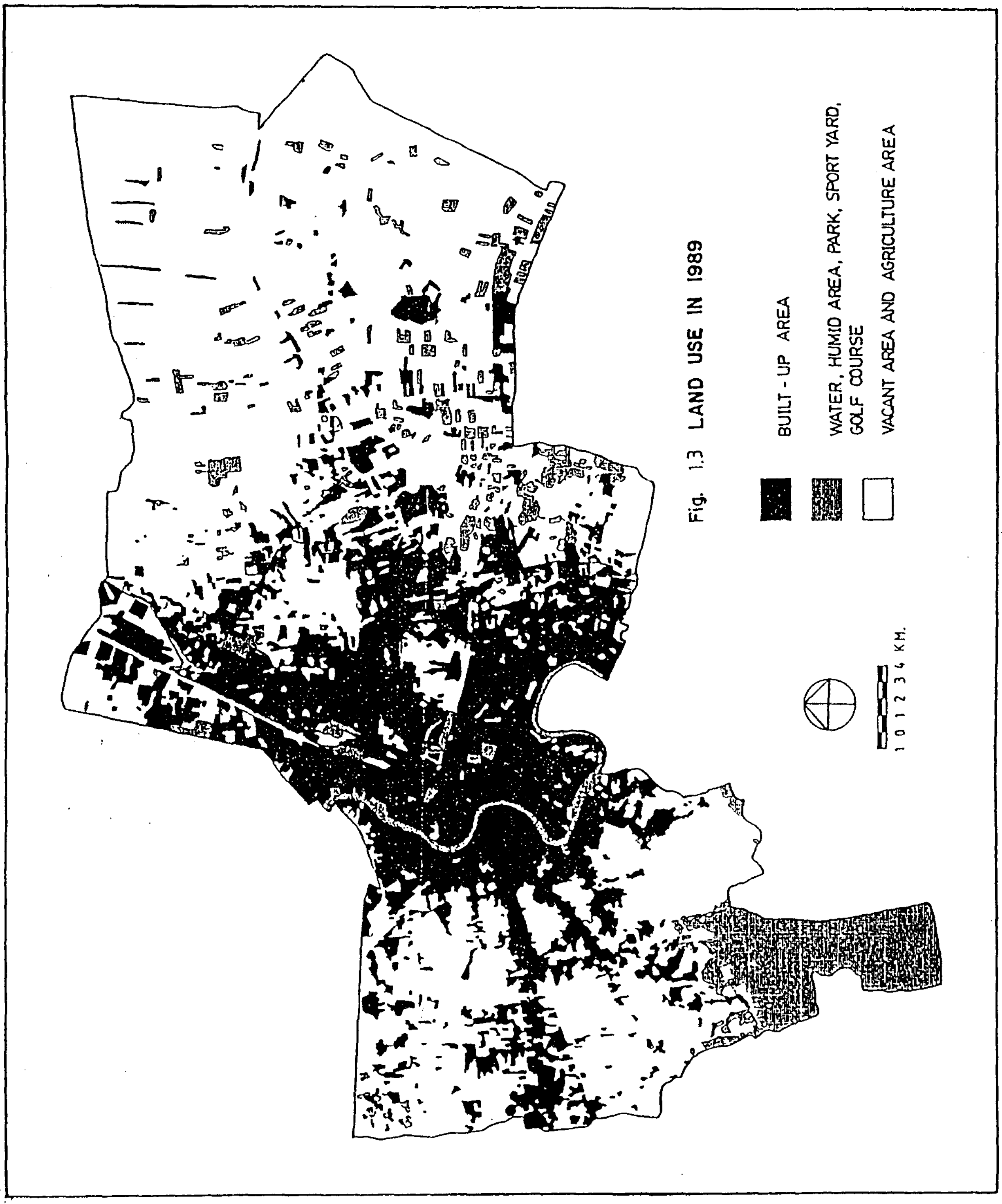


Fig. 1.3 LAND USE IN 1989

Table 1.5
Proportion of Land Uses in Bangkok, 1989

Type of Land Use	Percent
Vacant area/Agricultural area	62.69
Infrastructure	0.50
Chao Phraya River	0.58
Commercial	1.44
Residential (mixed)	14.37
Residential (land and house)	5.67
Residential (land subdivision)	2.56
Residential (apartment, flat)	0.11
Residential (slum)	0.19
Warehouse	0.26
Government	1.77
Education	0.51
Temple, Cemetery	0.17
Manufacturing	1.48
Golf Course	0.22
Sport Yard	0.35
Park	0.09
Water, Humid area	7.03
Total	100.00

Source: SPOT Satellite Image Interpretation.

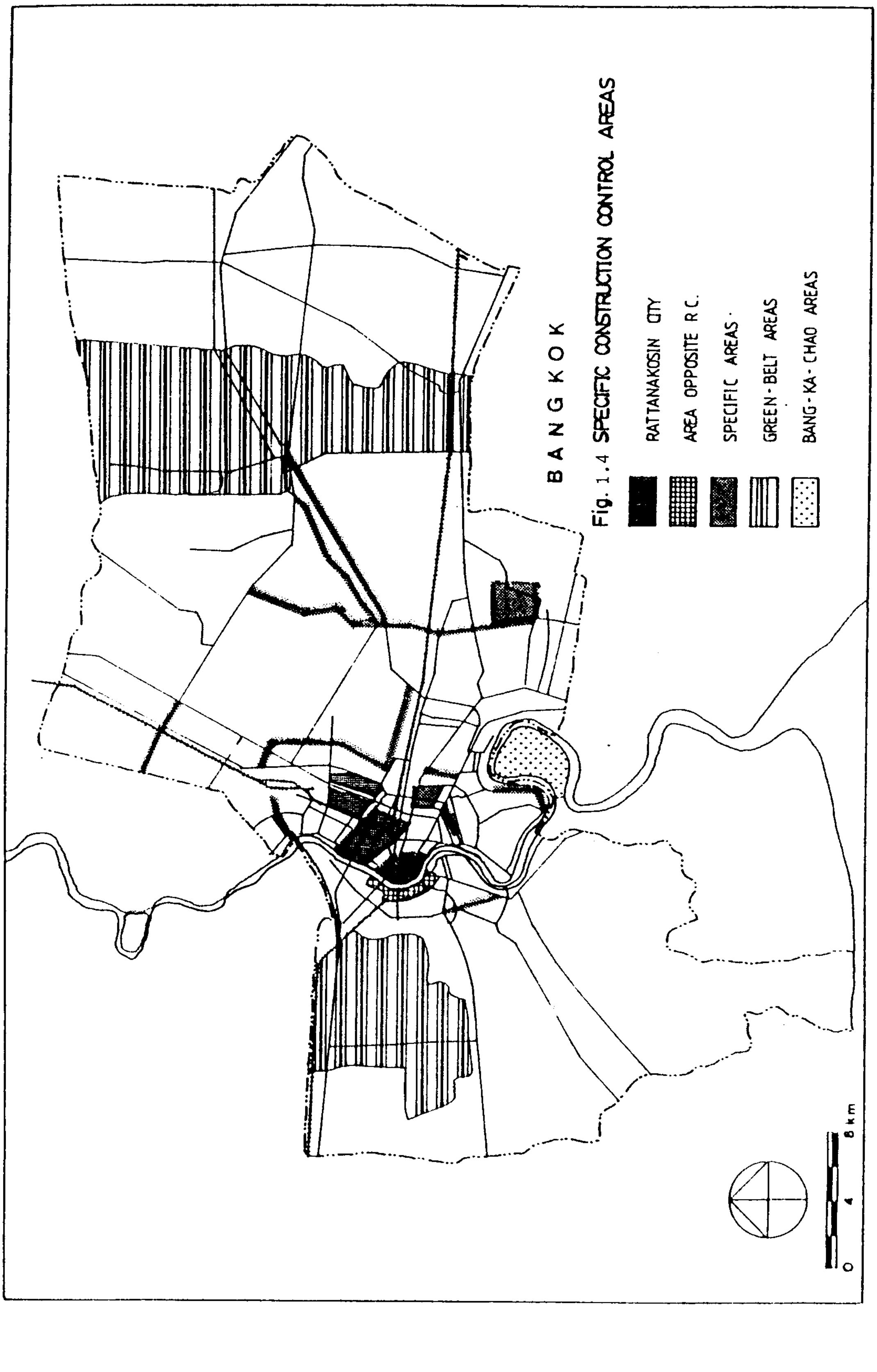


Fig. 1.4 SPECIFIC CONSTRUCTION CONTROL AREAS

1.5.7 Districts with High Potential for Residential Development

These districts include Klong Toei, Huay Kwang, Bangkapi, Don Muang, Sathorn, Pathumwan, Prakanong, and Bang Kor Laem. Development in the inner districts will be in vertical form while the outer districts will have both horizontal and medium-height vertical development.

The land use map presented in Figure 1.3 is an interpretation of SPOT Satellite Image acquired in December 1989. It shows that the inner city areas are occupied mostly by commercial, residential, and administrative development, while most industrial areas are located in the suburbs. Within the BMA's administrative boundary of 1,567.8 sq. km., 62.7% of the area are vacant or agricultural areas. The overall landuse proportion of Bangkok is shown in Table 1.5.

1.6 Urbanization Control Areas in Bangkok

Government controls of this type restrict land usage, height, set back, floor space allocations, and so on. The specific control areas are shown in Figure 1.4.

1.6.1 The Preservation Area of Rattanakosin City

This preserved area has been divided into three main parts as follows.

1) The Inner Rattanakosin Area

This is the location of the old city of Bangkok established more than two centuries ago. It contains many historic buildings, temples, government offices, and educational establishments. The area is about 2 square kilometers, stretching from the bank of the Chao Phraya River to Klong Lord.

In 1981, the Office of the National Environment Board (NEB), approved by the Cabinet, laid down policy guidelines regarding permissible land usage within this area. It strictly forbade the establishment of industries and residential complexes, limited the size of business buildings, and restored ancient building dating from the reign of His Majesty King Rama V. The height of new buildings has been limited to 16 meters, with at least 20% of open space. Not less than one-half of the open space must be green area.

2) The Outer Rattanakosin Area

This area has been divided into 10 sub-zones with varying degrees of restrictions. The essential controlling elements, such as the permissible height of buildings and types of businesses, are substantially the same as those in the inner area.

3) The Area Opposite Rattanakosin City

This area directly faces Rattanakosin City but is situated on the opposite bank of the Chao Phraya River. Controlling elements and features are the same as in the previous cases.

1.6.2 Green-belt Areas

In contrast to built-up areas, the green-belt area refers to vacant land or open space that can be utilized for agricultural purposes, public parks, exercising fields or reserved in its natural state as woods, swamps or simply vacant land. The green-belt area requires legal zoning of lands to keep productive agricultural areas from being diverted to other uses. Bangkok has about 140,000 rai of green-belt areas on the eastern and western parts of the metropolis.

1.6.3 The Bang-Ka-Chao Area

The Bang-Ka-Chao area covers 9,000 rai of land in Samut Prakan Province, south of Bangkok. Physically, it appears to meander along the Chao Phraya River. Most of the land is used for fruit gardening. The primary means of transportation is via waterways that also cater to the need of fruit gardening. Building codes have been enforced to preserve this agricultural area from urban development.

1.7 Bangkok Comprehensive Plan

A comprehensive plan is an important instrument affecting the appearance of the city, land utilization, and transport and communication systems. The present BMR's Comprehensive Plans consists of nine individual master plans covering Bangkok and its surrounding regions:

- Bangkok Metropolitan Area,
- Samut Prakan Province,

- Nonthaburi Province,
- Pathum Thani Province,
- Prachatipat-Klong Luang Area,
- Krathum Baen Area,
- Nakhon Pathom Province,
- Orm Yai Settlement area.

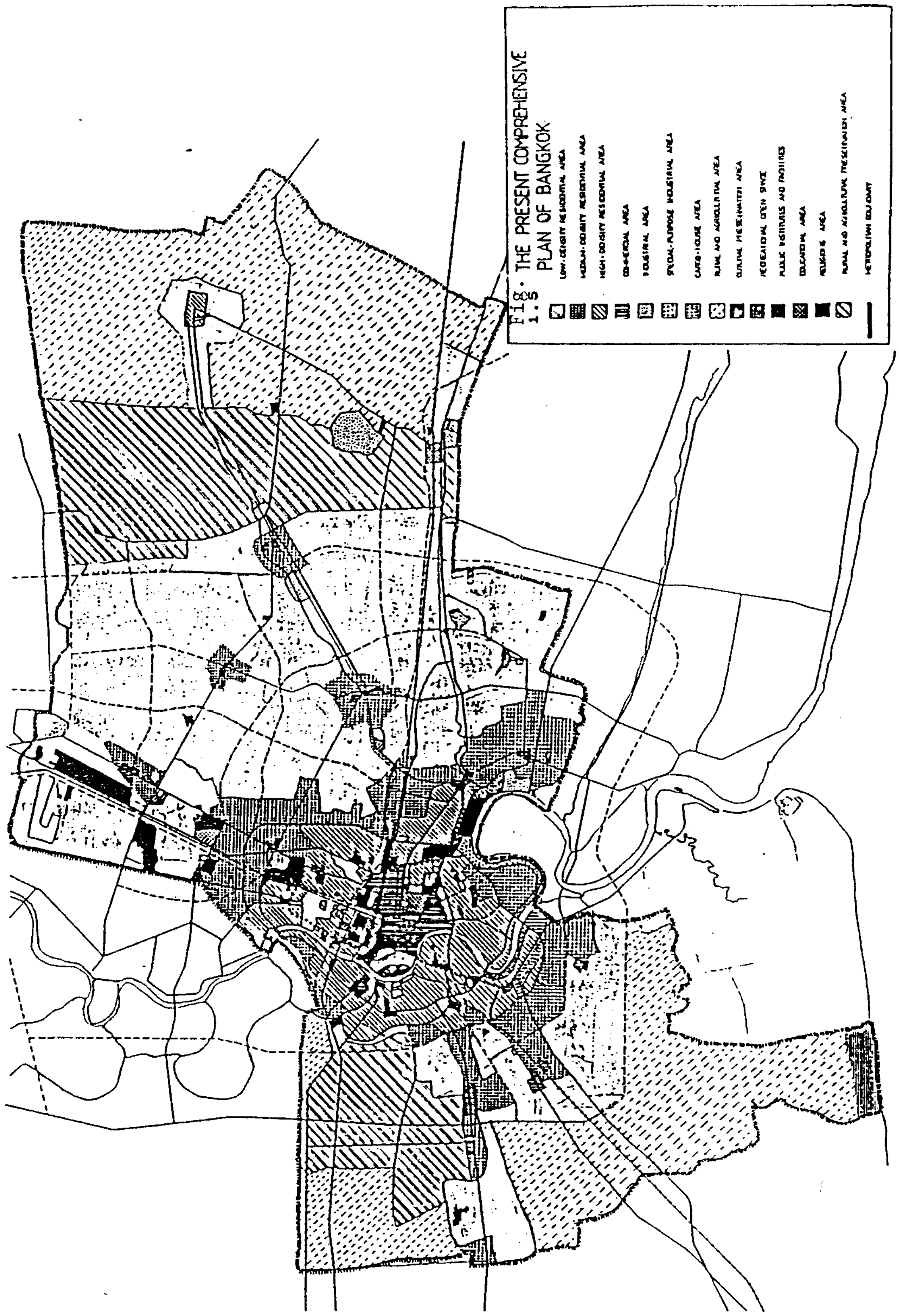
The BMA Comprehensive Plan, effective since July 1992, covers an area of 1,568.7 square kilometers, with a targeted population of 7.5 million for the year 2000 (figure 1.5). The concepts behind the BMA Comprehensive Plan are:

1) Suburban agricultural lands are preserved by confining development to prescribed city boundary limits and requiring self-sufficiency for its own future needs.
2) The majority of development projects will be confined within the outer city ring and flood prevention areas.
3) The pattern of future development will be that of multiple nuclei.
4) Industries will be distributed into the outer city districts of Bangkok and its surrounding regions, retaining only the cottage and service industries which are pollution-free.
5) The development process will be controlled in flooding areas and areas with subsidence problem.

The problems of the present BMA Comprehensive Plan can be summarized as follows:

1) Outdated data, from as far back as 1981, were used as bases for assembling the plan. As a result, it cannot accurately reflect the present state of the economy and society. The estimated population size of 7.5 million for the year 2000 is likely to be an underestimation. Therefore, significant variations between the actual case and the plan projections can complicate efforts to establish land requirements and allowable density rates for various kinds of land uses.

2) There is no systematic collaboration in designing the BMA Comprehensive Plan and the comprehensive plans for the Bangkok Metropolitan Region.



Source : DTCP

3) The BMA Comprehensive Plan does not conform to a polycentric type of planning. Land utilization is assumed to remain substantially unchanged. Only the expansions of some areas are examined. The plan tends to be unable to resolve the present traffic congestion problem and will not spread growth from the center.

4) The permissible uses for individual plots of land are not consistent with their size and price variations measured in terms of the distance from major roads -- the greater the distance from the major road, the cheaper the price of that particular plot of land. This inconsistency will create problems when the Plan is enforced. There will be problems associated with traveling across zones to obtain services in other zones as a result of land use restrictions.

5) Regulating density rates for certain forms of land utilization are inconsistent with the current rapid changes in housing and land prices. Traffic congestion has led to changing lifestyles and shifts toward residential condominiums with much smaller floor space and higher density. This, in turn, has led to the need for more public parks. The plan, however, is not flexible enough to cater to changing needs.

6) The designation of green-belt zones with low population density has received the most public objection. This objection reacted to the arbitrary nature of the control that limits the variety of possible land uses, especially those uses yielding the highest rate of return. This is particularly true for the current high land price situation. Since agricultural lands have become deteriorated due to the lack of proper soil maintenance, the farmers are unable to rely solely on agriculture. This often results in farmers selling their lands to property developers, investors, and land speculators.

7) Exemptions, permitting uses other than prescribed for a certain zone, are allowed up to 10 percent of the total land area in any bloc. These exemptions have posed problems in practice due to the lack of information on land usage in individual plots of land. Vacancy rates between individual users are, therefore, difficult to determine. This has kept the Bangkok Metropolitan Administration, the local controlling body of the Plan, from being able to perform its assigned tasks.

8) Roads proposed in the plan tend to encounter difficulties as a result of the inability to enact legislation controlling construction on both sides of them, the inability to procure financing for the expropriation of necessary lands, and the inability to strictly enforce the directions in which the planned roads will lead. The length and the number of these projected roads are too short and too few to make any real impact. It would be

more practical to divide the total area into blocs that would better suit the rapid growth of the city.

9) This Comprehensive Plan does not reflect the rapid urbanization resulting from economic, social, and technological advances. Bangkok in the next decade is planned to be stable, scattered, and inefficient in terms of land utilization. This is similar to the present form of horizontal expansion towards the suburbs and city boundaries that is characterized by the lack of regulations governing the height of high-rise buildings, the lack of adequate infrastructure provision for high-rise buildings, the unresolved problem of high-rise buildings scattered in low-density areas, and the lack of an industrial promotion zone for small-scale industries in the outer city districts.

Although it has several problems, the Bangkok Comprehensive Plan is now in effect. The plan needs to be revised, however. There is a high probability that it will be revised very soon since there have been a number of critiques from both developers and planners. Thus, the effect of this master plan on future development of Bangkok may only be temporary.

1.8 Population Distribution in the BMR

The distributions of population at the district level of the BMR are presented in Table 1.6 and Figures 1.6 and 1.7. The districts with highest population density (more than 30,000 persons/sq. km.) are Pom Prab, Samphan Thawong, and Thon Buri. The districts with high population density (10,001-30,000 persons/sq. km.) include Pranakorn, Pathumwan, Bangrak, Sathorn, Bang Kor Laem, Dusit, Bang Sue, Phayathai, Ratcha Thaewee, Huay Kwang, Klong Toei, Klong Sarn, Bangkok Noi, Bang Plad, and Bangkok Yai. The districts with moderate population density include Don Muang, Muang Nontaburi, Bangkapi, Lad Phrao, Phasi Charoen, Chom Thong, Ratburana, Prapadaeng, and Prakanong.

In terms of population change, the districts with highest population growth rates are Bang Bua Thong, Prapadaeng, and Bung Khum (more than 36%), following by Pak Kret, Muang Nontaburi, Don Muang, Bang Khen, Min Buri, Lam Lukka, Lad Phrao, Prakanong, Bang Pli, Taling Chan, Nong Kaem, Bang Khum Tien, and Kra Thum Ban (13-35%).

Table 1.6
Population Density and Change at the District Level of the BMR

Area code	District	Area (sq.km.)	No. of Pop. 1987 (prs.)	Density (prs./sq.km.)	No. of Pop. 1991 (prs.)	Density (prs./sq.km.)	Growth Rate (%)	Population Change (%)
1.1	Phra Nakhon	5.54	104,791	18,915	90,522	16,340	-3.40	-13.62
1.2	Pom Prap Sattru Phai	1.93	83,412	43,219	86,297	44,713	0.86	3.46
1.3	Samphanthawong	1.42	50,089	35,274	46,281	32,592	-1.90	-7.60
1.4	Pathum Wan	8.37	145,110	17,337	138,071	16,496	-1.21	-4.85
1.5	Bang Rak	5.54	88,554	15,984	85,420	15,419	-0.88	-3.54
1.6	Yan Nawa	16.66	114,321	6,862	110,129	6,610	-0.92	-3.67
1.7	Sathorn	9.93	152,656	15,373	142,095	14,310	-1.73	-6.92
1.8	Bang Ko Laem	13.92	147,258	10,579	150,288	10,797	0.51	2.06
1.9	Dusit	10.65	264,736	24,858	175,663	16,494	-8.41	-33.65
1.10	Bang Sue	11.56	297,243	25,713	189,873	16,425	-9.03	-36.12
1.11	Phaya Thai	10.27	231,659	22,557	201,261	19,597	-3.28	-13.12
1.12	Ratcha Thaewee	7.47	119,121	15,947	95,175	12,741	-5.03	-20.10
1.13	Huay Kwang	22.68	262,262	11,564	266,604	11,755	0.41	1.66
1.14	Phrakanong	45.92	182,910	3,983	209,461	4,561	3.63	14.52
1.15	Khlong Toei	22.83	280,582	12,290	251,431	11,013	-2.60	-10.39
1.16	Pra Wet	74.81	187,080	2,501	205,906	2,752	2.52	10.06
1.17	Bang Khen	76.62	186,668	2,436	221,274	2,888	4.63	18.54
1.18	Don Muang	59.79	195,544	3,271	235,155	3,933	5.06	20.26
1.19	Jatujak	32.91	199,026	6,048	207,239	6,297	1.03	4.13
1.20	Bangkapi	48.91	201,918	4,128	235,495	4,815	4.16	16.63
1.21	Lad Phrao	30.48	110,162	3,614	120,732	3,961	2.40	9.59
1.22	Bung Koom	69.99	130,340	1,862	188,789	2,697	11.21	44.84
1.23	Nong Jok	236.26	60,142	255	61,682	261	0.64	2.56
1.24	Min Buri	174.33	81,110	465	100,618	577	6.01	24.05
1.25	Lad Krabang	123.86	63,875	516	68,926	556	1.98	7.91
1.26	Thon Buri	8.63	274,949	31,860	259,345	30,052	-1.42	-5.68
1.27	Khlong San	6.05	146,781	24,261	121,780	20,129	-4.26	-17.03
1.28	Bangkok Noi	10.52	151,382	14,390	160,168	15,225	1.45	5.80
1.29	Bang Phlad	12.80	145,942	11,402	143,567	11,216	-0.41	-1.63
1.30	Bangkok Yai	6.18	108,171	17,503	102,600	16,602	-1.29	-5.15
1.31	Phasi Charoen	53.95	236,572	4,385	261,432	4,846	2.63	10.51
1.32	Bang Khun Thien	155.94	109,466	702	130,546	837	4.81	19.26
1.33	Chom Thong	25.73	180,699	7,023	174,976	6,800	-0.79	-3.17
1.34	Taling Chan	79.70	98,552	1,237	126,205	1,584	7.01	28.06
1.35	Rat Burana	42.87	154,177	3,596	169,036	3,943	2.41	9.64
1.36	Nong Khaem	48.28	65,822	1,363	86,439	1,790	7.83	31.32
2.1	Muang Nakhon Pathom	401.96	214,677	534	228,342	568	1.59	6.37
2.2	Nakhon Chaisri	325.10	93,545	288	99,144	305	1.50	5.99
2.3	Sam Phran	240.12	96,815	403	105,590	440	2.27	9.06
2.4	Bang Len	770.58	79,099	103	82,081	107	0.94	3.77
2.5	Kamphaeng Saen	275.00	99,005	360	103,995	378	1.26	5.04
2.6	Don Tum	165.00	36,377	220	38,030	230	1.14	4.54
3.1	Muang Samut Sakhon	480.13	168,387	351	179,690	374	1.68	6.71
3.2	Krathum Baen	132.00	81,977	621	92,853	703	3.32	13.27
3.3	Ban Phaeo	239.10	83,806	351	85,612	358	0.54	2.15

Table 1.6 (Continued)
Population Density and Change at the District Level of the BMR

Area code	District	Area (sq.km.)	No. of Pop. 1987 (prs.)	Density (prs./sq.km.)	No. of Pop. 1991 (prs.)	Density (prs./sq.km.)	Growth Rate (%)	Population Change (%)
4.1	Muang Nonthaburi	76.87	252,425	3,284	295,699	3,847	4.29	17.14
4.2	Bang Bua Thong	114.59	37,992	332	66,414	580	18.70	74.81
4.3	Pak Kret	83.84	129,579	1,546	154,829	1,847	4.87	19.49
4.4	Bang Kruai	60.64	71,514	1,179	77,286	1,274	2.02	8.07
4.5	Bang Yai	96.18	38,238	398	40,632	422	1.57	6.26
4.6	Sai Noi	185.63	32,693	176	33,900	183	0.92	3.69
5.1	Muang Pathum Thani	119.89	82,876	691	91,449	763	2.59	10.34
5.2	Sam Khok	94.76	38,567	407	38,868	410	0.20	0.78
5.3	Lat Lum Kaeo	190.58	34,341	180	35,201	185	0.63	2.50
5.4	Thanyaburi	111.88	75,679	676	83,029	742	2.43	9.71
5.5	Lam Luk Ka	299.87	73,158	244	84,311	281	3.81	15.25
5.6	Khlong Luang	298.45	72,180	242	79,788	267	2.64	10.54
5.7	Nong Sua	412.73	38,392	93	40,047	97	1.08	4.31
6.1	Muang Samut Prakan	281.82	359,072	1,274	433,698	1,539	5.20	20.78
6.2	Phra Pradaeng	65.58	181,687	2,770	260,367	3,970	10.83	43.31
6.3	Bang Phli	323.88	118,553	366	151,080	466	6.86	27.44
6.4	Bang Bo	219.00	82,593	377	85,696	391	0.94	3.76

Source : Registration Division, Ministry of Interior

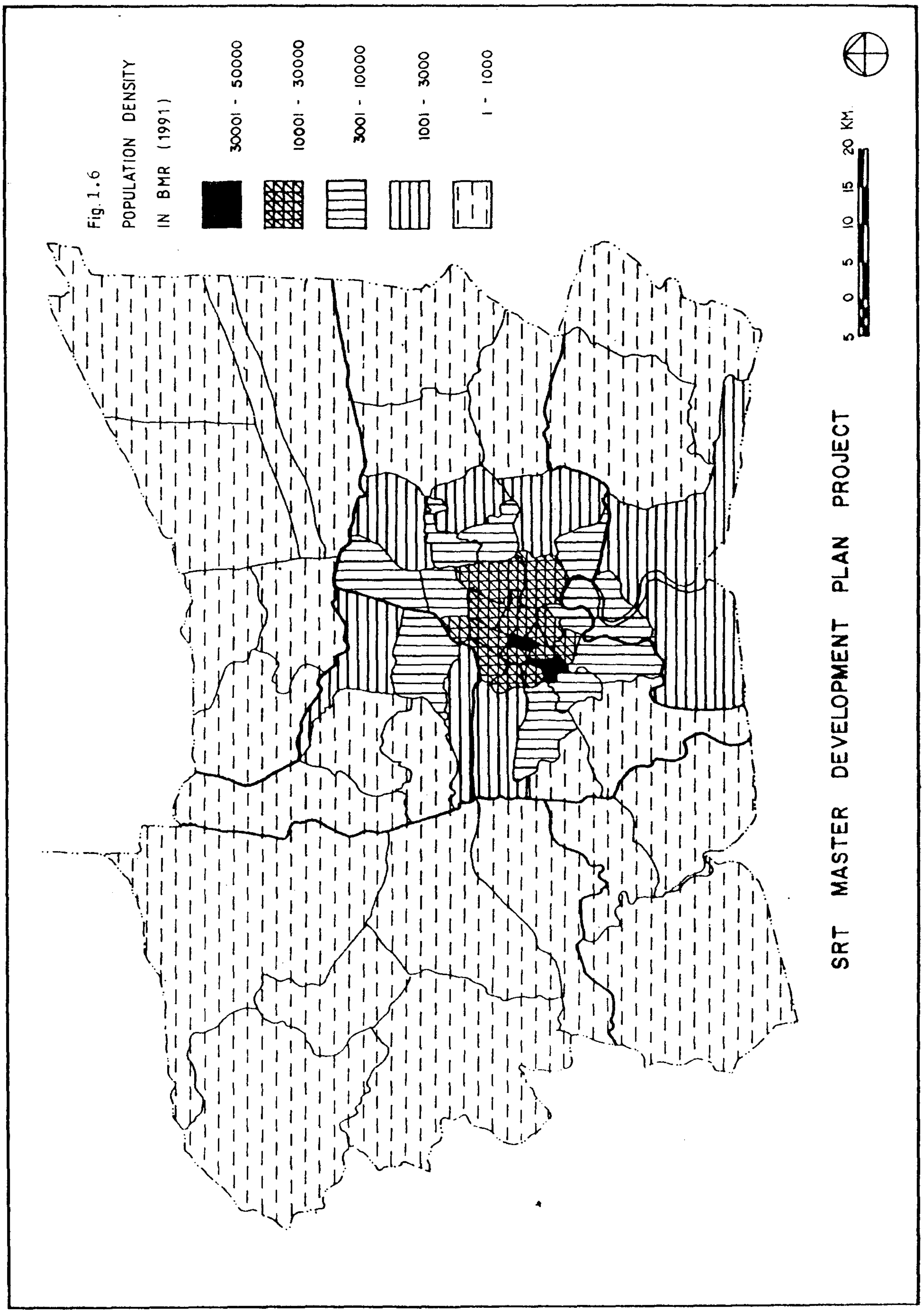


Fig. 1.6
POPULATION DENSITY
IN BMR (1991)
30001 - 50000
10001 - 30000
3001 - 10000
1001 - 3000
1 - 1000
5 0 5 10 15 20 KM.
SRT MASTER DEVELOPMENT PLAN PROJECT

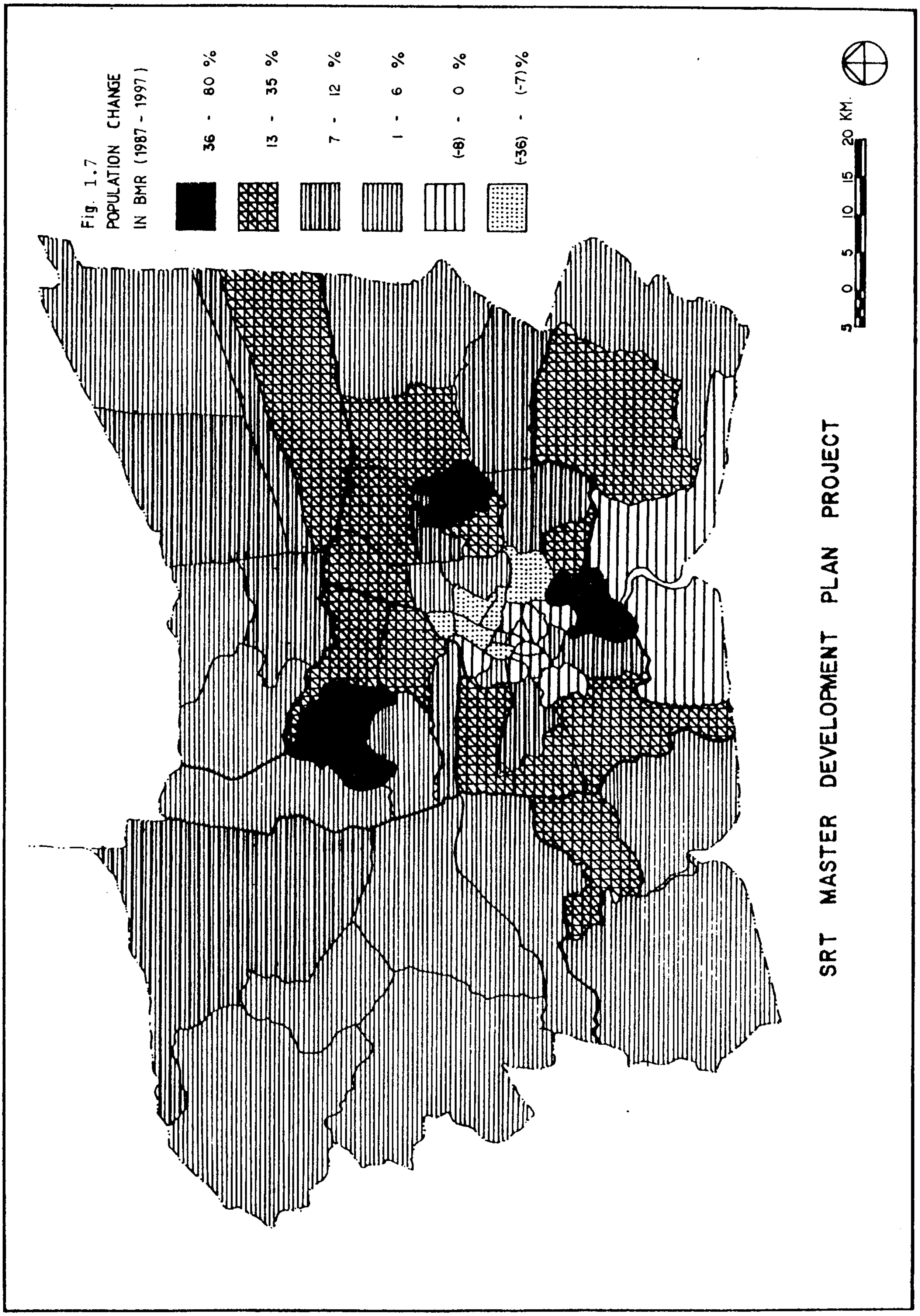


Fig. 1.7
POPULATION CHANGE
IN BMR (1987 - 1997)

It is obvious that the outer city districts and suburbs of Bangkok are now absorbing more urban population, while the inner city districts with high population density are losing population. This may due to the improvement of public infrastructure, especially transportation in the outer city areas, and the extremely high land prices of the inner city areas that makes it very difficult for most people to afford housing. The expansion of urban development in the outer city areas and suburbs will require a better public transportation system to allow people to commute to the CBD's and business centers. Since traffic congestion is now a serious problem, it is likely that mass rapid transportation will be required in these areas in the next few years.

1.9 Housing Development in the BMR

Table 1.7 and Figure 1.8 show the number of housing units registered in the BMR between 1987 and 1991 at the district level. Although the data for many districts are not available, they still provide a clear picture of housing development in Bangkok and its surrounding areas. The districts with highest number of housing units registered are Bangkapi, Bang Khen, and Muang Samut Prakan, following by Muang Nontaburi and Phasi Charoen. The districts with moderate number of housing units registered are Pak Kret, Don Muang, Min Buri, Bung Khum, Bang Pli, Taling Chan, Nong Kaem, Bang Khun Tien, Ratburana, and Prapadaeng.

Table 1.8 shows the type of housing units registered in 1991. Of the 129,981 housing units registered, 50% are housing complexes while 30% are flats and condominiums. Only 20% of them are self-constructed housing. This situation indicates that people tend to live more densely in the BMR. It is the result of the rapid increases in land prices and construction costs during the recent years.

1.10 Population Changes Outside the BMR

Table 1.9 and Figure 1.9 show population change at the district level in the commuter train service provinces outside the BMR. Half of the districts with high population growth rates are remote low-density districts (Thong Pha Phum, Sangkla Buri, Ko Si Chang). Only Bang Lamung, Phanat Nikom, and Nong Khae are developed areas that are served by commuter train. The districts with moderate population growth rate cluster around Kanchanaburi, Saraburi, Prachin Buri, Chon Buri, and Rayong. Except for the ones in the Eastern Seaboard Region, these districts are less developed, low-density areas.

Table 1.7
Number of Housing Units Registered in BMA and BMR by districts in 1987-1991

Area code	District	No. of Housing Unit (1987-1991)
1.1	Phra Nakhon	1,181
1.2	Pom Prap Sattru Phai	230
1.3	Samphanthawong	527
1.4	Pathum Wan	863
1.5	Bang Rak	581
1.6	Yan Nawa	5,839
1.7	Sathorn	840
1.8	Bang Ko Laem	1,554
1.9	Dusit	4,995
1.10	Bang Sue	1,956
1.11	Phaya Thai	4,408
1.12	Ratcha Thaewee	1,357
1.13	Huay Kwang	9,434
1.14	Phrakanong	29,825
1.15	Khlong Toei	5,526
1.16	Pra Wet	9,450
1.17	Bang Khen	36,757
1.18	Don Muang	9,749
1.19	Jatujak	3,398
1.20	Bangkapi	46,431
1.21	Lad Phrao	6,370
1.22	Bung Koom	16,324
1.23	Nong Jok	3,168
1.24	Min Buri	12,220
1.25	Lad Krabang	5,285
1.26	Thon Buri	2,788
1.27	Khlong San	1,506
1.28	Bangkok Noi	6,846
1.29	Bang Phlad	2,652
1.30	Bangkok Yai	1,671
1.31	Phasi Charoen	23,924
1.32	Bang Khun Thien	12,126
1.33	Chom Thong	5,920
1.34	Taling Chan	16,689
1.35	Rat Burana	11,860
1.36	Nong Khaem	12,712

Table 1.7 (Continued)
Number of Housing Units Registered in BMA and BMR by districts in 1987-1991

Area code	District	No. of Housing Unit
		(1987-1991)
*3.1	Muang Samut Sakorn	2,559
4.1	Muang Nonthaburi	22,742
*4.2	Bang Bua Thong	8,975
4.3	Pakkret	8,077
4.4	Bang Kruay	5,530
*4.5	Bang Yai	6,075
5.1	Muang Pathumthani	12,996
*5.2	Sam Kok	150
*5.4	Thanya Buri	2,552
*5.5	Lam Luk Ka	7,482
*5.7	Nong Sua	381
6.1	Muang Samut Prakarn	38,028
6.2	Phra Pra Daeng	13,851
6.3	Bang Phli	14,677
*6.4	Bang Bo	1,165
	Total	462,202

Source: The Government Housing Bank.
Remark: * 1990-1992 Approximated Data.

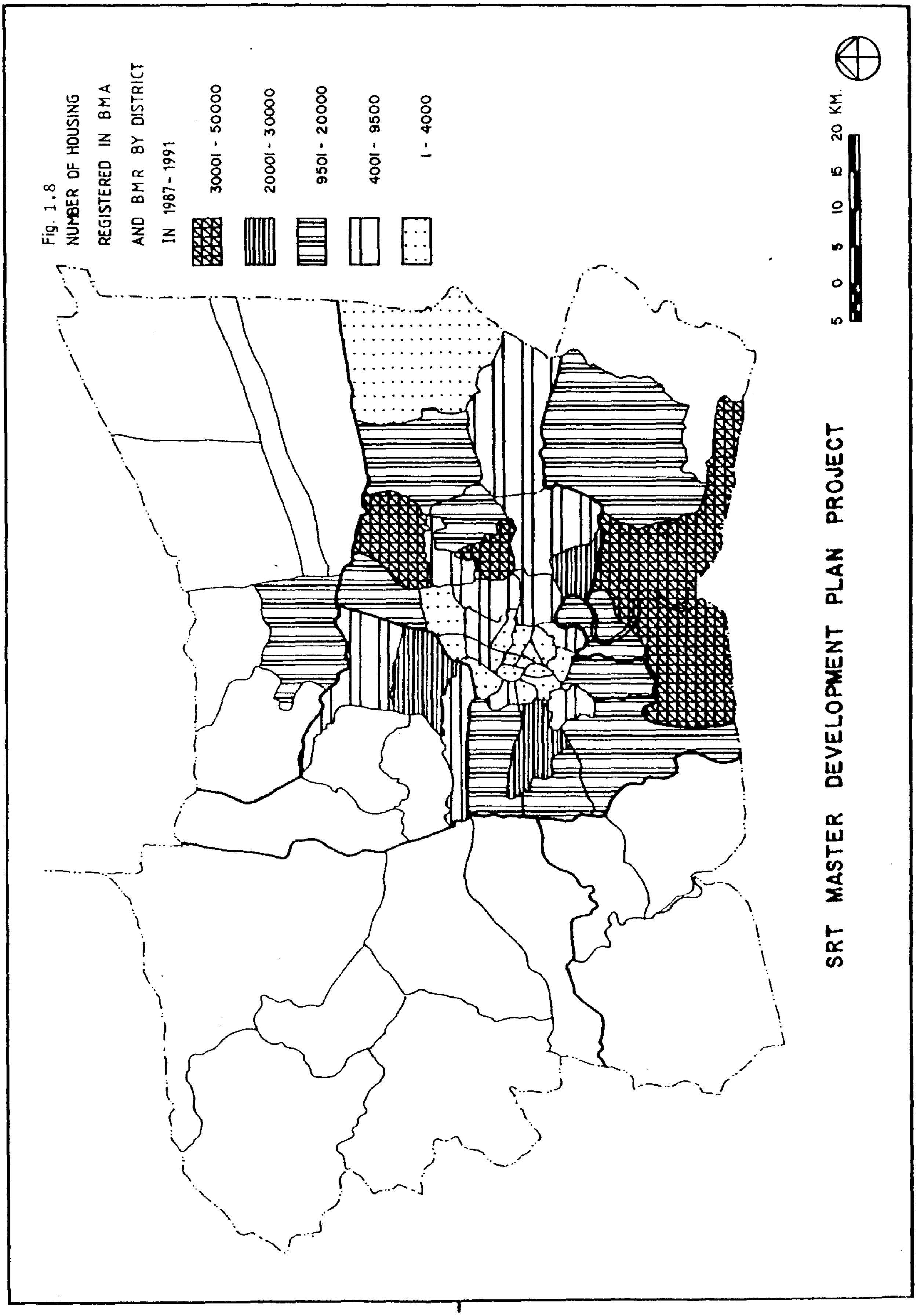


Fig. 1.8
NUMBER OF HOUSING
REGISTERED IN BMA
AND BMR BY DISTRICT
IN 1987-1991
30001 - 50000
20001 - 30000
9501 - 20000
4001 - 9500
1 - 4000
5 0 5 10 15 20 KM.
SRT MASTER DEVELOPMENT PLAN PROJECT

Table 1.8
Number of Housing Units Registered in BMA and BMR by Type in 1991

Area Code	District	Type of Housing Units: Self-constructed	Housing Complex	Flat, Condominium	Total
1.1	Phra Nakhon	48	559	170	777
1.2	Pom Prap Sattru Phai	11	42		53
1.3	Samphanthawong	7	42		49
1.4	Pathum Wan	21	8	377	406
1.5	Bang Rak	13	38		51
1.6	Yan Nawa	103	149	334	586
1.7	Sathorn	62	45	71	178
1.8	Bang Ko Laem	144	361		505
1.9	Dusit	253	279	219	751
1.10	Bang Sue	245	624		869
1.11	Phaya Thai	164	29	663	856
1.12	Ratcha Thaewee	29	103	851	983
1.13	Huay Kwang	288	1,158	1,938	3,384
1.14	Phrakanong	665	1,490	1,504	3,659
1.15	Khlong Toei	229	191	2,978	3,398
1.16	Pra Wet	1,058	1,248	3,384	5,690
1.17	Bang Khen	906	3,141	1,929	5,976
1.18	Don Muang	431	2,958	2,386	5,775
1.19	Jatujak	626	485	628	1,739
1.20	Bangkapi	742	2,296	7,716	10,754
1.21	Lad Phrao	380	2,242	979	3,601
1.22	Bung Koom	1,394	3,533	2,222	7,149
1.23	Nong Jok	464	463		927
1.24	Min Buri	968	2,237	57	3,262
1.25	Lad Krabang	905	683	275	1,863
1.26	Thon Buri	115	234		349
1.27	Khlong San	65	189		254
1.28	Bangkok Noi	281	458	102	841
1.29	Bang Phlad	228	724	540	1,492
1.30	Bangkok Yai	161	288		449
1.31	Phasi Charoen	853	5,765	56	6,674
1.32	Bang Khun Thien	542	1,856		2,398
1.33	Chom Thong	255	1,872	941	3,068
1.34	Taling Chan	2,016	2,781	128	4,925
1.35	Rat Burana	1,666	1,863		3,529
1.36	Nong Khaem	810	2,132		2,942
4.1	Muang Nonthaburi	1,214	5,222	3,459	9,895
4.3	Pak Kret	389	656	837	1,882
4.4	Bang Kruai	370	551	57	978
5.1	Muang Pathum Thani	703	1,177	1,058	2,938
6.1	Muang Samut Prakan	3,846	13,675		17,521
6.2	Phra Pradaeng	1,112	438	2,518	4,068
6.3	Bang Phli	1,269	854	414	2,537
	Total	26,051	65,139	38,791	129,981

Source : The Government Housing Bank.

Table 1. 9
Population Change at District Level of the Commuter Train Service Area
(Excluding the BMR)

Area Code	District	No.of Pop. 1987	No. of Pop. 1991	Pop. Change 1987-1991 (%)
7.1	Phra Nakhon Si Ayutthaya	118,412	121,435	2.55
7.2	Bang Ban	34,000	34,980	2.88
7.3	Phak Hai	45,989	45,675	-0.68
7.4	Bang Sai	19,380	19,889	2.63
7.5	Sena	58,833	60,793	3.33
7.6	Lat Bua Luang	31,268	33,354	6.67
7.7	Bang Sai	42,862	44,460	3.73
7.8	Ban Phraek	9,282	9,478	2.11
7.9	Maha Rat	23,280	23,493	0.91
7.10	Bang Pahan	35,918	36,759	2.34
7.11	Nakhon Luang	32,405	33,088	2.11
7.12	Tha Rua	50,929	51,904	1.91
7.13	Phachi	29,103	29,684	2.00
7.14	Uthai	36,198	37,885	4.66
7.15	Bang Pa-in	60,806	64,543	6.15
7.16	Wang Noi	39,946	43,655	9.29
8.1	Muang Suphan Buri	139,991	145,166	3.70
8.2	U Thong	123,434	128,674	4.25
8.3	Song Phi Nong	121,981	126,421	3.64
8.4	Bang Pla Ma	88,647	89,343	0.79
8.5	Si Prachan	63,890	65,271	2.16
8.6	Don Chedi	44,080	44,940	1.95
8.7	Sam Chuk	56,244	57,491	2.22
8.8	K.Nong Ya Sai	43,716	46,011	5.25
8.9	Doembang Nangbuat	75,416	77,090	2.22
8.10	Dan Chang	46,652	53,209	14.06
9.1	Muang Kanchanaburi	150,491	143,565	-4.60
9.2	Sai Yok	31,633	35,707	12.88
9.3	Thong Pha Phum	15,451	22,047	42.69
9.4	Sangkhla Buri	8,561	10,830	26.50
9.5	Si Sawat	15,829	17,993	13.67
9.6	Bo Phloi	66,289	74,089	11.77
9.7	Lao Khwan	47,142	52,058	10.43
9.8	Phanom Thuan	77,667	82,681	6.46
9.9	Tha Muang	98,949	104,665	5.78
9.10	Tha Maka	131,792	119,098	-9.63

Table 1. 9 (Continued)

Area Code	District	No.of Pop. 1987	No. of Pop. 1991	Pop. Change 1987-1991 (%)
10.1	Muang Ratchaburi	166,429	174,348	4.76
10.2	Ban Pong	136,442	143,446	5.13
10.3	Photharam	115,533	108,354	-6.21
10.4	Bang Phae	39,003	40,833	4.69
10.5	Damnoen Saduak	94,758	95,636	0.93
10.6	Wat Phleng	11,407	11,147	-2.28
10.7	Pak Tho	49,069	51,188	4.32
10.8	Chom Bung	48,747	50,149	2.88
10.9	Suan Phung	38,034	40,409	6.24
11.1	Muang Samut Songkhram	99,119	102,467	3.38
11.2	Bang Khonthi	38,675	37,813	-2.23
11.3	Amphawa	66,342	65,871	-0.71
12.1	Muang Lop Buri	245,656	257,462	4.81
12.2	Tha Wung	49,759	50,715	1.92
12.3	Ban Mi	78,732	86,851	10.31
12.4	Khok Samrong	137,826	144,948	5.17
12.5	Phatthana Nikhom	51,813	53,815	3.86
12.6	Tha Luang	22,157	24,323	9.78
12.7	Chai Badan	104,897	111,051	5.87
12.8	Sa Bot	23,564	24,445	3.74
13.1	Muang Saraburi	118,866	128,595	8.18
13.2	Wihan Daeng	31,245	32,421	3.76
13.3	Nong Khae	69,423	80,398	15.81
13.4	Nong Saeng	15,820	15,835	0.09
13.5	Sao Hai	25,498	25,697	0.78
13.6	Ban Mo	46,259	46,936	1.46
13.7	K.Don Put	6,292	6,308	0.25
13.8	Nong Don	13,459	13,834	2.79
13.9	Phra Phutthabat	47,100	52,651	11.79
13.10	Kaeng Khoi	75,736	74,607	-1.49
13.11	Muak Lek	60,052	62,673	4.36
14.1	Muang Nakhon Nayok	86,362	92,137	6.69
14.2	Ban Na	59,268	62,434	5.34
14.3	Ongkharak	46,664	49,176	5.38
14.4	Pak Phli	26,087	26,480	1.51
15.1	Muang Prachin Buri	101,072	81,190	-19.67
15.2	Ban Sang	32,020	31,963	-0.18
15.3	Khok Pip	17,573	17,700	0.72
15.4	Si Maha Phot	53,230	55,082	3.48

Table 1. 9 (Continued)

Area Code	District	No.of Pop. 1987	No. of Pop. 1991	Pop. Change 1987-1991 (%)
15.5	Prachantakham	49,425	50,968	3.12
15.6	Na Di	37,846	40,570	7.20
15.7	Kabin Buri	106,523	107,098	0.54
15.8	Sa Kaeo	131,745	142,808	8.40
15.9	Wang Nam Yen	76,687	87,694	14.35
15.10	Watthana Nakhon	106,417	116,061	9.06
15.11	Ta Phraya	52,419	57,863	10.39
15.12	Aranyaprathet	68,013	57,466	-15.51
16.1	Muang Chachoengsao	129,293	132,062	2.14
16.2	Bang Pakong	71,377	74,724	4.69
16.3	Ban Pho	44,605	45,449	1.89
16.4	Bang Nam Prieo	70,039	73,519	4.97
16.5	Bang Khla	59,769	61,131	2.28
16.6	K.Ratchasan	11,988	12,372	3.20
16.7	Phanom Sarakham	71,292	74,601	4.64
16.8	Plaeng Yao	28,402	31,308	10.23
16.9	Sanam Chai Khet	64,021	56,306	-12.05
17.1	Muang Chon Buri	207,643	208,558	0.44
17.2	Si Racha	123,973	137,126	10.61
17.3	Bang La Mung	104,547	125,576	20.11
17.4	Sattahip	93,169	104,657	12.33
17.5	Phan Thong	41,966	44,816	6.79
17.6	Phanat Nikhom	126,487	147,883	16.92
17.7	Ban Bung	80,276	80,269	-0.01
17.8	Nong Yai	20,381	21,212	4.08
17.9	Bo Thong	34,419	37,692	9.51
17.10	K.Ko Si Chang	3,450	4,086	18.43
18.1	Muang Rayong	139,110	150,906	8.48
18.2	Ban Chang	44,558	45,951	3.13
18.3	Ban Khai	77,092	79,107	2.61
18.4	Pluak Daeng	32,386	32,711	1.00
18.5	Klaeng	125,479	132,907	5.92
18.6	K.Wang Chan	16,999	18,253	7.38

Source: Registration Division, Ministry of Interior.

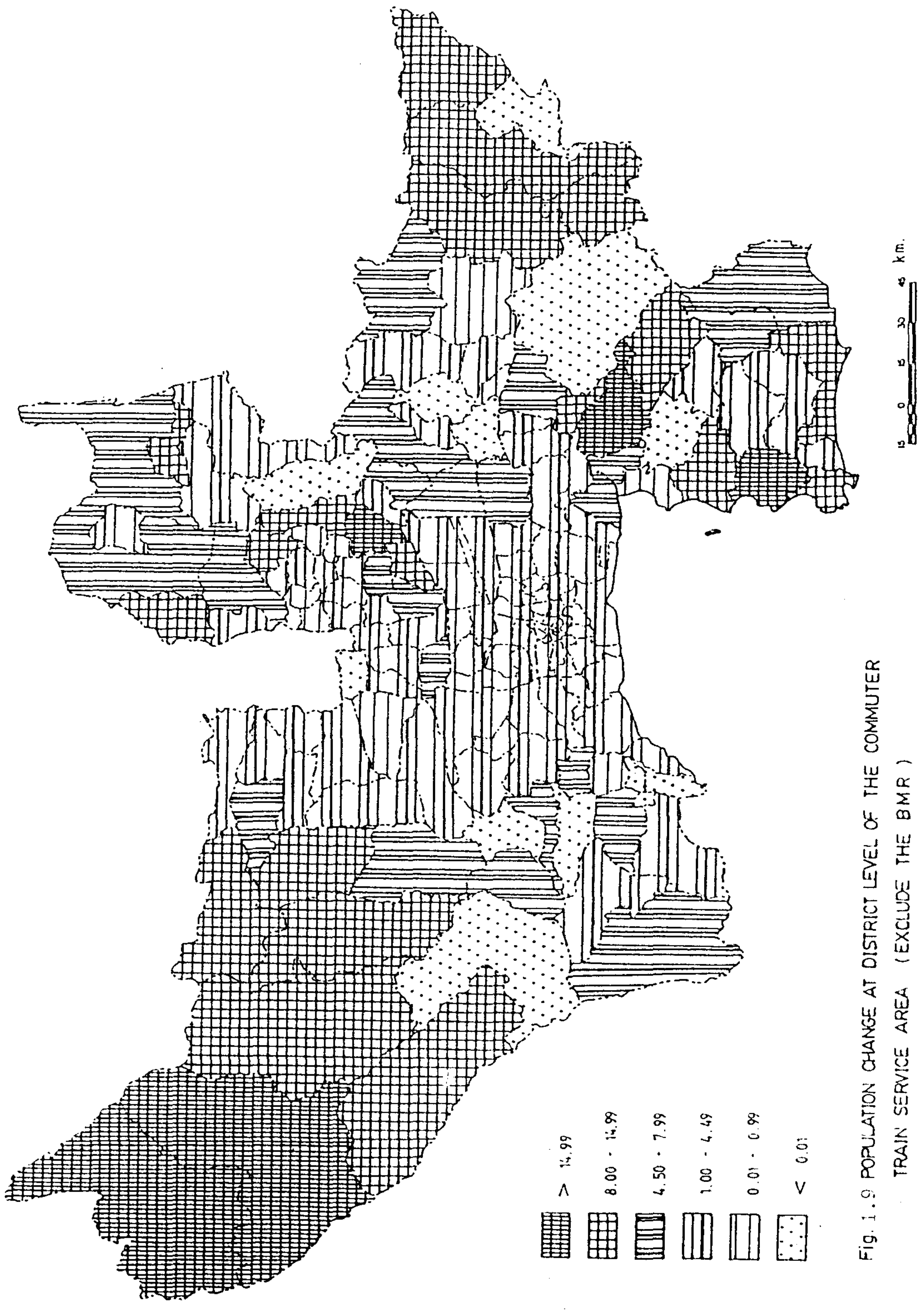


Fig. 1.9 POPULATION CHANGE AT DISTRICT LEVEL OF THE COMMUTER TRAIN SERVICE AREA (EXCLUDE THE BMR)

1.11 National Urban Development Policies

National urban development policies obviously affect the growth of Bangkok and its surrounding regions. The concept of regional cities was introduced in the Third National Economic and Social Development Plan. As a result, a large amount of budget were distributed to the regional growth centers for infrastructure development.

Although the concept of regional growth centers was elaborated in the Fourth and Fifth National Economic and Social Development Plans, the economic and population growth of Bangkok still continued and spreaded out to its neighboring cities. The long history of centralization in terms of administration, economic, and social development still dominated urban development of the nation.

Beginning with the Sixth National Economic and Social Development Plan, urban development policies have concentrated on infrastructure development. Public investment has been reduced by promoting the role of the private sector in large-scale infrastructure development projects. Most of these projects, especially the ones aimed at solving transportation problems, have been concentrated in the BMR. The development of the Eastern Seaboard Region as an exporting zone consisting of industrial estates and deep seaports has strongly affected the growth pattern of the BMR. It is recognized in the Seventh National Economic and Social Development Plan that the metropolitan region will extend to cover the Eastern Seaboard Region in the form of an urban corridor around the eastern seacoast of the Gulf of Siam.

1.12 Major Infrastructure Development Projects in the BMR and Extended BMR

1.12.1 The Expressway Project

The expressway project is under the responsibility of the Expressway and Rapid Transit Authority of Thailand. It is now in the second stage of construction. With the completion of the second stage expressway system, there will be 6 expressway lines in Bangkok:

- Din Daeng - Port (first stage)
- Port - Bang Na (first stage)
- Port - Dao Kanong (first stage)
- Ekamai - Ram Indra (second stage)

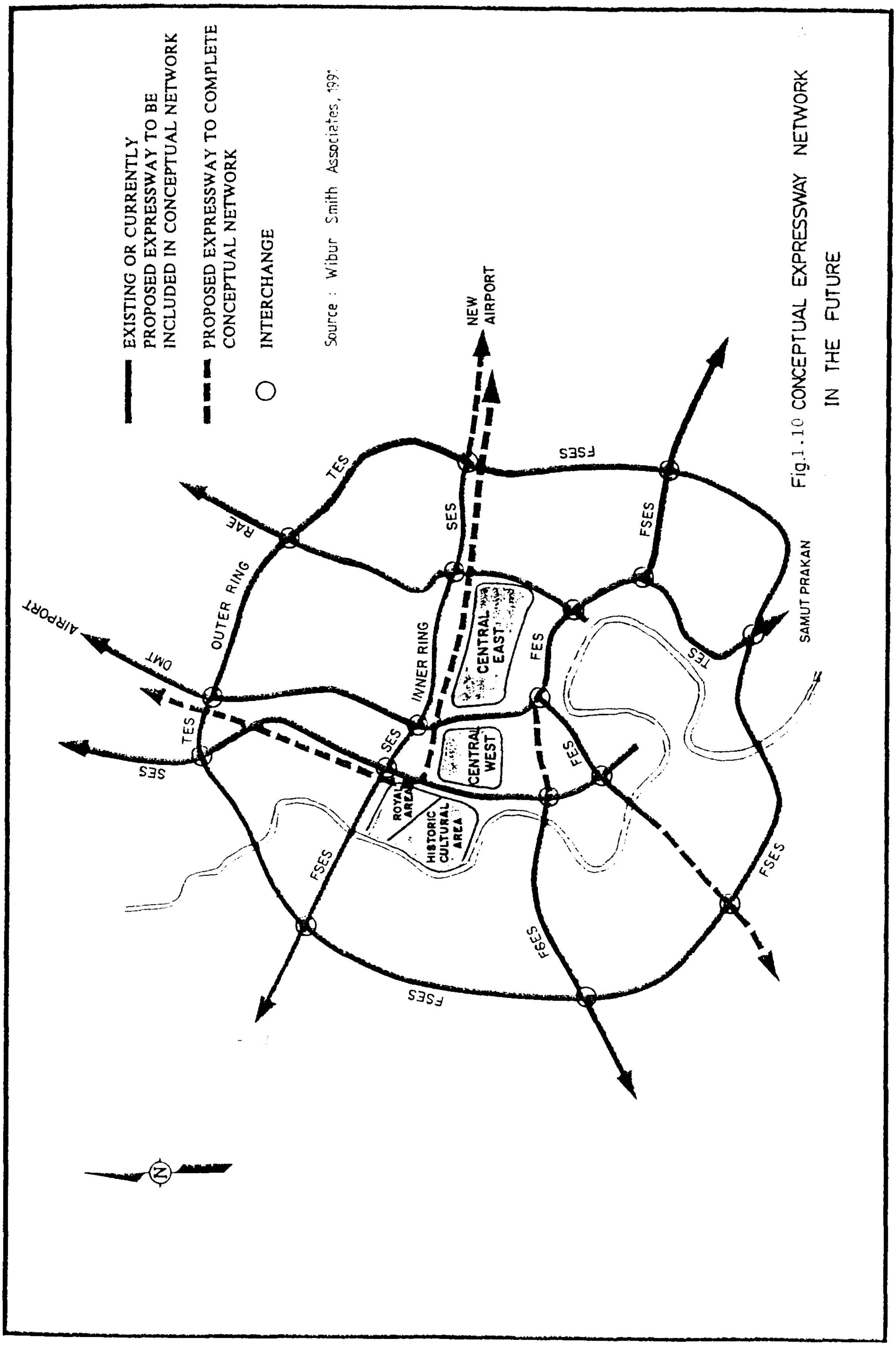


Fig.1.10 CONCEPTUAL EXPRESSWAY NETWORK IN THE FUTURE

- Bang Khlo - Chaeng Wattana (second stage)
- Phaya Thai - Sri Nakarin (second stage)

The third and fourth stage expressway systems are conceptually planned to be interconnected to form rings and radius roads around the BMR (see Figure 1.10). Completion of all the expressway systems would stimulate urban expansion in the suburbs in all directions.

1.12.2 Don Muang Tollway

The Don Muang Tollway project is under the responsibility of the Department of Highway. The project consists of 19.5 kms. of elevated highway along the Vibawadi Rangsit Highway. It connects with the first stage expressway at Din Daeng and ends at Don Muang. The project is now under construction and is scheduled to be completed in 1993.

1.12.3 Mass Rapid Transit Projects

There are three mass rapid transit projects in the BMR at the present time; the Hopewell Project under the responsibility of the SRT, the BMA Mass Transit Project under the responsibility of the BMA, and the Metropolitan Rapid Transit System under the responsibility of the Metropolitan Rapid Transit Authority (MRTA). The three systems will be further discussed in section 2.

1.12.4 Nong Ngu Hao Airport

Nong Ngu Hao Airport, the second international airport of Bangkok, is located near the Bang Na-Trad Highway (No. 34), 30 kms. east of Bangkok. It covers 20,000 rai of land. The first phase of this airport is scheduled to be completed in the year 2000, when the Don Muang International Airport is expected to reach its full capacity.

1.12.5 New Highway Projects

The Department of Highway (DOH) also has new highway projects in the BMR and Extended BMR. The projects in the period of the Seventh National Economic and Social Development Plan include:

- Eastern Ring Road (No. 340) from Bang Pa-in to Bang Pli;

- Bangkok-Chon Buri New Highway;
- Klongton Highway (No. 3344);
- Bang Bua Thong Highway (No. 3111);
- Nonthaburi Bridge-Bang Bua Thong (No. 345);
- Bang Phoon-Bang Pa-in (No. 347)
- Thanyaburi-Wang Noi (No. 3261).

1.13 Industrial Estate Projects in the BMR and Extended BMR

The scattering of industrial factories without proper controls represents an environmental hazard. The Industrial Estate Authority of Thailand (IEAT) was established to set up and operate industrial estates. The government has given special privileges to factories located in industrial estates, such as tax reductions or exemptions, the right to apply for promotional privileges from the Board of Investment (BOI), privileges regarding exports, and the granting of work permits to foreign workers. The IEAT acts as the provider of necessary basic infrastructures, including a centralized waste water disposal system.

Industrial estates are currently operating in the Bangkok Metropolitan Region, the eastern region of Thailand, and some major provinces. The increased popularity of industrial estates has resulted from incentives. The increased inflow of foreign investment into Thailand and a shift within the IEAT towards joint-investment with the private sector have led to an increase in the number of applications to industrial estates. Similarly, the Ministry of Industry has permitted the private sector to set up industrial estate look-alike compounds under different titles such as industrial parks, minifactories, and industrial condominiums. However, all industrial estate look-alike schemes must conform to the ministerial regulations and industrial standards issued and enforced by the Industrial Works Department.

The industrial estates and industrial zones in the BMR and the extended BMR are shown in Table 1.10. A large number of industrial workers in industrial complexes commute between Bangkok and the factories. Many factories provide shuttle buses for workers since there is no appropriate mass transportation system linking the capital and its surrounding region. An effective mass transportation system will be needed to serve commuter passengers who work in industrial complexes and service centers around Bangkok.

Table 1.10
Industrial Estates and Zones in the BMR and Extended BMR

Industrial Estate	Area (rai)	Entrepreneur
Bangkok		
Bangchan Industrial Estate	677	IEAT
Lad Krabang Industrial Estate	2393	IEAT
Samut Prakan		
Bang Poo Industrial Estate	3930	IEAT, private firm
Bang Pli Industrial Estate	1004	IEAT, NHA
Chachoengsao		
Bang Pakong Industrial Estate	2000	IEAT, private firm
Well Grow Industrial Estate	3000	IEAT, private firm
Gateway City Industrial Estate	6900	IEAT, private firm
Chon Buri		
Laem Chabang Industrial Estate	3556	IEAT, PAT, NHA
Chon Buri Industrial Estate	2000	IEAT, private firm
Thong Grow Industrial Estate	400	private firm
Rayong		
Mab Taphud Industrial Estate	6000	IEAT, PAT, NHA
Rayong Industrial Park	600	private firm
Saraburi		
Saraburi Industrial Park	3000	IEAT, private firm
Nong Khae Industrial Estate	4000	IEAT, private firm
Ayutthaya		
Hi-tech Industrial Estate	2150	IEAT, private firm
Bang Pa-in Industrial Estate	2000	private firm
Bang Sai Industrial Estate	2227	private firm
Nakhon Rachasima		
Saharatana Nakhon Industrial Estate	2050	private firm
Samut Sakhon		
Samut Sakhon Industrial Estate	2476	IEAT, private firm
Ekkachai Industrial Zone	930	private firm
Factory House	200	private firm
Nonthaburi		
Hi-tech Industrial Park	680	private firm

Source: The IEAT.

1.14 Urban Development Trends in the BMR over the Next Twenty Years

The momentum of rapid urban development of the BMA and its region tends to affect the growth of the region in the future. Development in the BMA and the BMR is expected to be more intense in the next twenty years. Growth will spread more beyond the BMR in all directions. Ribbon development along major roads will still exist, especially the ones leading to the Eastern Seaboard Region. The major roads along which development are expected to expand include:

- Phahol Yothin and Vibawadi Rangsit Roads in the north;
- Ram Indra, Ramkamhaeng, Sukha Phiban II, On Nut, and Bang Na-Trad Roads in the east;
- Chaeng Wattana, Rattana Thibet, Bangkok Noi-Nakon Chaisri, Petchakasem, and Pra Ram II Roads in the west;
- Sukumvit, Sri Nakarin, and Suk Sawat Roads in the south.

Over the next twenty years, the BMR is expected to become a megalopolis that accommodates about 1/5 of the nation's population. High land price will affect the development of the inner city areas. Land uses within the boundary of Rathcada Phisek Ring Road and in Klong Toei (the location of the new CBD) and Prakanong would be transformed from residential and small-scale shop-houses and office buildings to high-rise office buildings, high-income condominiums, and commercial and service centers.

In the outer city districts, the intensity of urban development is also expected to increase. Agricultural and vacant lands will be replaced with residential complexes, factories, shopping centers, and food gardens. Expensive land price will limit the lot size of housing and the unit size of condominiums. As a result, many low-density residential areas designated in the present comprehensive plan will become medium-density areas. Many large-scale real-estate projects will also occur in these areas. The high land price will continue to push the urban fringe outward. Low-income housing, therefore, will be located further away from downtown, while people will have to commute at a longer distance to work in the city center.

In the Extended BMR, the rapid urbanization process, particularly in the promoted areas such as the Eastern Seaboard Region, will also affect the urban pattern. Industrial estates, new towns, residential complexes, and entertainment areas will increase rapidly. Transportation systems linking these areas to Bangkok will form the strip of urban development between Bangkok and major urban centers in the region.

2. BANGKOK COMMUTER TRAIN SERVICES

The SRT has been commissioned to operate 75 commuter trains and 12 Airport Express trains a day -- 35 via Hua Lam Phong Central Station, 6 via Thon Buri Station, and 34 via Wong Wien Yai Station. As shown in Figure 2.1, the Bangkok commuter train network radiates from Bangkok at a distance of about 130 kilometers. During rush hours, trains arrive or depart Hua Lam Phong Central Station at a 10-minute interval, carrying some 60,000 passengers daily.

In 1991, there were 30,636,550 commuter passengers. According to the statistics available from the Information System Department, most passengers bought one-way tickets (Tables 2.1 and 2.2). Eighty-seven percent of them were general passengers who paid full price for the tickets, eight percent were students, and three percent were the SRT's employees and their children. Children and discounted passengers consisted of less than two percent of the total, while grouped passengers consisted of less than one percent.

2.1 Commuter Train Passenger-Volume

Tables 2.3 to 2.6 and Figures 2.2 to 2.5 show passenger-volume at each station for each railway line in 1991. The major part of each line where passengers traveled most can be summarized as follows.

1) The Northern Line

The passenger-volume is very high between Hua Lam Phong and Don Muang then decreases sharply. The volume is stable from Don Muang School to Klong Nung before dropping again from Chiang Rak to Ban Pho, bouncing back from Ayutthaya to Ban Phachi Junction, and dropping sharply beyond the latter station. The most important part of this line is from Hua Lam Phong Central Station to Don Muang Station.

2) The Eastern Line

The most important part of this line is between Makkasan and Hua Maak stations, followed by the part between Ban Tab Chang and Hua Ta Ke. The passenger-volumes from Chachoengsao to Prachin Buri and from Chachoengsao to Pattaya are considerably low, therefore, they are not included in the analysis.

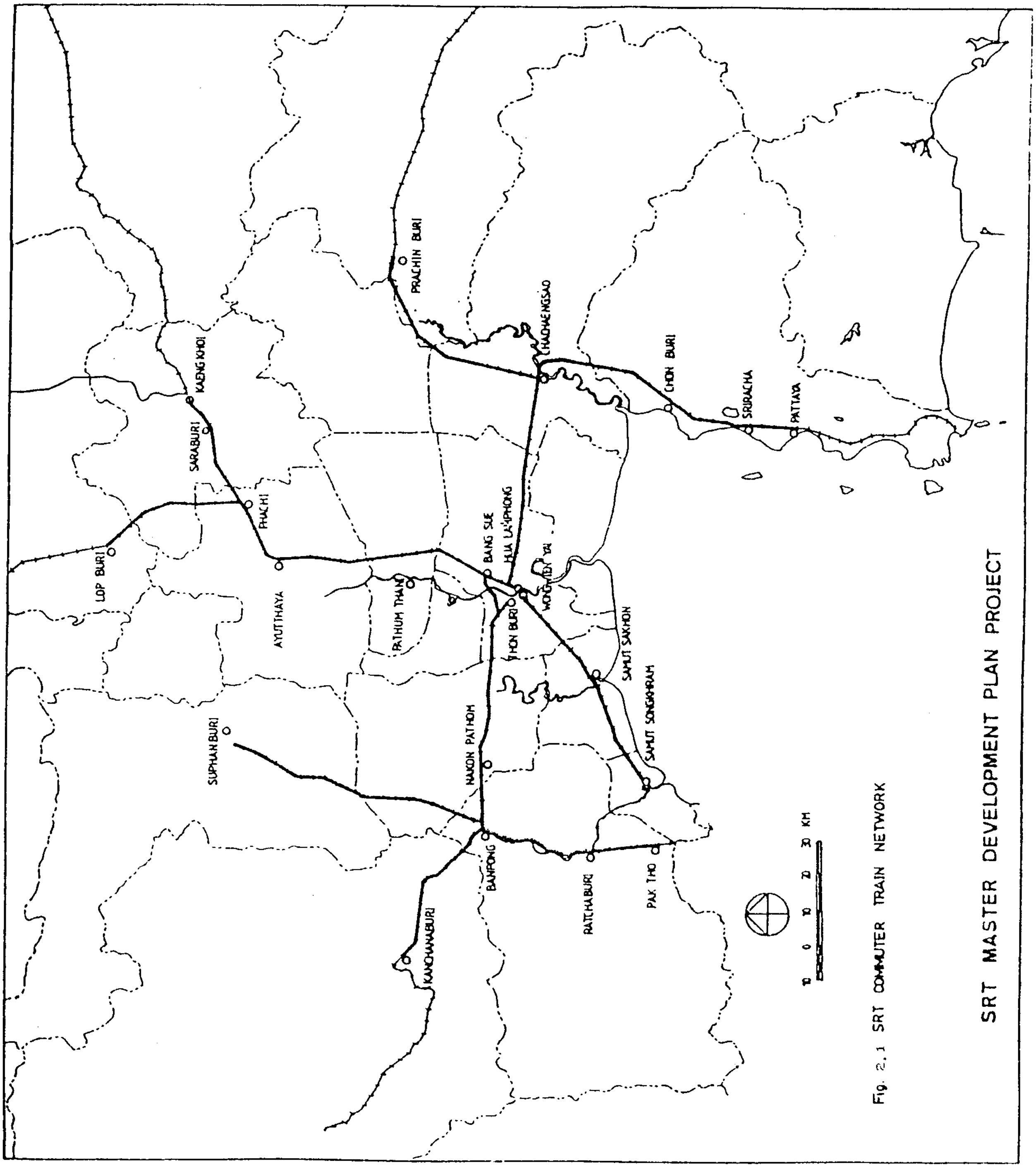


Fig. 2.1 SRT COMMUTER TRAIN NETWORK

SRT MASTER DEVELOPMENT PLAN PROJECT

Table 2.1
SRT Commuter Passengers in 1991

Month	No. of Passengers
January	2,503,723
February	2,243,309
March	2,292,829
April	2,172,570
May	2,418,480
June	2,658,770
July	2,853,502
August	2,878,318
September	2,826,546
October	2,523,340
November	2,660,099
December	2,605,064
Total	30,636,550

Source: Information System Department, SRT.

Table 2.2
SRT Commuter Passengers by Type During January, 1992

Type of Passengers	No. of Passengers	%
General Passengers	1,684,071	87.21
Round-Trip	152,080	7.88
Oneway-Trip	1,531,991	79.33
Students	154,720	8.01
Round-Trip	154,720	8.01
Oneway-Trip	-	-
SRT's Employees and their Children	60,960	3.16
Round-Trip	50,813	2.63
Oneway-Trip	10,147	0.53
Children and Discounted Passengers	29,307	1.52
Round-Trip	29,307	1.52
Oneway-Trip	-	-
Grouped Passengers	2,096	0.11
Round-Trip	2,096	0.11
Oneway-Trip	-	-
Total	1,931,154	100.00

Source: Information System Department, SRT.

Table 2.3
Passenger-Volume at Northern-Line Stations, 1991

Station#	Station Name	Outbound	Inbound
1001	Krung Thep	3,273,304	
1002	Hor Prajaekon Yommarat	3,273,324	3,406,184
1003	Hor Prajaekon Jitlada	3,273,332	3,406,306
1004	Sam Sen	3,867,003	3,406,464
1005	Sam Sen School	3,867,106	3,982,176
1006	Pratu Thanon Pradiphat	3,867,446	3,982,262
1007	Bang Sue Jct.	4,034,889	3,982,582
1008	Ban Phahon Yothin	4,034,933	4,173,607
1009	Nikom Rot Fai Lad Yao	3,890,935	4,173,663
1010	Wat Samian Naree	3,890,914	4,166,688
1011	Bang Khen	3,618,752	4,166,668
1012	Wat Thewa Soon Thorn	3,618,667	3,889,428
1013	Thung Song Hong	3,544,837	3,889,309
1014	Soon Fuk Nakhonban	3,544,573	3,885,607
1015	Lak Si	3,016,586	3,885,381
1225	Garn Keha	2,868,906	3,189,635
1016	Talad Mai Don Muang	2,868,804	2,868,004
1017	Don Muang	2,188,840	2,868,174
1018	Don Muang School	2,188,841	2,112,174
1019	Lak Hok	2,187,557	2,112,190
1020	Klong Rang Sit	2,079,311	2,110,895
1021	Talad Rang Sit	2,067,662	2,144,109
1223	Klong Nung	2,032,597	2,132,696
1022	Chieng Rak	1,800,508	2,032,247
1023	Nawa Nakorn	1,799,967	1,779,312
1024	Chieng Rak Noi	1,769,923	1,778,887
1026	Klong Pudsa	1,773,099	1,744,631
1028	Bang Pa-In	1,724,233	1,744,271
1029	Ban Pho	1,725,038	1,730,390
1031	Ayutthaya	1,962,319	1,726,772
1032	Ban Mah	1,962,848	1,967,005
1033	Mab Phrajan	1,920,044	1,963,812
1034	Ban Don Glang	1,907,424	1,928,763
1035	Phra Gaew	1,875,335	1,941,384
1036	Ban Pha Chi Jct.	1,534,467	1,904,404

Source: Recalculated from the SRT Data.

Station#	Station Name	Outbound	Inbound
1224	Don Ya Nang	1,191,769	1,156,351
1037	Nong Wiwat	1,166,724	1,147,328
1038	Ban Plak Rad	1,165,417	1,145,123
1039	Tha Rua	819,831	1,144,031
1041	Ban Moa	791,705	808,481
1042	Tha Lan	791,792	776,339
1043	Tha Luang	791,725	776,439
1045	Nong Done	809,794	776,455
1047	Ban Glub	808,891	806,305
1048	Ban Pa Wai	804,802	798,383
1050	Lop Buri		787,069

Station#	Station Name	Outbound	Inbound
2001	Nong Guay	321,685	414,370
2002	Nong Sang	247,472	395,713
2004	Nong Sida	236,806	324,707
2005	Ban Pok Pak	233,967	313,597
2007	Saraburi	123,230	308,029
2009	Nong Bua	122,815	203,661
2011	Kang Khoi Jct.		201,958

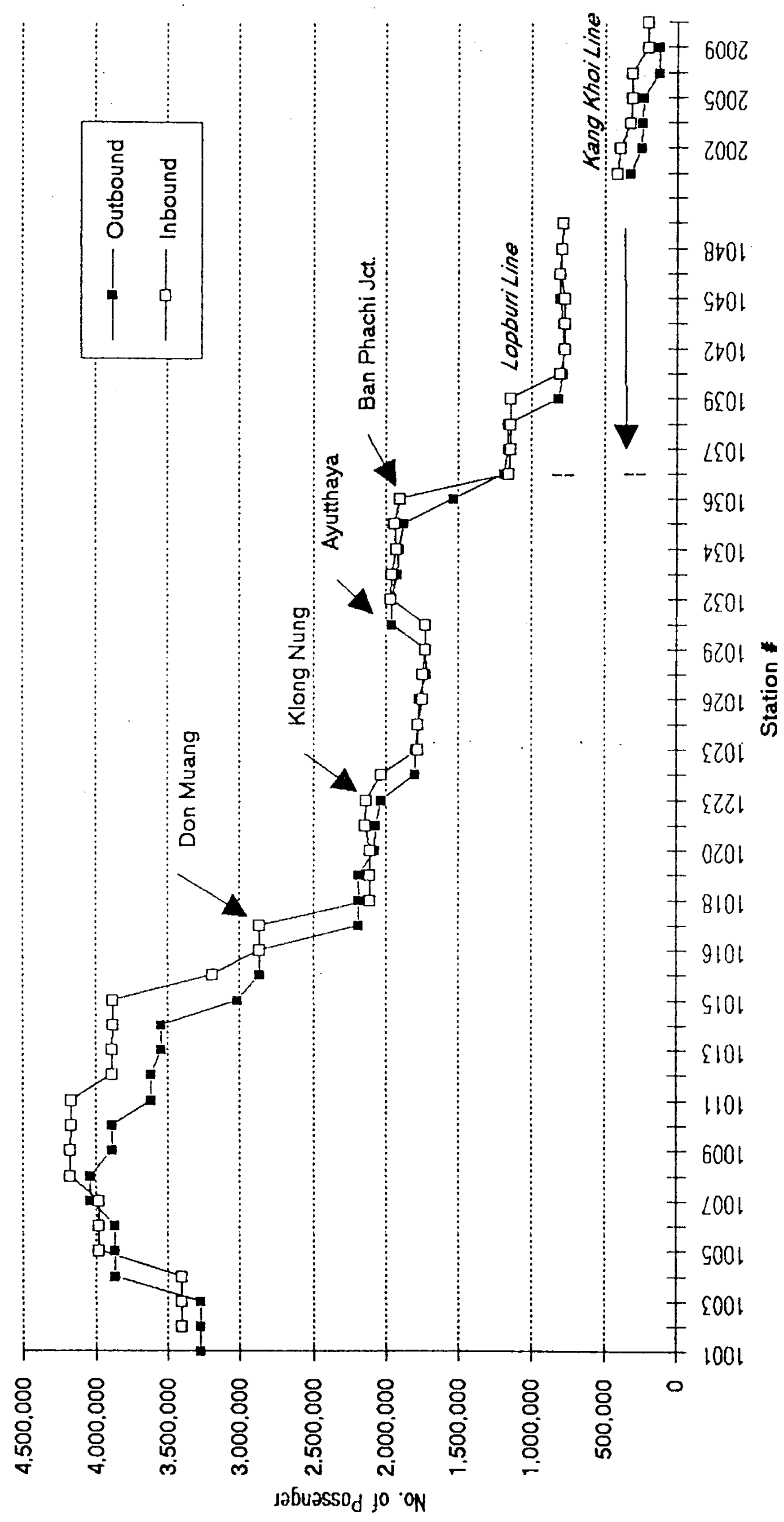


Fig. 2.2 Passenger - Volume at Northern-Line Stations, 1991

Table 2.4
Passenger-Volume at Eastern-Line Stations, 1991

Station#	Station Name	Outbound	Inbound
1001	Krung Thep	844,829	
1002	Hor Prajaekon Yommarat	845,269	1,180,478
3001	Makkasan	1,271,545	1,185,778
3002	Mae Nam	1,271,544	1,730,744
3003	Tha Rua Mai	1,271,524	1,730,740
3004	Mae Nam (Bang Jak Oil Refinery)	1,271,564	1,730,761
3009	Klong Ton	1,302,737	1,730,725
3106	Sukhumvit 71	1,302,736	1,800,434
3010	Hua Maak	1,222,068	1,803,086
3012	Ban Tub Chang	1,071,668	1,264,558
3013	Soi Wat Lan Boon	1,052,286	1,158,102
3014	Lad Krabang	988,247	1,157,141
3015	Hua Ta Ke	883,722	960,792
3017	Klong Luang Pang	764,055	823,861
3018	Klong Udom Cholajorn	740,080	712,021
3019	Praeng	654,231	729,898
3020	Klong Kwaeng Glun	636,388	675,911
3021	Klong Bang Phra	645,471	697,870
3022	Bang Tei	650,487	727,171
3023	Chachoengsao		732,451

Source: Recalculated from the SRT data.

Fig. 2.3 Passenger-Volume at Eastern-Line Stations, 1991

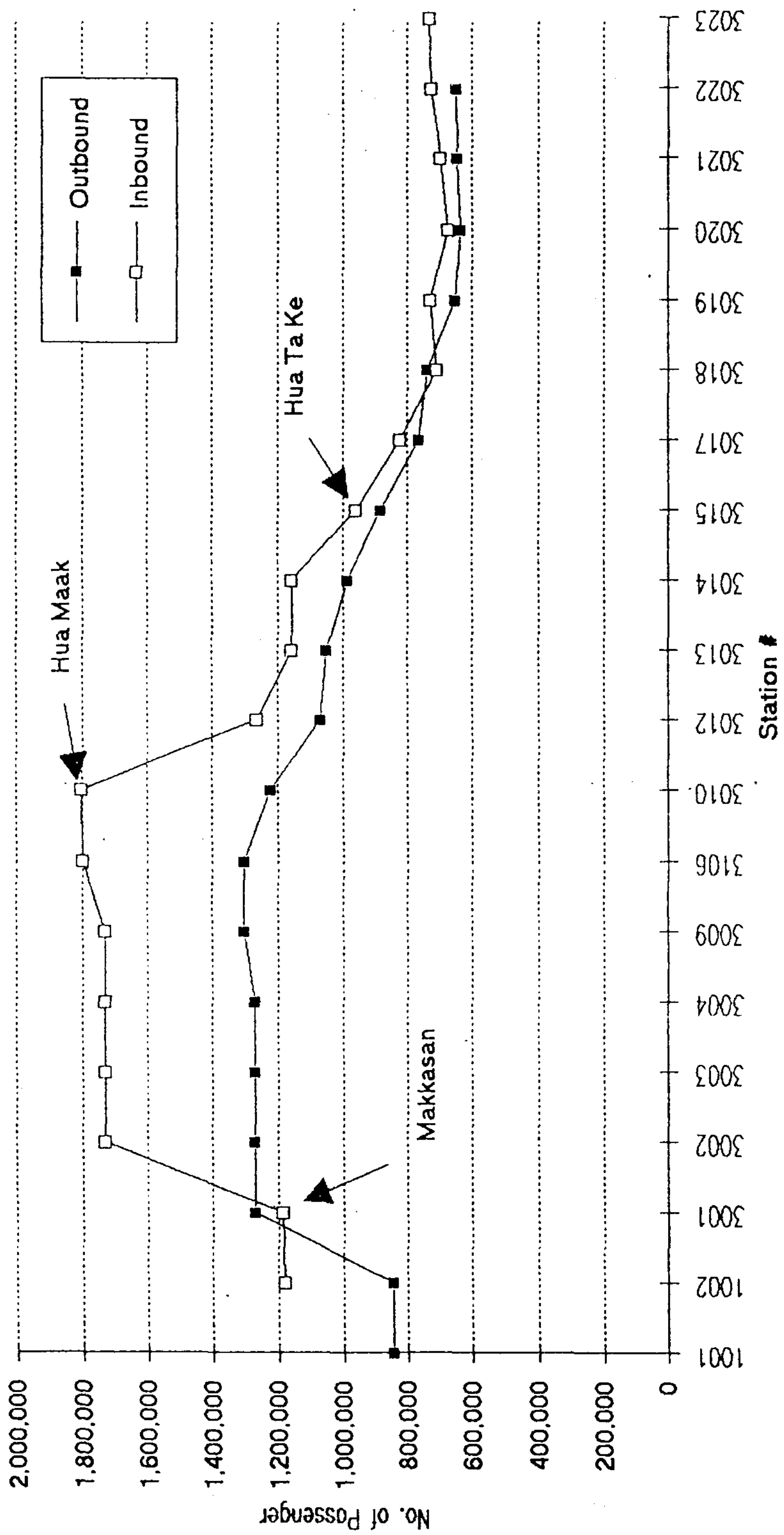


Table 2.5
Passenger-Volume at Southern-Line Stations, 1991

Station#	Station Name	Outbound	Inbound
4002	Thon Buri	435,511	
4003	Bang Ra Maad	435,734	477,690
4004	Talingchan Jct.	411,476	484,459
4005	Bang Bam Ru	413,284	449,494
4006	Bang Son	413,286	450,299
4007	Ban Chim Phli	397,877	450,297
4008	Sala Thammasop	310,109	426,256
4009	Salaya	336,565	324,985
4010	Wat Suwan	294,086	338,154
4011	Klong Maha Sawat	249,211	293,547
4012	Wat Ngew Rai	135,735	249,211
4013	Nakorn Chaisri	127,004	142,917
4014	Tha Cha Laab	126,955	133,518
4015	Ton Sam Rong	118,870	129,944
4016	Nakorn Pathom	97,772	119,311
4018	Prong Ma Dua	88,064	106,167
4019	Klong Bang Tan	77,747	98,818
4020	Nong Pla Dook Jct.	61,193	93,803
4079	Ban Pong	57,522	72,130
4081	Nakorn Choom	55,739	66,985
4082	Klong Takod	48,049	63,206
4083	Photharam	49,124	51,935
4085	Jed Samian	40,130	49,080
4087	Ban Kluay	39,705	34,806
4088	Saphan Ratchaburi	33,264	33,652
4089	Ratchaburi		11,126

Source: Recalculated from SRT Data

Fig. 2.4 Passenger-Volume at Southern- Line Stations, 1991

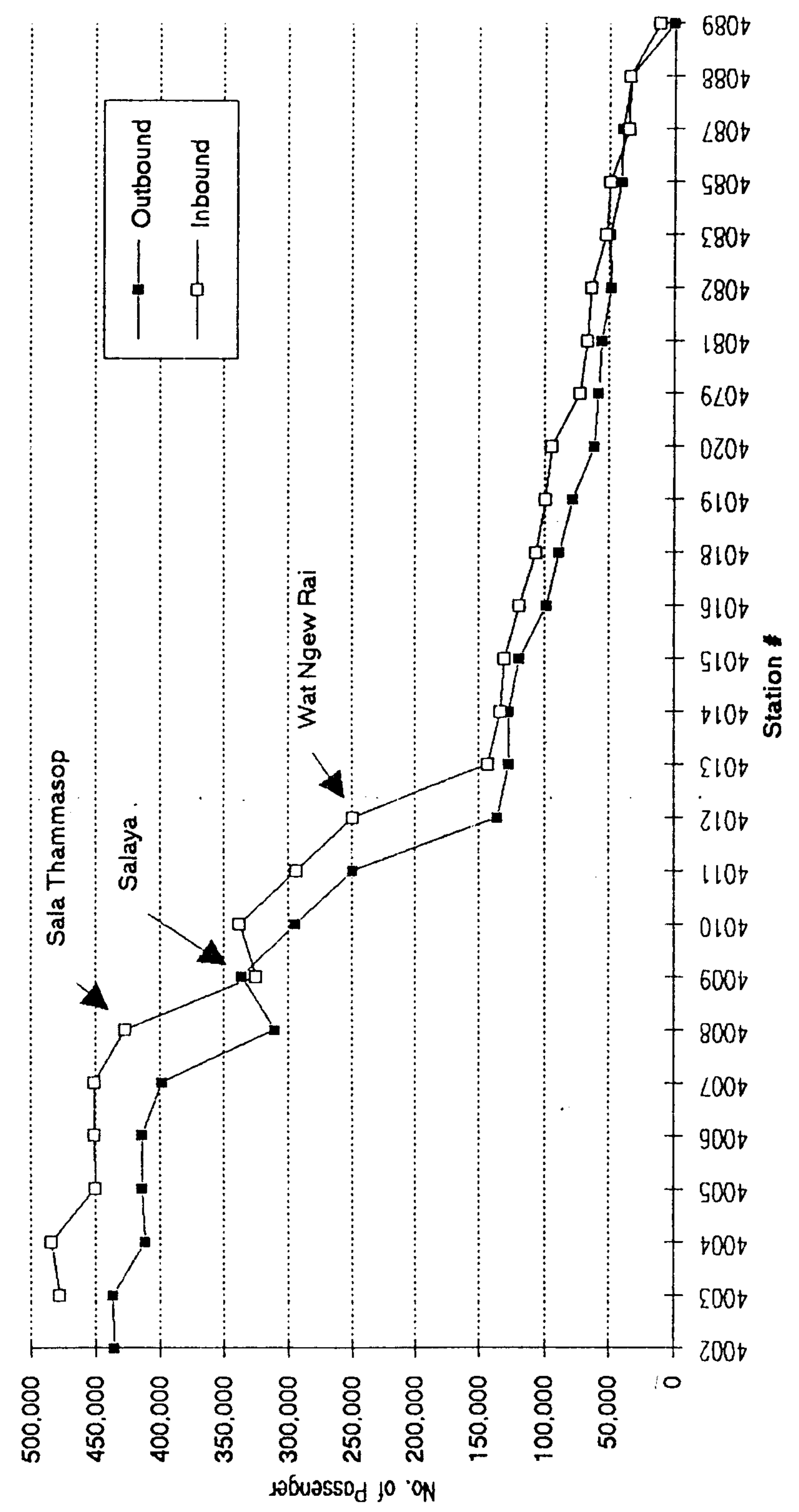
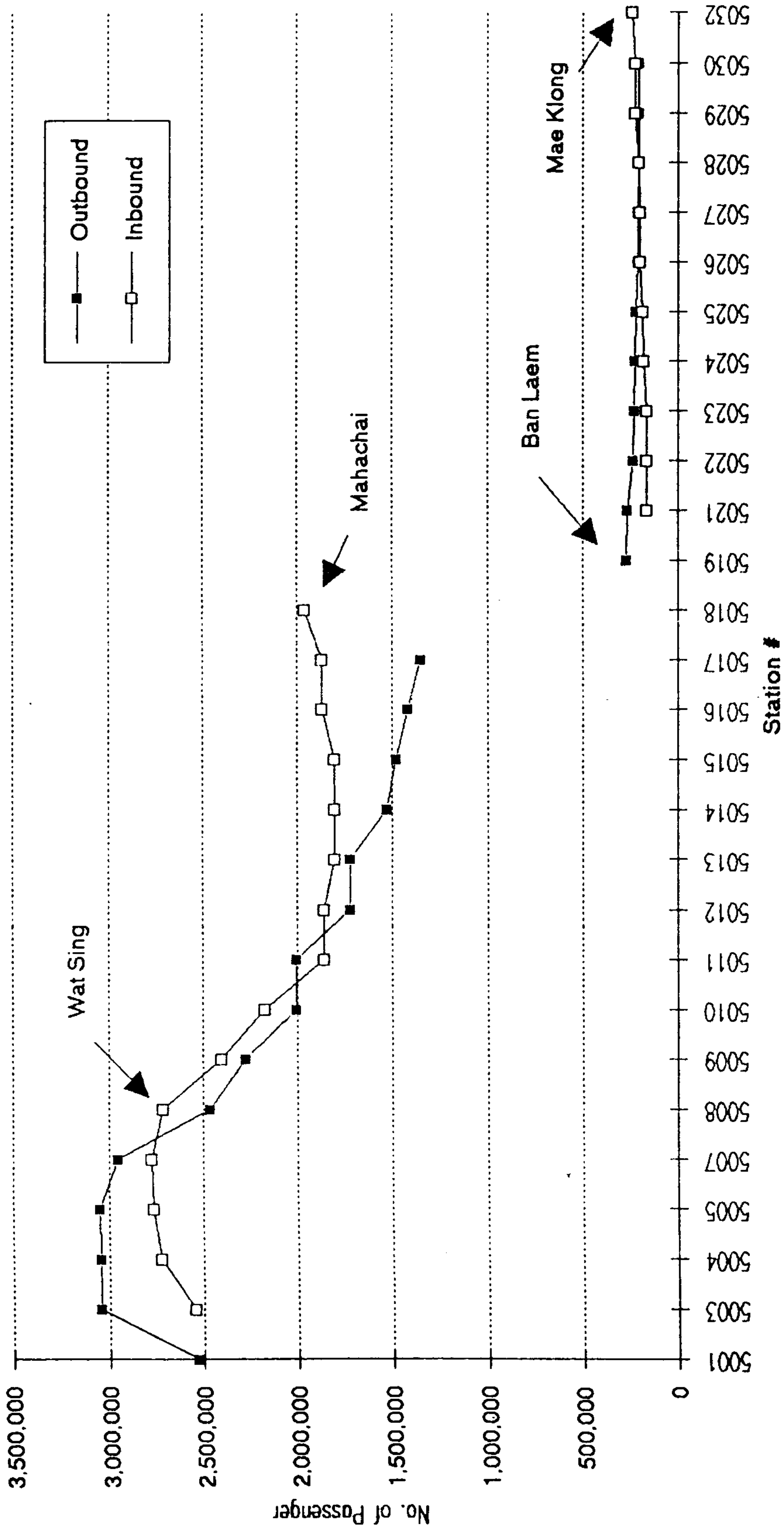


Table 2.6
Passenger-Volume at Mae Klong-Line Stations, 1991

Station#	Name	Outbound	Inbound
5001	Wong Wian Yai	2,531,848	
5003	Talad Phlu	3,043,236	2,544,569
5004	Klong Ton Si	3,043,392	2,725,214
5005	Jom Thong	3,048,081	2,764,452
5007	Wat Si	2,955,684	2,774,569
5008	Wat Sing	2,464,656	2,714,137
5009	Bang Bon	2,278,371	2,406,273
5010	Garn Keha	2,007,125	2,175,700
5011	Rang Sa Gae	2,007,068	1,859,184
5012	Rang Pho	1,722,889	1,859,101
5013	Sam Yaak	1,722,581	1,803,322
5014	Phrom Dan	1,530,658	1,803,078
5015	Bang Nam Jud	1,475,808	1,803,379
5016	Kok Kwai	1,417,867	1,870,904
5017	Ban Khom	1,349,772	1,868,412
5018	Mahachai		1,961,752
5019	Ban Laem	270,210	
5021	Ban Chi Pha Kao	270,149	165,010
5022	Bang Si Kod	238,027	165,617
5023	Bang Ga Jao	234,327	167,082
5024	Ban Boa	228,056	183,440
5025	Bang Tho Rud	221,578	184,083
5026	Ban Ga Long	209,982	200,696
5027	Ban Na Kwang	209,979	201,765
5028	Ban Na Koke	207,751	204,209
5029	Ket Muang	207,374	225,659
5030	Lad Yai	206,883	228,685
5032	Mae Klong		239,823

Source: Recalculated from SRT Data

Fig. 2.5 Passenger-Volume at Mae Klong-Line Stations, 1991



3) The Southern Line

The passenger-volume of the Southern Line is considerably low compared to the other lines. The most important part of this line is between Bangkok Noi (Thon Buri Station) and Sala Thammasop, following by the part between Salaya and Wat Ngew Rai. The volumes of the other parts of the line are considerably lower and insignificant.

4) The Mae Klong Line

The passenger-volume is very high between Wong Wien Yai and Wat Sing, followed by the volume between Bang Bon and Mahachai. The volume between Ban Laem and Mae Klong is considerably lower compared to the volume between Wong Wien Yai and Mahachai.

2.2 Commuter Train O-D Analysis

The analysis of passenger-volume above shows the cumulative passengers at certain stations. However, it does not provide the information about the actual distance passengers traveled most. The O-D analysis will provide this information that, in turn, will help identify the influenced areas of the commuter train.

As shown in Table 2.7, the distances passengers traveled most on the Northern Line are between Hua Lam Phong (Krung Thep) and Don Muang, following by the distances between Hua Lam Phong and Lak Si and between Hua Lam Phong and Bang Khen. The number of passengers traveling between Hua Lam Phong and Lopburi is surprisingly high.

The distances passengers traveled most on the Eastern Line are between Hua Lam Phong and Chachoengsao and between Hua Lam Phong and Hua Maak. Not many passengers traveled among the Southern Line stations. Only the distance between Bangkok Noi (Thon Buri) and Sala Thammasop had passengers over 100,000 in 1991. The number of passengers traveling between Wong Wien Yai and Mahachai of the Mae Klong Line is the highest of all -- more than ten times those traveling between Sala Thammasop and Bangkok Noi. The other important distances of the Mae Klong Line are between Wong Wien Yai and Wat Sing, and between Wong Wien Yai and Bang Bon.

Table 2.7
Origins and Destinations which Generated More Than 100,000 Trips in 1991

		Outbound					Inbound				
Line	Trip Range		From		To	No. of		From		To	No. of
		No.	Station Name	No.	Station Name	Trip	No.	Station Name	No.	Station Name	Trip
Northern	> 1,000,000	-		-		-	-		-		-
	500,001-1,000,000	1001	Krung Thep	1017	Don Muang	691,769	1017	Don Muang	1001	Krung Thep	637,263
							1015	Lak Si	1001	Krung Thep	615,383
	100,001-500,000	1001	Krung Thep	1015	Lak Si	492,942	1011	Bang Khen	1001	Krung Thep	487,851
		1001	Krung Thep	1011	Bang Khen	455,937	1050	Lopburi	1001	Krung Thep	283,413
		1001	Krung Thep	1050	Lopburi	289,218	1225	Karn Keha	1001	Krung Thep	228,171
		1031	Ayutthaya	1036	Ban Pha Chi Jct.	245,703	1036	Ban Pha Chi Jct.	1031	Ayutthaya	225,728
		1001	Krung Thep	1031	Ayutthaya	191,834	1031	Ayutthaya	1001	Krung Thep	190,535
		1001	Krung Thep	1007	Bang Sue Jct.	187,742	1017	Don Muang	1004	Sam Sen	182,479
		1031	Ayutthaya	1039	Tha Rua	180,059	1039	Tha Rua	1031	Ayutthaya	179,821
		1004	Sam Sen	1017	Don Muang	144,519	2011	Kang Khoi Jct.	1001	Krung Thep	155,364
		1001	Krung Thep	1009	Nikom Rot Fai (km.11)	137,428	1007	Bang Sue	1001	Krung Thep	151,520
		1001	Krung Thep	1022	Chieng Rak	125,913	1015	Lak Si	1004	Sam Sen	128,116
		1001	Krung Thep	1225	Karn Keha	108,752	1022	Chieng Rak	1001	Krung Thep	117,429
							1004	Sam Sen	1001	Krung Thep	105,271
Eastern	> 1,000,000	-		-		-	-		-		-
	500,001-1,000,000	-		-		-	-		-		-
	100,001-500,000	1001	Krung Thep	3023	Chachoengsao	262,098	3010	Hua Maak	1001	Krung Thep	391,169
		1001	Krung Thep	3010	Hua Maak	172,526	3023	Chachoengsao	1001	Krung Thep	254,747
		1001	Krung Thep	3015	Hua Ta Ke	139,245	3010	Hua Maak	3001	Makkasan	245,444
		3001	Makkasan	3012	Ban Thab Chang	129,526	3015	Hua Ta Ke	1020	Khlong Rang Sit	194,636
		1001	Krung Thep	3009	Khlong Tan	127,989	3015	Hua Ta Ke	1017	Don Muang	190,015
		1017	Don Muang	3015	Hua Ta Ke	116,363	3015	Hua Ta Ke	1001	Krung Thep	156,611
		1020	Khlong Rang Sit	3015	Hua Ta Ke	105,237	3009	Khlong Tan	1001	Krung Thep	152,833
							3014	Lad Krabang	1001	Krung Thep	101,696

Table 2.7 (Continued)
Origins and Destinations which Generated More Than 100,000 Trips in 1991

Southern	> 1,000,000	-		-		-	-		-		-
	500,001-1,000,000	-		-		-	-		-		-
	100,001-500,000	-		-		-	4008	Sala Thammasop	4002	Thon Buri	113,488
Mae Klong	> 1,000,000	5001	Wong Wien Yai	5018	Mahachai	1,157,248	5018	Mahachai	5001	Wong Wien Yai	1,612,617
	500,001-1,000,000	-		-		-	-		-		-
	100,001-500,000	5001	Wong Wien Yai	5008	Wat Sing	473,934	5008	Wat Sing	5001	Wong Wien Yai	358,990
		5001	Wong Wien Yai	5009	Bang Bon	252,170	5009	Bang Bon	5001	Wong Wien Yai	225,159
		5019	Ban Laem	5032	Mae Klong	206,883	5032	Mae Klong	5019	Ban Laem	157,390
		5001	Wong Wien Yai	5010	Karn Keha	155,822	5010	Karn Keha	5003	Talad Phlu	150,294
		5001	Wong Wien Yai	5012	Rang Pho	136,956	5007	Wat Sai	5001	Wong Wien Yai	138,639
		5001	Wong Wien Yai	5007	Wat Sai	136,915	5010	Karn Keha	5001	Wong Wien Yai	133,625
		5003	Talad Phlu	5008	Wat Sing	132,562					
		5003	Talad Phlu	5010	Karn Keha	106,011					
		5003	Talad Phlu	5018	Mahachai	103,657					
		5001	Wong Wien Yai	5014	Phrom Dan	103,158					
		5003	Talad Phlu	5012	Rang Pho	102,134					

Source: Statistical Section, State Railway of Thailand

Table 2.8
Rush Hour Passengers of the Northern Line

Station	Station Name	06.00-09.00 A.M.					Total		04.00-07.00 P.M.							Total	
		(arrival)					arrival	Capacity	(departure)							departure	Capacity
No.		#210	#222	#224	#228	#168			#209	#221	#223	#227	#249	#159	#166		
1001	Krung Thep	0	0	0	0	0	0	3225	692	750	677	509	424	495	0	3547	3543
1004	Sam Sen	1332	1109	910	500	1698	5549	3225	713	1061	885	606	495	590	875	5225	3543
1007	Bang Sue	1493	1332	1107	622	1916	6470	3225	648	1109	960	609	521	616	1046	5509	3543
1009	Nikom Rot Fai (km.11)	1454	1346	1144	645	1947	6536	3225	606	1044	920	563	492	615	1073	5313	3543
1011	Bang Khen	1351	1291	1096	615	1898	6251	3225	531	963	881	427	501	634	1056	4993	3543
1013	Tung Song Hong	1204	1037	1027	593	1473	5334	3225	504	898	862	413	490	640	1018	4825	3543
1015	Lak Si	1157	981	958	563	1433	5092	3225	428	617	671	215	430	613	988	3962	3543
1225	Karn Keha (km.19)	837	731	771	507	1091	3937	3225	380	514	622	197	392	584	770	3459	3543
1017	Don Muang	742	598	657	424	839	3260	3225	239	351	553	163	351	575	666	2898	3543
1020	Khlong Rang Sit	607	444	506	327	3	1887	3225	186	267	465	146	313	539	399	2315	3543
1021	Talad Rang Sit	686	475	544	330		2035	2137	188	280	508	154	332	560	437	2459	3543
1223	Khlong Nung	548	346	451	278		1623	2137	177	249	467	152	332	580	338	2295	3543
1022	Chieng Rak	397	251	451	278		1377	2137	159	190	372	125	284	550	260	1940	3543
1023	Nawa Nakorn	324	251	451	235		1261	2137	158	190	372	125	283	550	222	1900	3543
1024	Chieng Rak Noi	294	207	389	235		1125	2137	154	166	313	122	271	540	198	1764	3543
1026	Khlong Pudsa	264	192	361	235		1052	2137	148	157	291	121	269	536	183	1705	3543
1028	Bang Pa-in	251	179	354	236		1020	2137	129	122	277	129	233	550	182	1622	3543
1029	Ban Pho	230	150	309	269		958	2137	129	122	275	128	229	550	137	1570	3543
1031	Ayutthaya	221	151	316	269		957	2137	87	77	504	355	209	841	133	2206	3543

Source: Passenger Sales Division , State Railway of Thailand.

Fig. 2.6 Rush Hour Passengers of the Northern Line

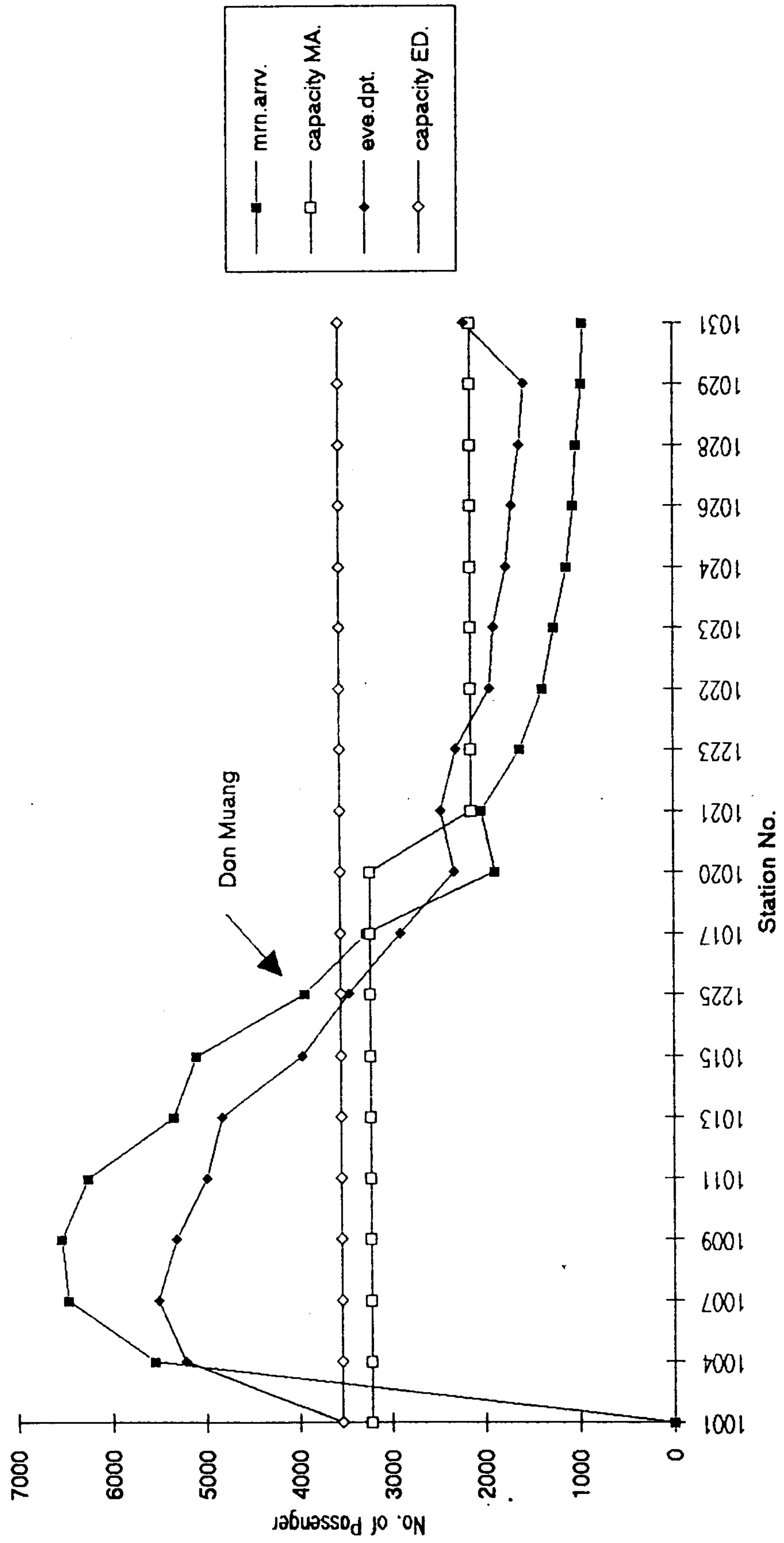


Table 2.9
Rush Hour Passengers of the Eastern Line

Station		06.00-09.00 A.M.			Total		06.00-09.00A.M.		04.00-07.00P.M.		04.00-07.00 P.M.		Total	
No.	Station Name	(arrival)			arrival	Capacity	(departure)	Capacity	(arrival)	Capacity	(departure)		departure	Capacity
		#182	#202	#196			#151		#		#181	#201		
1001	Krung Thep	0	0	0	0	3409	293	218	0	218	533	650	1183	945
1002	Yommarat	2561	945	915	4421	3409	293	218	277	218	533	650	1183	945
3001	Makkasan	2561	945	915	4421	3409	345	218	277	218	680	840	1520	945
3009	Khlong Tan	4763	1179	2710	8652	3409	344	218	335	218	553	807	1360	945
3010	Hua Maak	4411	1111	2476	7998	3409	391	218	290	218	342	578	920	945
3012	Ban Thab Chang	1436	828		2264	2471	391	218	307	218	311	503	814	945
3013	Soi Wat Lan Bun	1341	746		2087	2471	391	218	306	218	301	475	776	945
3014	Lad Krabang	1216	661		1877	2471	392	218	308	218	230	390	620	945
3107	Phra Chom Klao	953	537		1490	2471	191	218	308	218	230	333	563	945
3015	Hua Ta Ke	933	537		1470	2471	88	218	305	218	178	492	670	945
3017	Khlong Luang Phang	896	447		1343	2471	88	218	125	218	153	356	509	945
3018	Khlong Udom Chonlajorn	694	328		1022	2471	112	218	143	218	153	346	499	945
3019	Preng	655	321		976	2471	104	218	161	218	153	253	406	945
3020	Khlong Khwaeng Klan	531	236		767	2471	120	218	211	218	153	242	395	945
3021	Khlong Bang Phra	515	232		747	2471	125	218	247	218	143	210	353	945
3022	Bang Toey	498	215		713	2471	127	218	346	218	143	209	352	945
3023	Chachoengsao	480	207		687	2471	0	218	362	218	114	0	114	945

Source: Passenger Sales Division, State Railway of Thailand.

Fig. 2.7 Rush Hour Passengers of the Eastern Line (Morning)

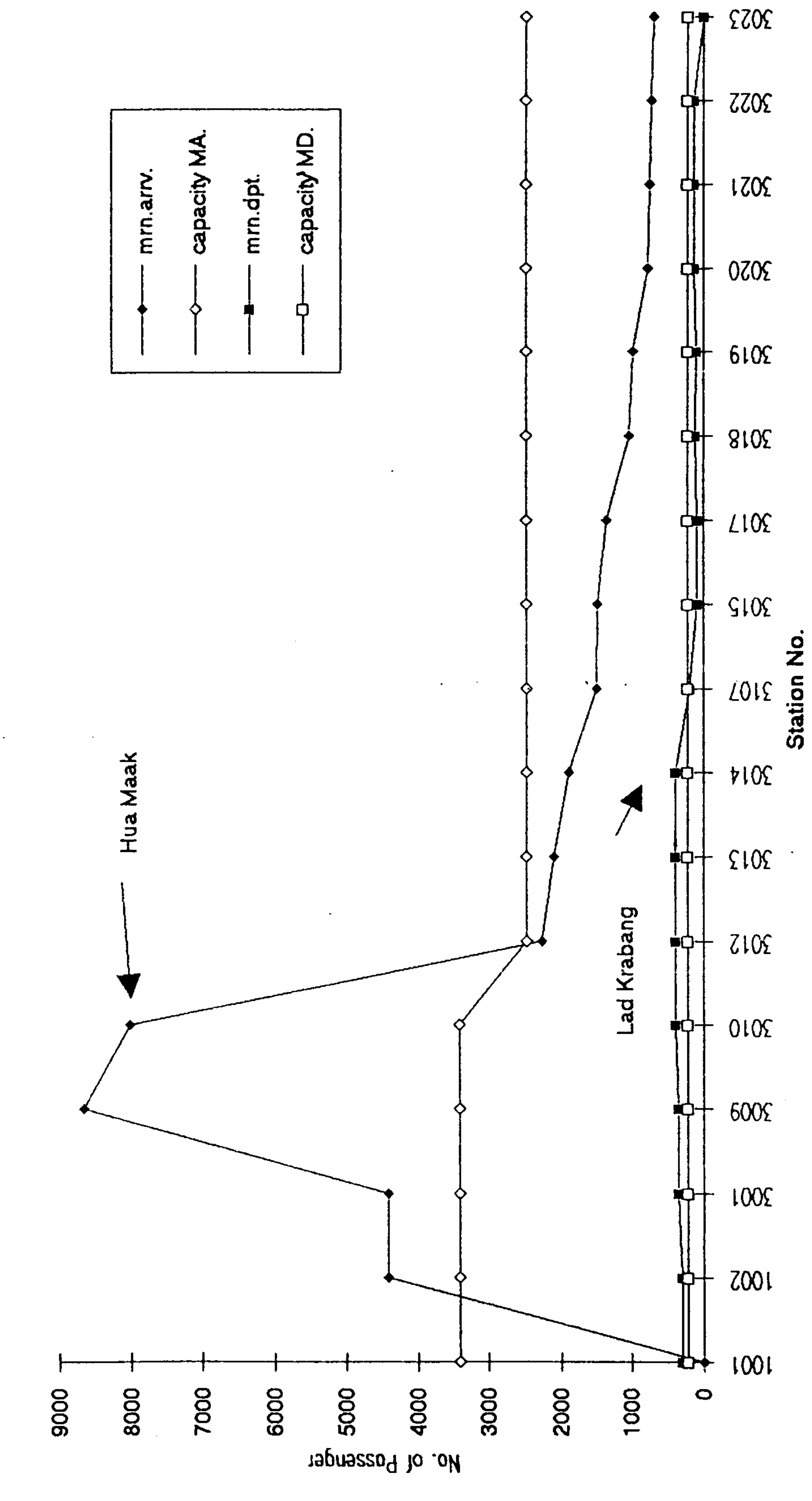


Fig. 2.8 Rush Hour Passengers of the Eastern Line (Evening)

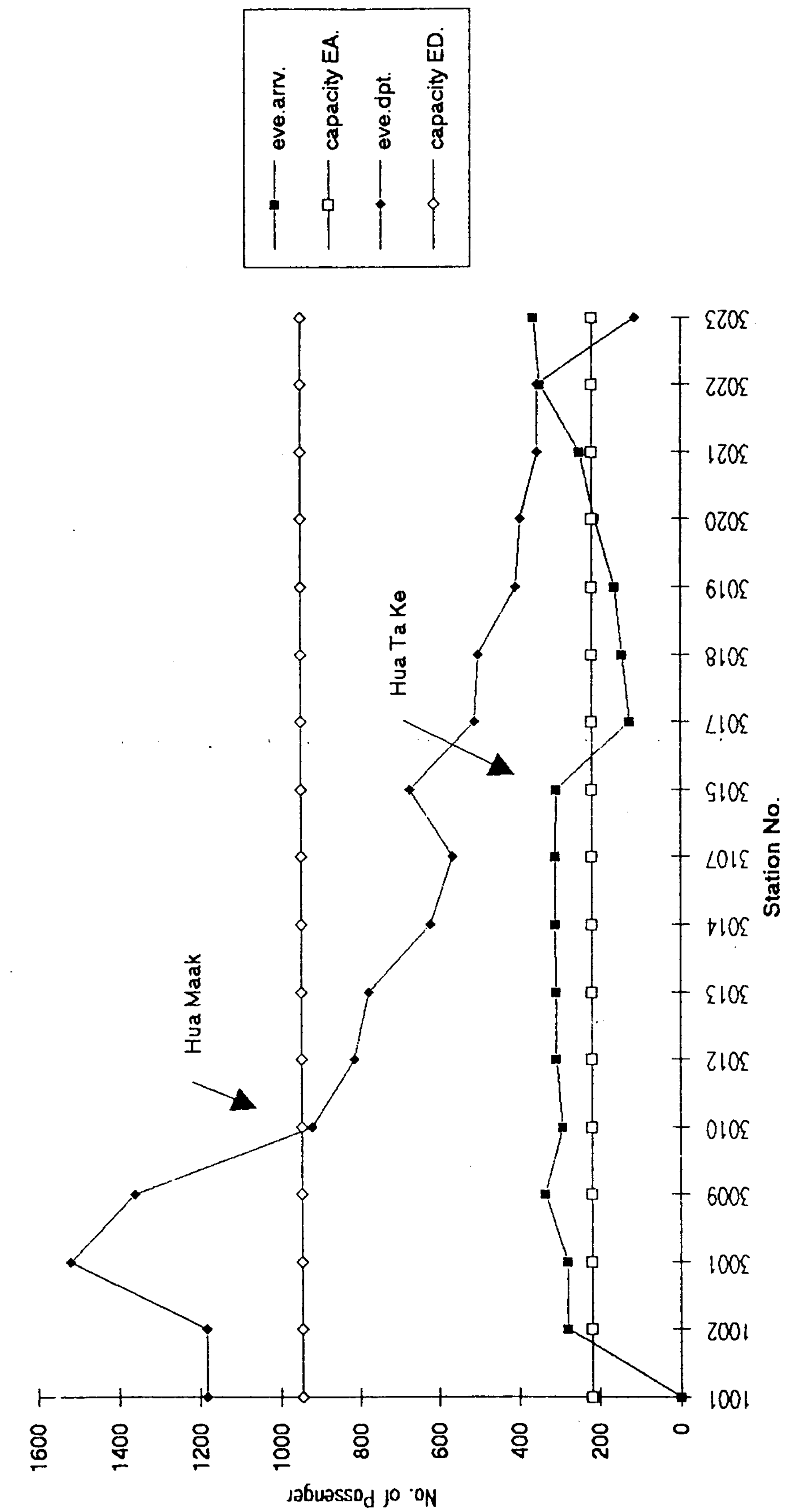


Table 2.10
Rush Hour Passengers of the Hua Ta Ke - Rangsit Line

Station No.	Station Name	Departure #191	Capacity	Arrival #192	Capacity
3015	Hua Ta Ke	20	674	0	717
3107	Phra Chom Klao	181	674	115	717
3014	Lad Krabang	188	674	289	717
3013	Soi Wat Lan Bun	193	674	294	717
3012	Ban Thab Chang	195	674	293	717
3010	Hua Maak	175	674	298	717
3106	Sukhumvit 71	272	674	329	717
3009	Khlong Tan	407	674	390	717
3105	Asoke	521	674	490	717
3104	Ratchaprarop	591	674	630	717
3103	Phya Thai	637	674	678	717
3102	Urupong	785	674	795	717
1004	Sam Sen	766	674	913	717
1006	Pradiphat	724	674	998	717
1007	Bang Sue	596	674	960	717
1009	Nikom Rot Fai (km.11)	554	674	980	717
1011	Bang Khen	428	674	943	717
1013	Tung Song Hong	380	674	805	717
1015	Lak Si	227	674	753	717
1225	Karn Keha (km.19)	144	674	619	717
1016	Talad Don Muang	126	674	527	717
1017	Don Muang	8	674	451	717
1020	Khlong Rang Sit	0	674	12	717

Source: Passenger Sales Division.

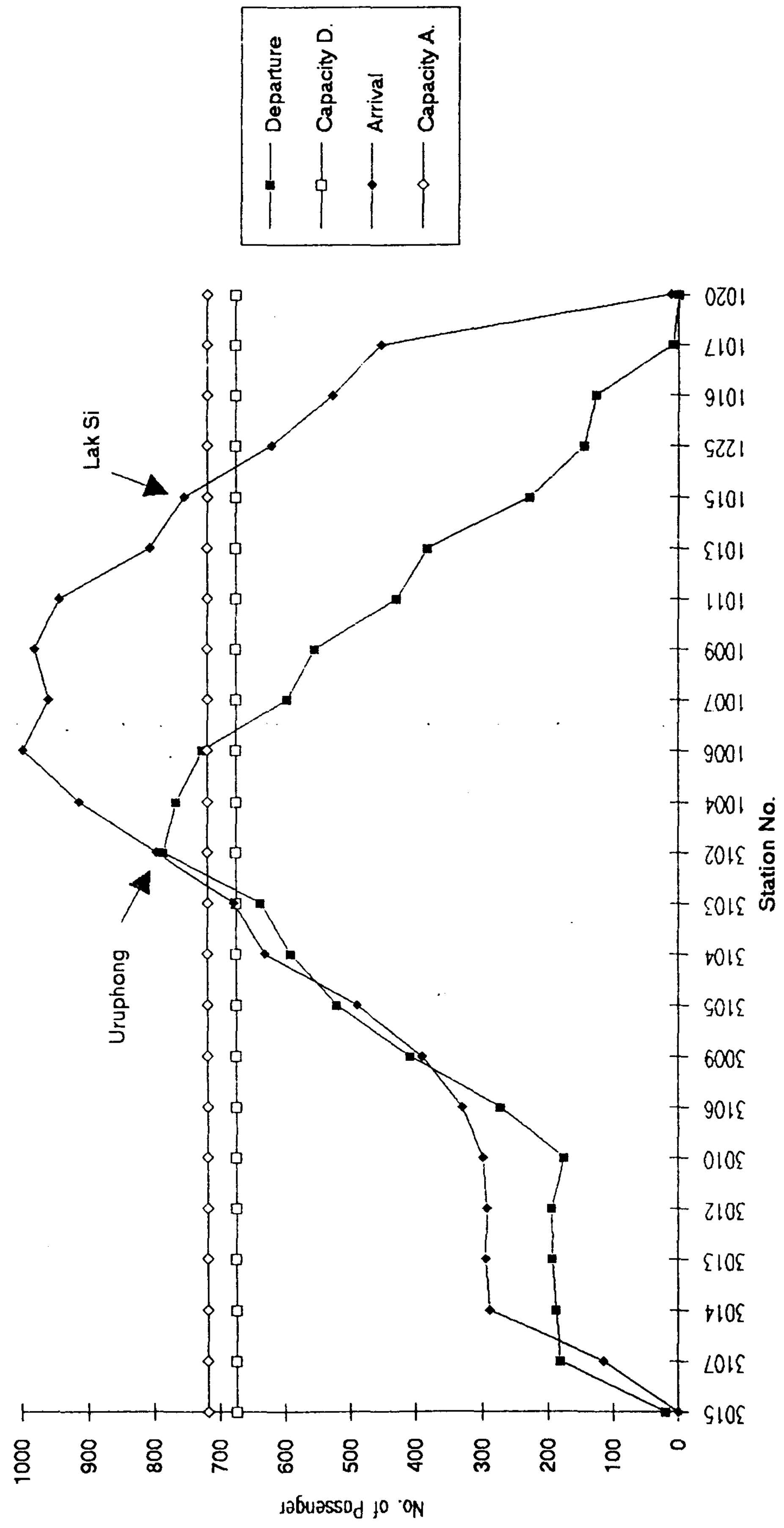


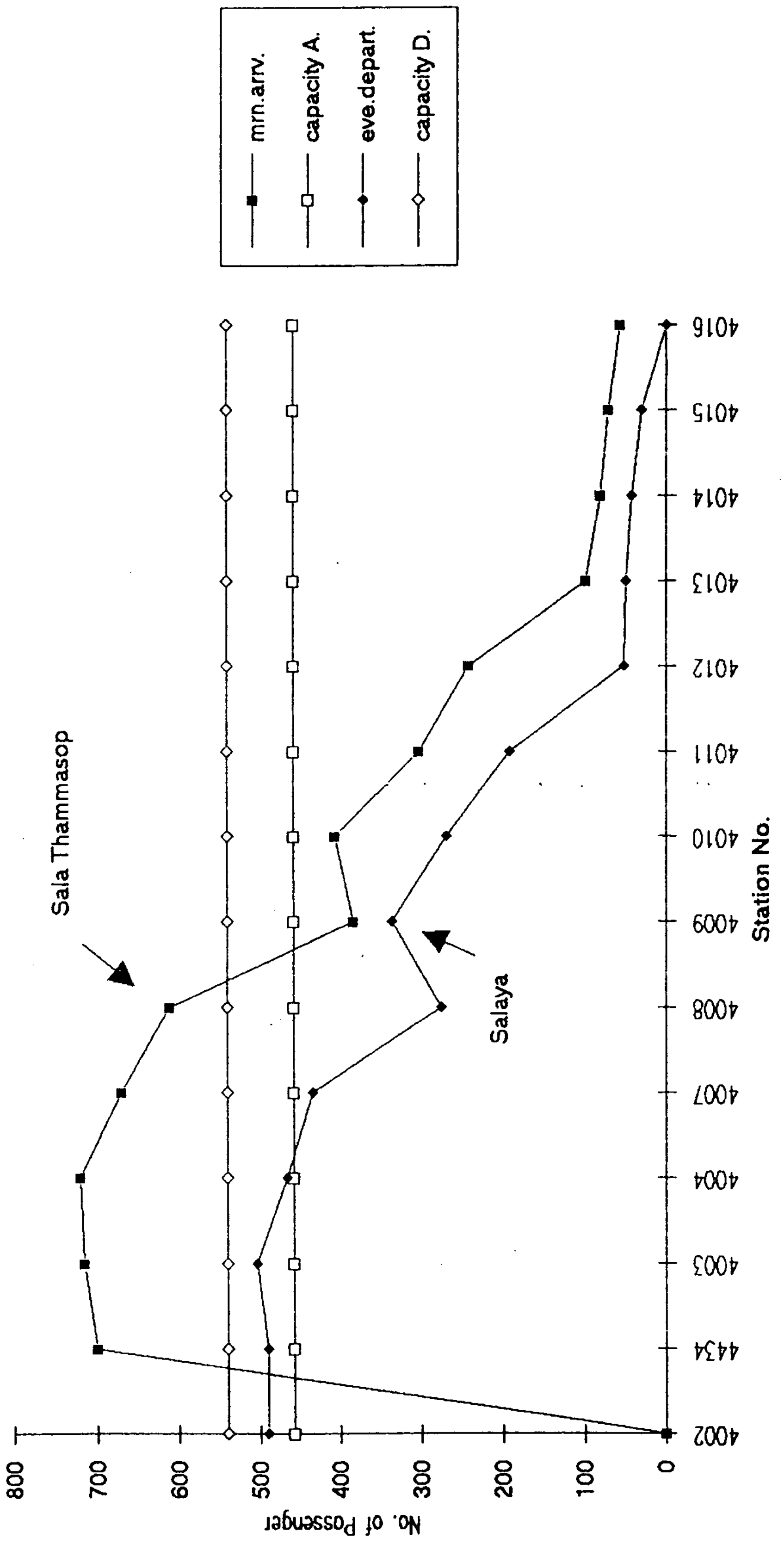
Fig. 2.9 Rush Hour Passengers of the Hua Ta Ke - Rangsit Line

Table 2.11
Rush Hour Passengers of the Southern Line

Station No.	Station Name	06.00-09.00 A.M. (arrival) #174	Capacity	04.00-07.00 P.M. (departure) #175	Capacity
4002	Thon Buri	0	458	490	540
4434	Charansanitwong	699	458	490	540
4003	Bang Ramaad	715	458	504	540
4004	Talingchan Jct.	720	458	467	540
4007	Ban Chim Phli	670	458	434	540
4008	Sala Thammasarn	611	458	274	540
4009	Salaya	384	458	336	540
4010	Wat Suwan	407	458	269	540
4011	Khlong Maha Sawat	302	458	191	540
4012	Wat Ngew Rai	241	458	52	540
4013	Nakorn Chai Sri	99	458	50	540
4014	Tha Chalaeb	81	458	43	540
4015	Ton Samrong	71	458	31	540
4016	Nakorn Pathom	57	458	0	540

Source: Passenger Sales Division , State Railway of Thailand.

Fig. 2.10 Rush Hour Passengers of the Southern Line



2.3 Demand and Supply of Commuter Trains During Rush Hours

The following demand and supply analysis uses the data available from the Passenger Sales Division, SRT. Several surveys were conducted during the past 5 years and the actual origin-destination was recorded for each passenger on certain trains. The survey was not complete for all commuter trains servicing the rush hours. However, it is very helpful in showing the picture of the overall demand and supply of each commuter train line.

Tables 2.8 to 2.11 and Figures 2.6 to 2.10 show rush hour passengers of all commuter train lines of which data are available from the Passenger Sales Division. The "total arrival" column shows the actual demand at certain stations while the "capacity" column shows the actual supply of commuter trains for those stations.

Figure 2.6 clearly indicates that the supply of the Northern Line commuter trains between Hua Lam Phong and Don Muang is much lower than the demand. The situation is the same for the Eastern Line commuter trains between Hua Lam Phong and Hua Maak. For the Southern Line, only the morning arrival trains had the problem of insufficient supply.

2.4 Influenced Zone of the Commuter Train

The analyses of the passenger-volume, the O-D, and the demand and supply of the commuter trains indicate that the role of the commuter train is concentrated mostly within the BMR. The area served by commuter trains can be divided into 3 zones:

1) Inner influenced zone

This is the zone where people use the train service intensively. The passenger-volume and the number of the O-D passengers are usually high for stations within this zone, while the demand exceeds the supply. The zone radiates from Hua Lam Phong to Don Muang in the north, to Hua Maak in the east, to Sala Thammasop in the west, and to Wat Sing station in the southwest.

2) Middle influenced zone

This is the zone where passenger-volume at the station is rather high, and so is the number of O-D passengers. However, the supply is still sufficient. The zone extends from the inner influential zone to Ban Phachi Junction in the north, to Chachoengsao in the east, to Wat Ngew Rai station in the west, and to Mahachai in the southwest.

3) Outer influenced zone

This zone includes the areas outside the two zones mentioned above but are served by the commuter train network.

These zones will be used later as the framework for planning the commuter train system of the BMR.

2.5 The Characteristics of Current Commuter Passengers

To obtain information on the characteristics of commuter passengers, a field survey was conducted for three commuter lines: the Northern Line, the Eastern Line, and the Southern Line. A total of 374 commuter passengers were interviewed. The results of the survey are summarized below.

1) There are more men than women who use commuter train service, 58% of men versus 42% of women.
2) The majority of commuter passengers are between 16 and 50 years of age, comprising 89% of the total.
3) 66% of commuter passengers are government staffs, 18% are students, and 16% are business employees.
4) Nearly one half of the passengers (44%) have income less than 5,000 Baht per month, 28% of them earn 5,000 to 10,000 Baht, while 28% of them earn more than 10,000 Baht a month.
5) The major purposes of the trips are to go to work and to go back home from work (80% of the total).
6) Most commuter passengers (70%) need other means of transportation to go to or from the railway stations. The means they use most is the local bus (68%).
7) The traveling distances by commuter train for most passengers (67%) are between 6 and 20 kms.
8) Almost all commuter passengers (96%) can choose another means of transportation to get to their destinations.
9) Traffic congestion and overcrowded buses make people turn away from using local bus. They feel that the train can take

them to the destination faster, more comfortably, and safer. The fare of the commuter train is also cheaper.

10) Suggestions for commuter train improvement include adding more wagons, keeping the train on time, and increasing the speed of the train.

2.6 The Airport Express Train

The Airport Express Train, operated since November 1991, is the joint operation of the SRT and Thai Airways International to serve the hotel and tourist industries. Twelve trains are operated daily at about a 2-hour interval. A limousine connection is provided by Thai Airways International between the Airport Terminal and the railway station.

According to the Marketing Department of the SRT, only 15% of the passengers work or do businesses at the Airport. 78% of them take the train to work and to school at other places. Only a small percentage of them are tourists (7%).

2.7 Other Mass Transportation Systems in the BMR

In addition to the SRT commuter train, there are three other mass transportation systems serving people in the BMR. They include the BMTA local bus, the bus-boat, and the inter-city bus (Bor Khor Sor).

2.7.1 The BMTA Local Bus

The Bangkok Mass Transit Authority (BMTA) is the fourth largest bus service organization of the world. It owns about 4,400 buses and also licenses the operation of some bus and mini-bus routes to private companies. The BMTA local bus system serves passengers in Bangkok, Nonthaburi, Pathum Thani, Samut Prakan, and part of Nakhon Pathom (see Figure 2.11).

At the present, there are 173 total bus routes serving the public -- 144 regular bus routes and 29 air-conditioned bus routes. According to the BMTA, its local buses serve about 4,176,000 passenger-trips per day. Of these trips, 3,979,000 passenger-trips (95%) are made by regular bus passengers and 198,000 passenger-trips (5%) are made by air-conditioned bus passengers.

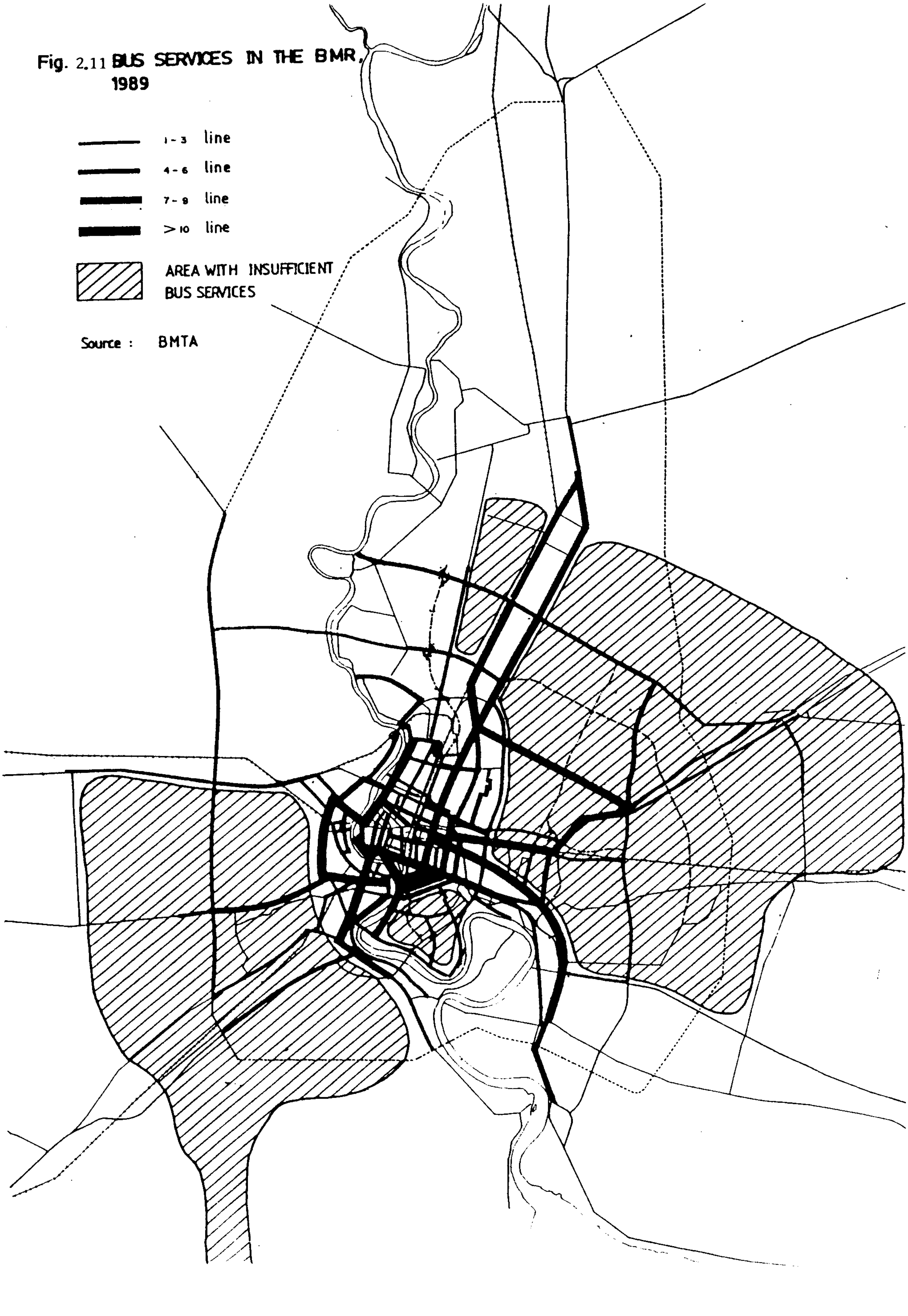


Fig. 2.11 BUS SERVICES IN THE BMR, 1989
1-3 line
4-6 line
7-9 line
>10 line
AREA WITH INSUFFICIENT BUS SERVICES
Source : BMTA

Some BMTA bus routes duplicate the SRT commuter train lines. A field interview of commuter passengers who take the bus instead of the train was carried out for this study. The bus number 29 (Hua Lam Phong-Rangsit) was selected as the competitive mode for the train. The passengers were interviewed at Rangsit in the morning and at Hua Lam Phong in the evening. The results can be summarized as follows:

1) Most of these passengers (95%) are in the working age group (16-50 years old).
2) Most of them are in the low-to-medium income group -- 45% of them earn 5,000 Baht or less per month while 87% earn 10,000 Baht or less.
3) 43% of these passengers live within 1 km. from the railway station while 68% live within 3 kms.
4) More than one-half of these passengers (52%) have never traveled by train.
5) They choose the bus because, in their opinions, it is the most convenient mode of transportation (53%).
6) The major reasons for them not to take the train are: over-crowding; their destinations are far from the railway stations; the train does not arrive on time; and no train is available at the wanted time.

2.7.2 The Bus Boat

1) The Express Boat

The express boat service is operated by the Chao Phraya Express Boat Ltd., serving passengers who travel along the Chao Phraya River -- from Wat Ratcha Singkhon to Nonthaburi (18 kms.) and from Wat Ratcha Singkhon to Pakkret (27 kms.). According to the Harbor Department, there are about 30,000 passenger-trips daily -- 17,000 passenger-trips southbound and 13,000 passenger-trips northbound.

2) The Long-Tailed Boat

In 1990, there were 229 long-tailed boats serving passengers along the canals in Bangkok, Nonthaburi, and Samut Sakhon. There were nearly 50,000 passenger-trips per day at 21 piers along the Chao Phraya River. The important piers are at Sathu Pradit and the Memorial Bridge.

Table 2.12
Inter-city Bus

No.	Line	Bus Fare	No. of Bus/Day	No. of Passenger/Day
38	BKK - Chon Buri	18.50 - 35	49	10616
50	BKK - Chon Buri	21.50	17	3120
53	BKK - Chachoengsao	18 - 24	22	2328
907	BKK - Chachoengsao	26.00	24	3600
59	BKK - Prachin Buri	35.50 - 65	51	7008
17	BKK - Bang Pa-in - Ayutthaya	31 - 40	11	960
901	BKK - Ayutthaya	17.50 - 33	35	10104
904	BKK - Saraburi	23 - 44	32	8250
85	BKK - Samut Sakhon	10.50	27	9840
980	BKK - Samut Sakhon (B)	9.00	23	7080
972	BKK - Samut Songkhram (C)	26.50	13	4080
78	BKK - Samut Songkhram (A)	28.00	24	600
976	BKK - Samut Songkhram (B)	18.00	18	13680
76	BKK - Ratchaburi	24 - 45	54	11960
951	BKK - Ang Thong - Suphan Buri	47 - 60	26	4752
952	BKK - Suphan Buri	33.00	8	720
88	BKK - Suphan Buri	34.00	40	6240
974	BKK - Bang Bua Thong	23 - 42	9	3168
81	BKK - Kanchanaburi	28 - 53	101	13000
	Total		584	121106

Source: The Transport Company Limited.

2.7.3 The Inter-City Bus

The inter-city bus service (Bor Khor Sor) is operated by the Transport Company, Ltd. There are regular and air-conditioned buses running between Bangkok and major cities across the country.

Table 2.12 shows the statistics of the inter-city bus service within the service area of the commuter train. There are 19 bus-routes linking Bangkok with major cities in 12 provinces, serving 121,106 passenger-trips daily. This is about 1.5 times the number of passenger-trips served by the SRT commuter train. Although the fares of the two systems are competitive, the inter-city bus network is more widespread and more buses are available than trains.

2.8 The Need for Mass Rapid Transportation in the BMR

The large cities that depend mainly on road transportation throughout the world are experiencing social and economic difficulties resulting from increases in population and the use of motorcars. Examples of these difficulties include increases in travel time and traffic accidents due to chronic road congestion, noise pollution, vibration, air pollution, and wasteful energy consumption. Using only road transportation, there is very little chance to solve these problems. Thus, it is essential that mass rapid transportation be introduced.

Over the past two decades, the Bangkok Metropolitan Region (BMR) has grown rapidly. Bangkok alone is now accommodating more than 6 million people or about 1/3 of the urban population of the nation. If the BMR is considered, the area would accommodate more than 8 million people, or nearly one-half of the national urban population. The accelerating population growth and urban development in the BMR have resulted in a substantial demand for transportation. Traffic volumes have reached the existing road capacities.

Car ownership has also growing rapidly. According to the ETA, there were 562,000 private cars registered in 1989 and the number is expected to grow to over 2.0 million by 2006. The numbers of public and private buses, taxies, trucks, and vans are also increasing. According to the ETA's projection, the traffic in Bangkok is expected to increase by about 150% by the end of the century. High tratfic volumes and congestion have resulted in very low travel speeds for buses during the rush hours, about 10 kms. per hour. The situation will be more serious in the future if nothing is done to solve the problem.

It is apparent that the existing transportation system is incapable of serving the increasing traffic. To stimulate development within the BMR, some important long-term improvements in the area's transportation system must be undertaken. The most promising alternative is the construction of one or more mass rapid transit systems.

2.9 Advantages and Disadvantages of Mass Rapid Transportation

Mass rapid transportation, including the railway, have several advantages over regular buses, private cars, and taxies. Their advantages can be summarized as follows.

1) Large transportation capacity

According to the Japan Railway Technical Service (JARTS), guided transportation systems can transport 30,000 to 80,000 passengers per hour per direction, compared to 20,000 passengers for a bus system with an exclusive lane.

2) Construction and operating costs

Mass rapid transit systems have high construction cost. In terms of cost per passenger, however, the cost is roughly about the same as that of a bus system. According to JARTS, the elevated mass rapid transit is cheaper than roads in terms of construction cost per passenger of peak hours. The operating cost of a mass rapid transit system, including depreciation and interest, is nearly the same cost as a bus system.

3) National economic and social benefits

Mass rapid transportation has four national economic and social benefits over road transportation: time saving, energy saving, safety, and environmental protection. In a city such as Bangkok, where traffic congestion is considerable throughout the day, mass rapid transit systems would be the most reliable transportation mode. In terms of energy consumption, a mass rapid transit system consumes only 60% of a bus system and 1/6 of private automobiles. Mass rapid transit systems are the safest transportation modes, and they cause much less air pollution than the automobile.

The major disadvantages of mass rapid transit systems are their requirements for a large investment and a long period to recover the investment. Thus, building a mass rapid transit system requires careful planning and integration among various systems.

Table 2.13
Mass Rapid Transit Salient Features

Feature	Hopewell Community Train	MRTS	BMA Electric Train
Vehicle			
Gauge	to be determined	N/A	1.435 m.
Power	750 VDC	N/A	750 VDC
Basic Consist	2 cars	N/A	2 cars
Ruling Grade	3 % (assumed)	N/A	3 - 5 %
Space Available	61.3 sq.m./car	N/A	84.3 sq.m./car
Headway (Min.)	2	N/A	2
Capacity (Six Standees per sq.m. plus seated)			
Station Length	300 m.	N/A	75 m.
Riders per car	200/car	N/A	457/3 segment car
Rider space	367.8 (6 cars)	N/A	168.6 (2 cars)
(Sq.m./train)	735.6 (12 cars)		
No. of car	6	N/A	2
(per Contract)			
Rider/hour/track/ direction	49,500	N/A	27,420
(per contract)			
No. of cars (Maximum)	12	N/A	2
Rider/hour/track/ direction	99,000	N/A	27,420
(maximum)			

Source: Wilbur Smith Associates, 1991.

2.10 Mass Rapid Transit Projects in the BMR

The movement for the construction of mass rapid transit system in Bangkok is not new. Between 1971 and 1973, the government, with the assistance from a German advisory group, conducted a comprehensive transportation study. The following is a summary of parts of the results:

1) A recommendation was made on the construction of an efficient mass rapid transit system for the BMR.

2) The government was recommended to develop the national policy to encourage the use of public transportation and restrict the use of private cars. This measure would greatly help relief the economic loss due to transportation problems.

Between 1978 and 1981, the ETA conducted a feasibility study and detailed design for the First Stage Mass Rapid Transit System in Bangkok. The system consisted of 3 Skytrain lines totaling 59 kms. Due to the financial burden, the ETA revised the project in 1984, cutting the line into one and a half of Stage I with total length of 34 kms.

It took 6 years before the Cabinets approved the Lavalin International Group as the investor for the project in 1990. During this period, two other mass rapid transit systems were proposed; the Hopewell Project of the SRT, and the BMA Lightrail Mass Rapid Transit. The responsible authorities have made more progress on the latter two projects than the ETA has with the Skytrain. At present, the concessions have already been granted and the contracts have been signed for the latter projects. The contract for the Skytrain Project, however, has been voided by the investor's failing to meet certain requirements. In August 1992, the government established a new Metropolitan Rapid Transit Authority (MRTA) to revise the former Skytrain scheme. The initial stage of the new system, the Metropolitan Rapid Transit System (MRTS), was approved by the Cabinet in September 1992. The new authority is also responsible for integrating all mass rapid transit systems in the BMR. The salient features of the mass transit projects are shown in Table 2.13.

2.10.1 The Hopewell Project

The Hopewell Project consists of 60.1 kms. of elevated railway with mass transit services, 57 kms. of expressway above the railway, and the development of over 500 rai of SRT land at 5 sites. The mass transit/expressway network extends from Taling Chan to Hua Maak and from Rangsit to Po Nimit. The cross-shaped system links Hua Lum Phong and Wong Wien Yai, as well as Yommarat and Thon Buri (Bangkok Noi). The alignments from Bang Sue to Taling Chan, Bang Sue to Klong Tan, and a new loop from Bangkok Noi to Po Nimit are listed as possible future extensions (Figure 2.12).

The Hopewell (Thailand) Ltd. was granted in November 1990 a 30 year concession period to build and operate the system. Its revenues will come from real estate development, toll fees, community train fares, etc. The construction schedule is divided into 5 stages and should be completed within 8 years. The system will provide an elevated dual 3-lane toll road, track structure with facilities for SRT and community trains, retail and station concourses and local roads at the ground level (Figure 2.13).

2.10.2 The Metropolitan Rapid Transit System (MRTS)

In August 1992, the government established the Metropolitan Rapid Transit Authority (MRTS) and transferred the responsibility to build mass rapid transit in the metropolis from the ETA to the new authority. The new Metropolitan Rapid Transit System (MRTS) was introduced to replace the former Skytrain System. The initial MRTS line was approved by the Cabinet in September 1992. The system consists of a semi-looped line totaling about 20 kms. It starts at Hua Lam Phong, running along Rama IV Road, Ratchada Phisek Road, and Lad Phrao Road, then cutting down along Phahol Yothin Road to the Northern Bus Station before turning westward to meet the Hopewell System at Bang Sue.

2.10.3 The BMA Mass Rapid Transit Project

The BMA Mass Rapid Transit System consists of two lines -- the Sukhumvit Line, and the Victory Monument-Silom Line. The Sukhumvit Line, about 8.5 kms. in length, runs from the National Stadium along Rama I Road and Sukhumvit Road and ends at Klong Tan. The Victory Monument-Silom Line, about 6 kms. in length, starts from the Victory Monument and ends at Silom-Surasak Junction.

The objective of the BMA in providing this system is to provide extended public transport services as well as to alleviate the extremely congested traffic situation in the CBD of Bangkok. The system is intended to attract car users thereby freeing the road.

The Tanayong Consortium has been granted the concession to build and operate the BMA Mass Rapid Transit System. It has 1,228 days to build the system and has the right to operate it for 30 years after which it will be transferred to the BMA.

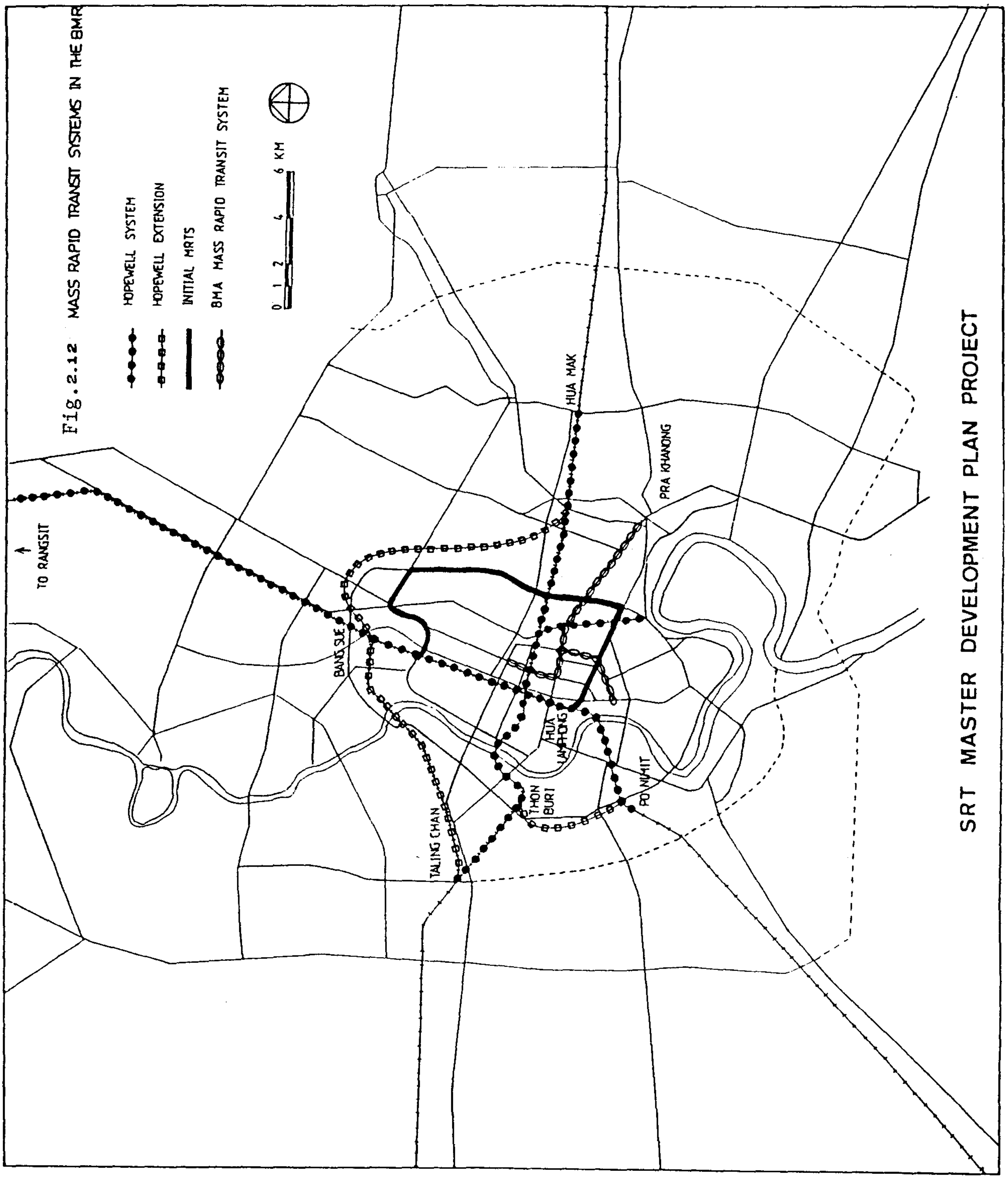


Fig. 2.12 MASS RAPID TRANSIT SYSTEMS IN THE BMR
HOPEWELL SYSTEM
HOPEWELL EXTENSION
INITIAL MRTS
BMA MASS RAPID TRANSIT SYSTEM
0 1 2 4 6 KM
TO RANGSIT
BANG SUE
HUA MAK
PRA KHANONG
HUA LAMPHONG
THON BURI
TALING CHAN
PO NIMIT
SRT MASTER DEVELOPMENT PLAN PROJECT

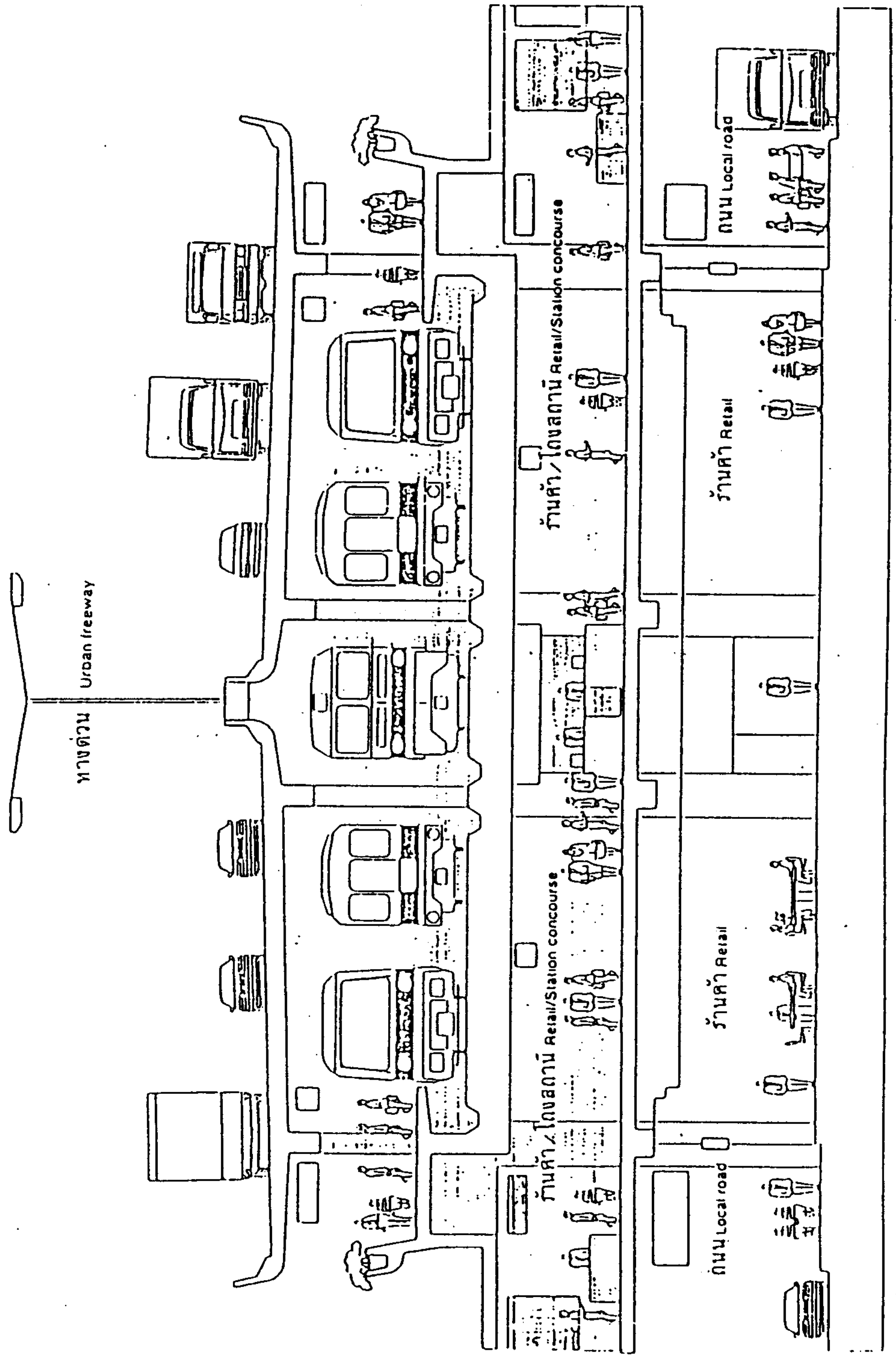


Fig. 2.13 SECTION THROUGH RAMTUFS TYPICAL STATION

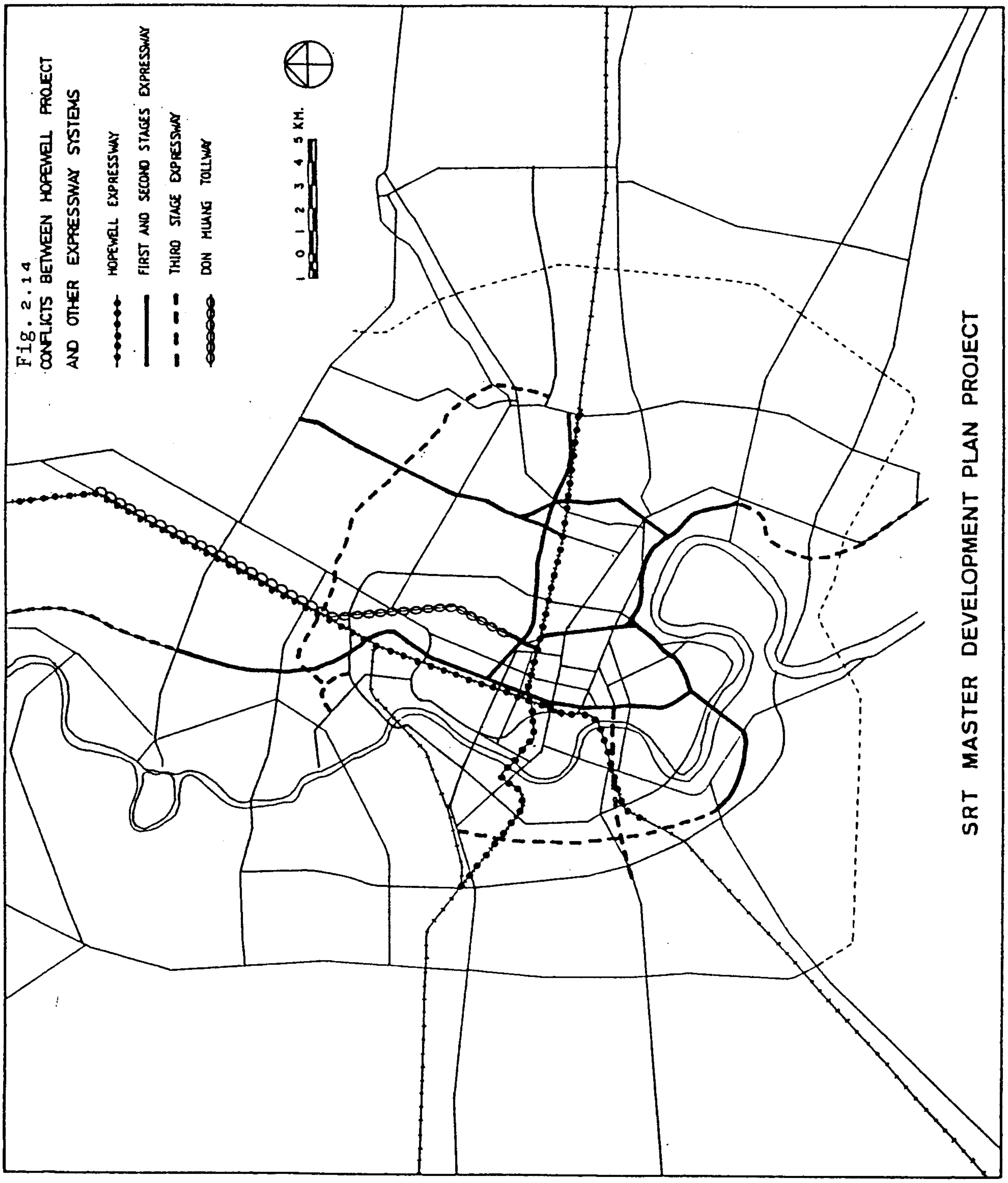


Fig. 2.14 CONFLICTS BETWEEN HOPEWELL PROJECT AND OTHER EXPRESSWAY SYSTEMS

2.11 Problems of the Hopewell Project

Bangkok now has three mass rapid transit systems. According to SPURT (1991), the Hopewell alignments are good -- the main north-south line is the one recommended by STTR and the eastern line is quite good. The replacement of the Skytrain with the new MRTS has reduced most of the conflicts among different mass rapid transit systems. Only at the points where they cut across each other that construction problems might occur. The Hopewell System has four construction conflict points with the other two systems -- at Sri Ayutthaya, Petchaburi-Asoke, Ploenchit, and Rama IV Road (Figure 2.14).

To reduce the mass transit problems, we recommend that the three systems be integrated, with joint-stations at the points they meet. If possible, one of the two systems cutting across should be placed underground. A joint ticketing system would also be required. We also recommended that the SRT reconsider building the Makkasan-Maenum Line of the Hopewell System. Although it does not overlap with the other systems, the areas it intends to serve are already served by those systems.

The Hopewell Project also has expressway problems. According to Wilbur Smith Associates (1991), the Hopewell east-west lines could not proceed to the west from Yommarat without violating structural height restriction or sound engineering principles while the north-south lines could not proceed to the south and across the Chao Phraya River without causing extreme property damage or environmental damage or both at a very high cost.

In addition to the vertical problems, there are also horizontal problems. The wasteful duplication of services appears in both the east-west and the north-south corridors. According to SPURT (1991), the new expressways of the so-called "megaprojects" would bring 40,000 vehicles an hour altogether into the inner city area. The arterial roads and expressways together would grossly overload the ordinary surface roads because these roads are already overloaded and there are no plans to reconstruct them.

Solving the expressway problems is beyond the scope of this study. We believe, however, that using road transportation has its price. Expressways need a corresponding expansion of the supporting network and car parks. In the case of the inner city areas, it would require expensive expenditure and efforts. The result would also adversely affect the landscape and environment of the area.

To minimize the problems, the SRT might want to reconsider revising the Hopewell expressway scheme, especially when the system passes through the inner city areas. Negotiation with the investor might be required.

2.12 The Future Role of the SRT Commuter Train

The SRT commuter train is one of the public mass transit systems in the BMR which include itself, the MRTS, the BMA Mass Rapid Transit System, the BMTA local bus, the bus-boat, and the inter-city bus (Bor Khor Sor). Since the SRT commuter train, the MRTS, and the BMA Mass Rapid Transit System are faster and have their own tracks to operate, they should serve as the backbone of the whole mass transit system of the BMR.

Figure 2.15 shows the conceptual diagram of the whole mass transit system for the BMR. The major role of the SRT commuter train is to bring passengers from the suburbs and outer cities into the inner areas of Bangkok and to distribute passengers around the outer areas of Bangkok. The Skytrain and the BMA Lightrail Mass Transit concentrate their roles on distributing passengers around the inner areas and extending their services into the outer areas where there are no commuter train services. The other three systems help bringing passengers to and distributing them from the backbone systems and serving less developed areas within and around the BMR where there are no backbone systems available.

We recommend that the following requirements be met to have the overall system work:

1) Mass transportation should have priority over private cars, taxies, trucks, and motor-cycles. This is the most important requirement of all. According to SPURT (1991), Bangkok's busways are an important complement to mass rapid transportation in providing a transport strategy for all the people. The bus lane concept should be re-established, enforced, and extended. It also recommended the implementation and demonstration of the Prachathipok/Taksin and Phahol Yothin/Phayathai busways. Transport-related agencies should concentrate their efforts on developing good mass transit systems rather than building flyovers and expressways that lures people away from using public transportation and adds more cars to the already congested roads.

2) The government should use mass transits systems to lead and control urban development. This means the systems should be planned ahead of land development made by the private sector. There must be an effective measure to control land speculation and

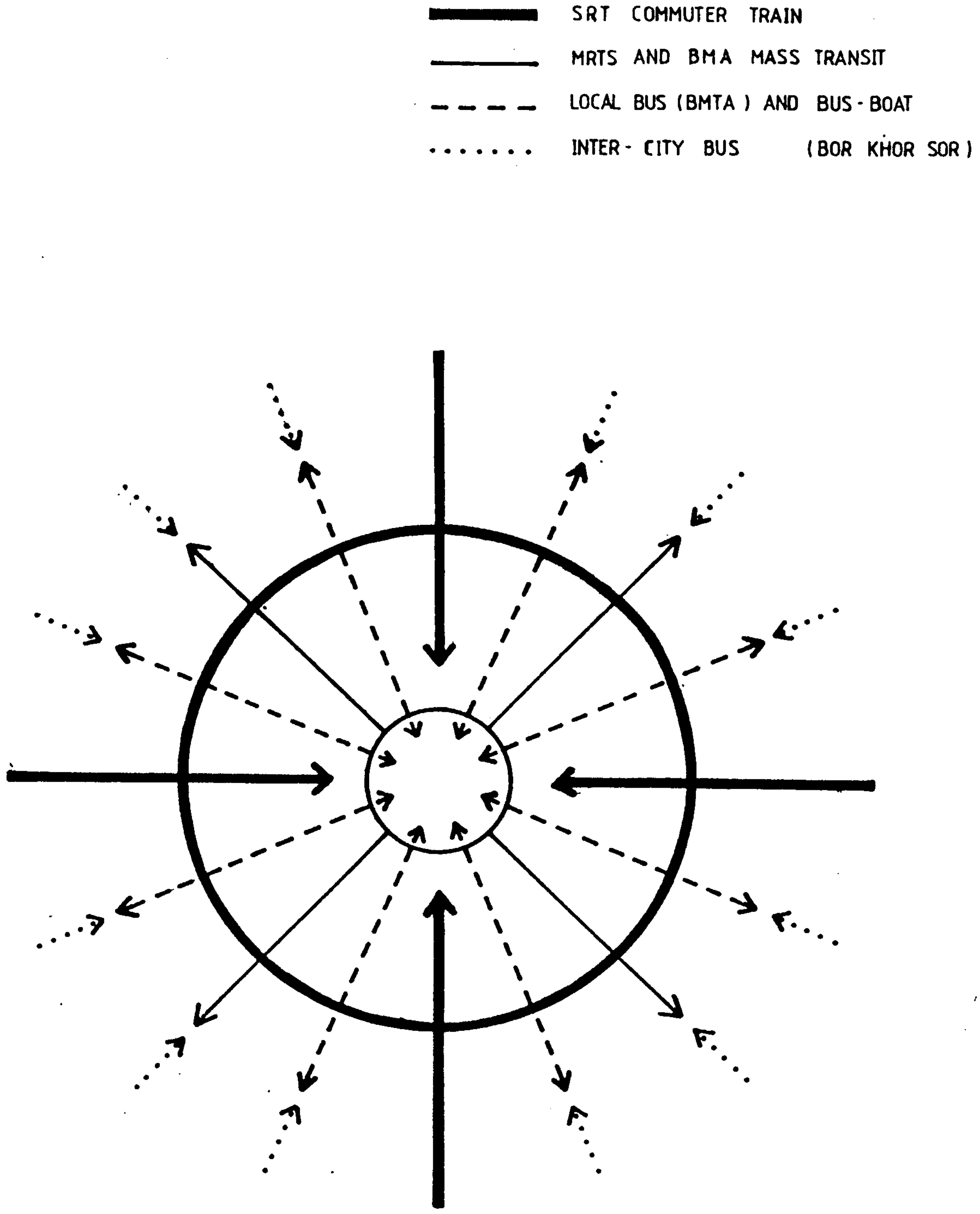


Fig. 2.15 CONCEPTUAL DIAGRAM SHOWING THE ROLE OF THE SRT COMMUTER TRAIN AS PART OF THE WHOLE MASS TRANSIT SYSTEM FOR BMR

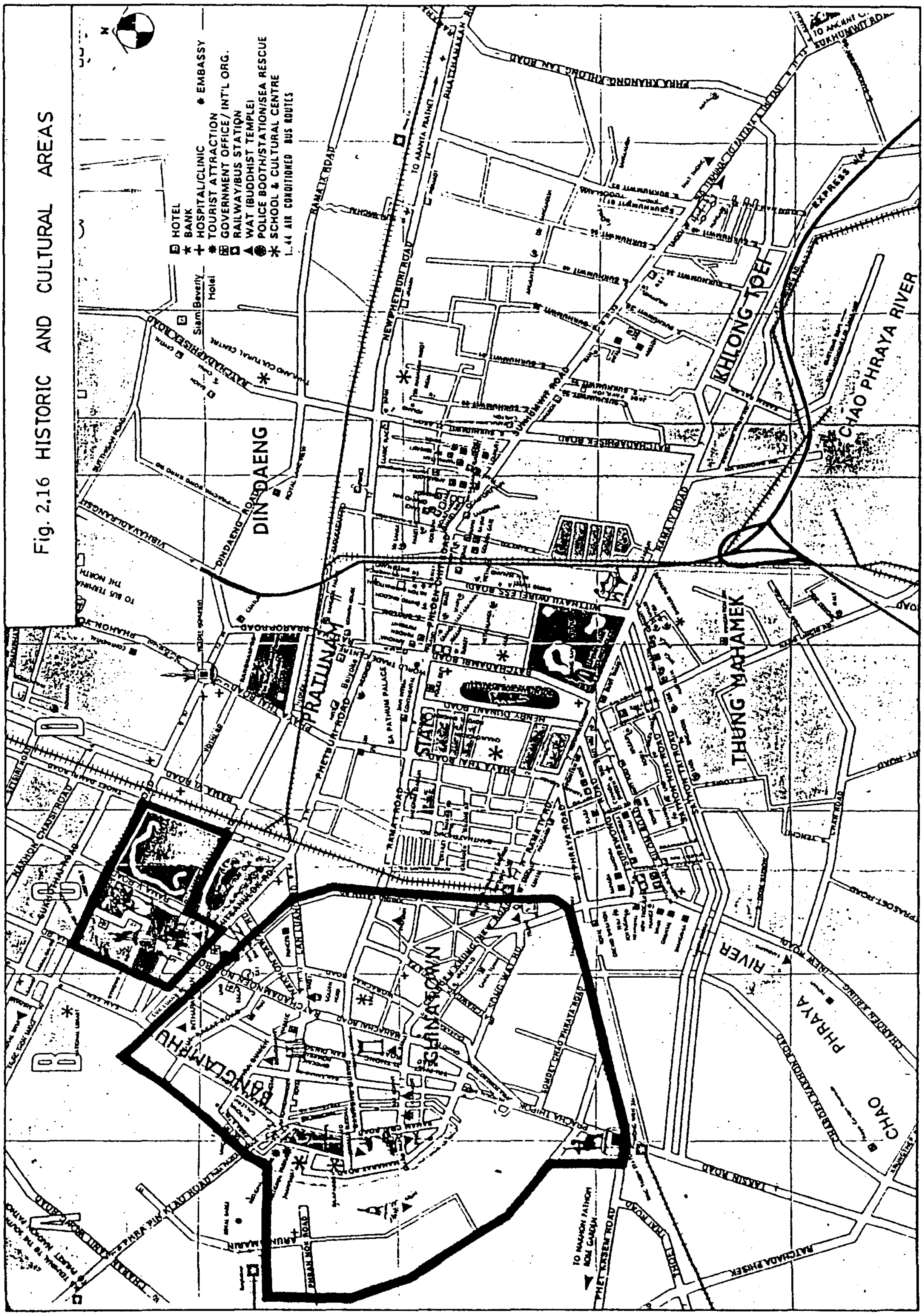


Fig. 2.16 HISTORIC AND CULTURAL AREAS

usage. We recommend using property taxes and land use controls by means of comprehensive planning and building code regulation.

3) All the mass transit systems should be integrated. The role of each system should be identified as above. The concept of PSO should be applied here. Each system should serve the needs of the commuters as part of an integrated network, rather than strive for maximum profit. Rather than compete with each other, they should be complimentary. The mass rapid transit systems should be treated as a single network when they are planned. Common stations should be provided at the points where different systems meet. The ticket and fare for the three systems should also be the same. We also recommend relocating the Northern and Northeastern Bus Station at Rangsit, and the Southern Bus Station outside the outer ring road.

4) All mass transit systems should be planned and designed to have the smallest impact on the environment. The pattern and cityscape of historic and cultural areas, especially the Rattanakosin City, must be preserved. We recommend that the government allows no "megaprojects" to pass through the historic and cultural areas shown in Figure 2.16.

2.13 Areas that Would Require Mass Rapid Transportation in the Next Twenty Years

The areas that would require mass rapid transportation in the next twenty years should be the ones with moderate to high development density. Figure 2.17 shows the potential areas with high and medium development density resulting from the analysis of urban development and trends in section 1. The development would expand from the city center outward along the following major roads:

Northward: Phahol Yothin and Vibawadi Rangsit Roads;
Eastward: Ram Indra, Ramkamhaeng, Sukha Phiban II, Sukhumvit 77 (On Nut), and Bang Na-Trad Roads;
Westward: Chaeng Wattana, Rattana Thibet, Bangkok Noi- Nakon Chaisri, Petcha Kasem, and Pra Ram II Roads;
Southward: Sukhumvit, Sri Nakarin, and Suksawat Roads.

We believe that urban development would expand considerably in the medium density zones shown in Figure 2.17. We recommend that the government uses mass rapid transit systems to guide and control development in these areas along with land-use controls.

While urban development tends to spread outward in all directions, the service area of the three mass rapid transit systems is limited mostly within the inner area of Bangkok. There are three major urbanized areas that would not benefit from the systems even though they have the highest population growth rates over the past five years. The first area includes three districts in the north of the BMR -- Muang Nontaburi, Pakkret, and Muang Pathum Thani. The second area includes Bangkapi, Bung Khum, and Lad Phrao Districts in the east. The third area includes Muang Samut Prakan, Phra Padaeng, and Bang Pli Districts in the South. The lack of mass rapid transportation, along with the inefficiency of the local bus services would make local people depend more on private transportation, and serious traffic congestion would occur in these areas in the near future.

Table 2.14 shows SPURT's forecasts for trip statistics in the BMR to the year 2006. As shown in the table, most personal trips occur within Bangkok. In 1989, public transport trips accounted for more than one-half of the total trips made in the BMA. In 2006, the proportion of private transport trips would exceed the proportion of public transport trips. From 1989 to 2006, private transport trips would increase by 79 percent, compare with 36 percent for public transport trips. Thus, there is a tendency that there will be more cars and motorcycles in the road during the peak period in the BMA and the problem of traffic congestion will be more serious than in the present.

As shown in Table 2.14, even when more than five hundred thousand passengers are served by mass rapid transportation, the AM peak PCU trips would still increase by 90 percent during the period from 1989 to 2006. The development of efficient and integrated mass rapid transit systems is, therefore, crucial in the next twenty years.

Table 2.15 shows SPURT's forecasts for future vehicles in the BMR. The region is divided into 4 zones: the central area; the inner Bangkok area that is surrounded by the Ratchada Phisek Ring Road; the outer Bangkok area between the Ratchada Phisek Ring Road and the outer ring road; and the area beyond these areas. The number of car and motorcycle ownership are projected to increase by more than 100 percent in all four areas during the period from 1989 to 2001. If the size of the areas are considered, the central area and the inner Bangkok area would experience serious traffic congestion. Thus, mass rapid transportation would be absolutely required in these areas in the next twenty years.

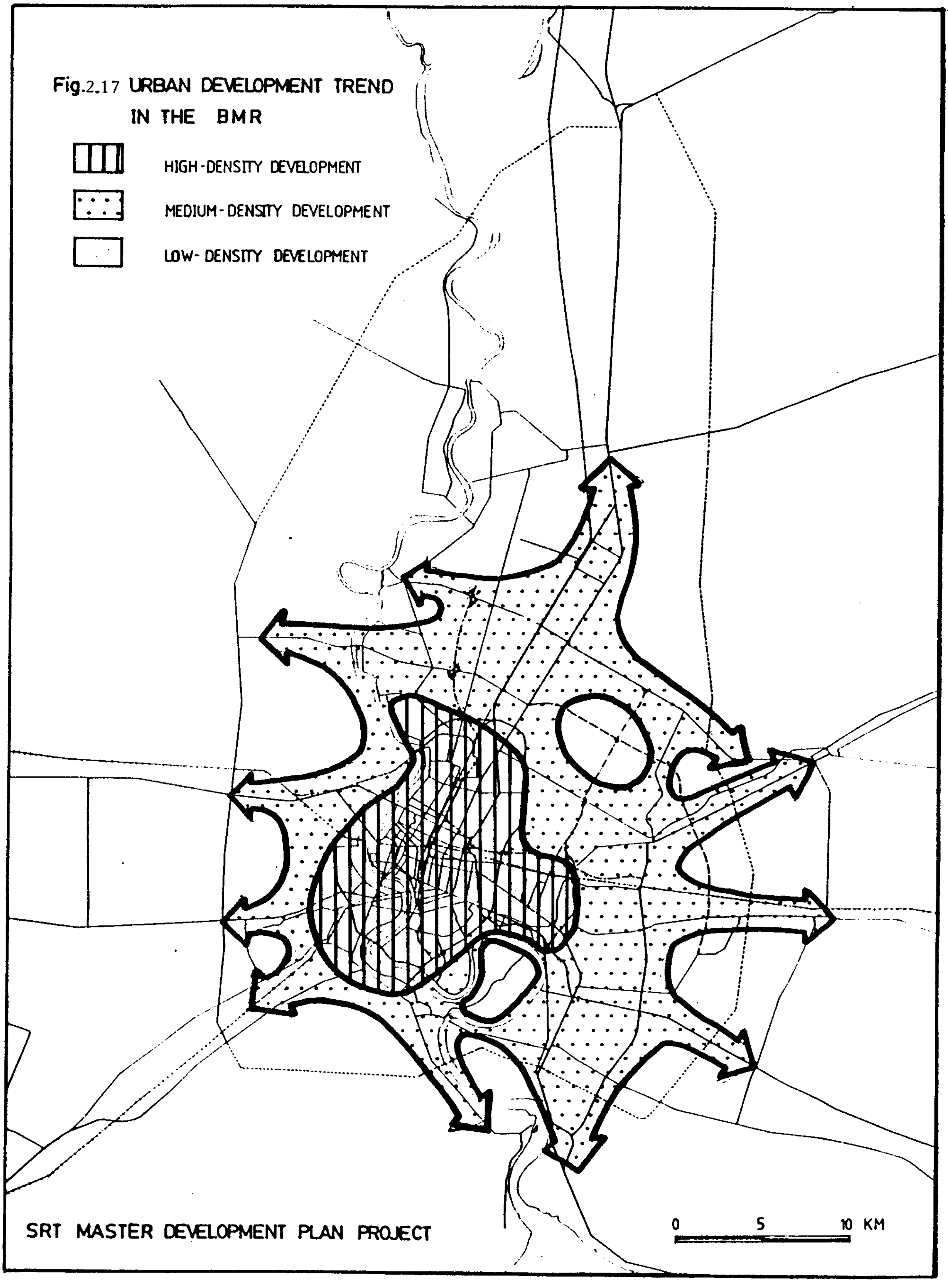


Fig.2.17 URBAN DEVELOPMENT TREND
IN THE BMR
HIGH-DENSITY DEVELOPMENT
MEDIUM-DENSITY DEVELOPMENT
LOW-DENSITY DEVELOPMENT
SRT MASTER DEVELOPMENT PLAN PROJECT
0 5 10 KM

Table 2.14
SPURT's Summary of Trip Statistics*

	Mechanized Person Trips (Per Day)				Truck Trips (Per Day)	External Trips	AM Peak PCU Trips
		Bangkok		Bangkok+Region**			
	Private	Public	Total	Total			
1989	8,520,000	9,790,000	18,310,000	20,300,000	240,000	110,000	260,000
1997	11,330,000	11,760,000	23,090,000	25,200,000	260,000	140,000	400,000
2006	15,260,000	13,270,000	28,530,000	30,800,000	280,000	190,000	495,000++
Growth (Percent) (1989-2006)	79.11	35.55	55.82	51.72	16.67	72.73	90.38

Notes: * Trips are rounded to the nearest 10,000
** The trips in the region are inter urban trips only
++ There is a correction allowed for the removal of buses due to the introduction of mass transit.
It is expected that mass transit will carry 531,000 passengers in the peak hour.

Source: SPURT, 1991.

Table 2.15
SPURT's Forecasts for Future Vehicles in the BMR

Area	Car/Motorcycle Ownership (Thousand of Vehicles)			Growth 1989-2001
	1989	1997	2001	
Central Area	190	270	390	105%
Inner Bangkok (excl. Central Area)	260	400	580	123%
Outer Bangkok (excl. Inner Bangkok)	470	840	1390	196%
Bangkok Region (excl. Bangkok)	110	200	340	209%
Total	1030	1710	2700	162%

Source: SPURT, 1991.

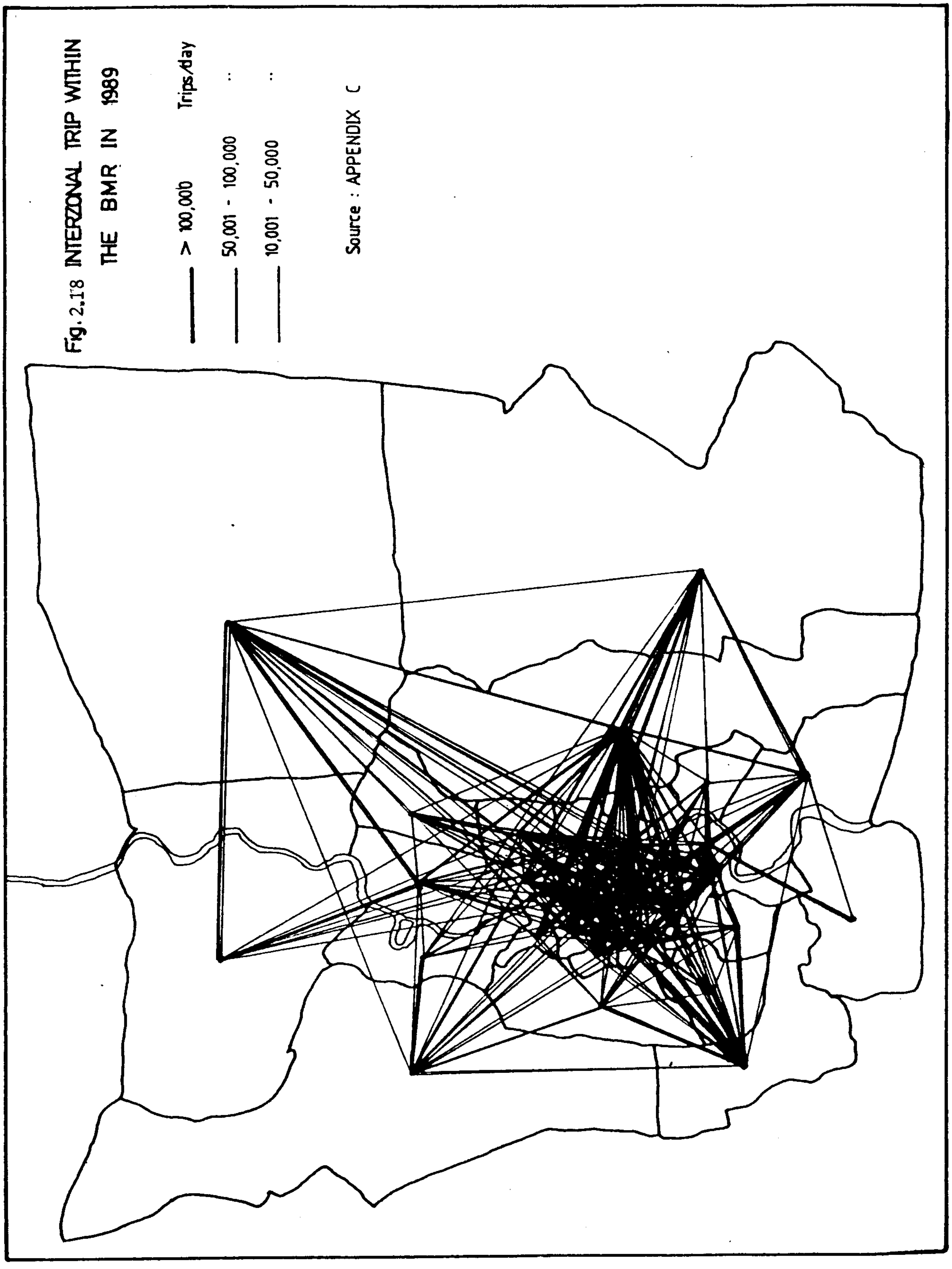


Fig. 2.18 INTERZONAL TRIP WITHIN THE BMR IN 1989

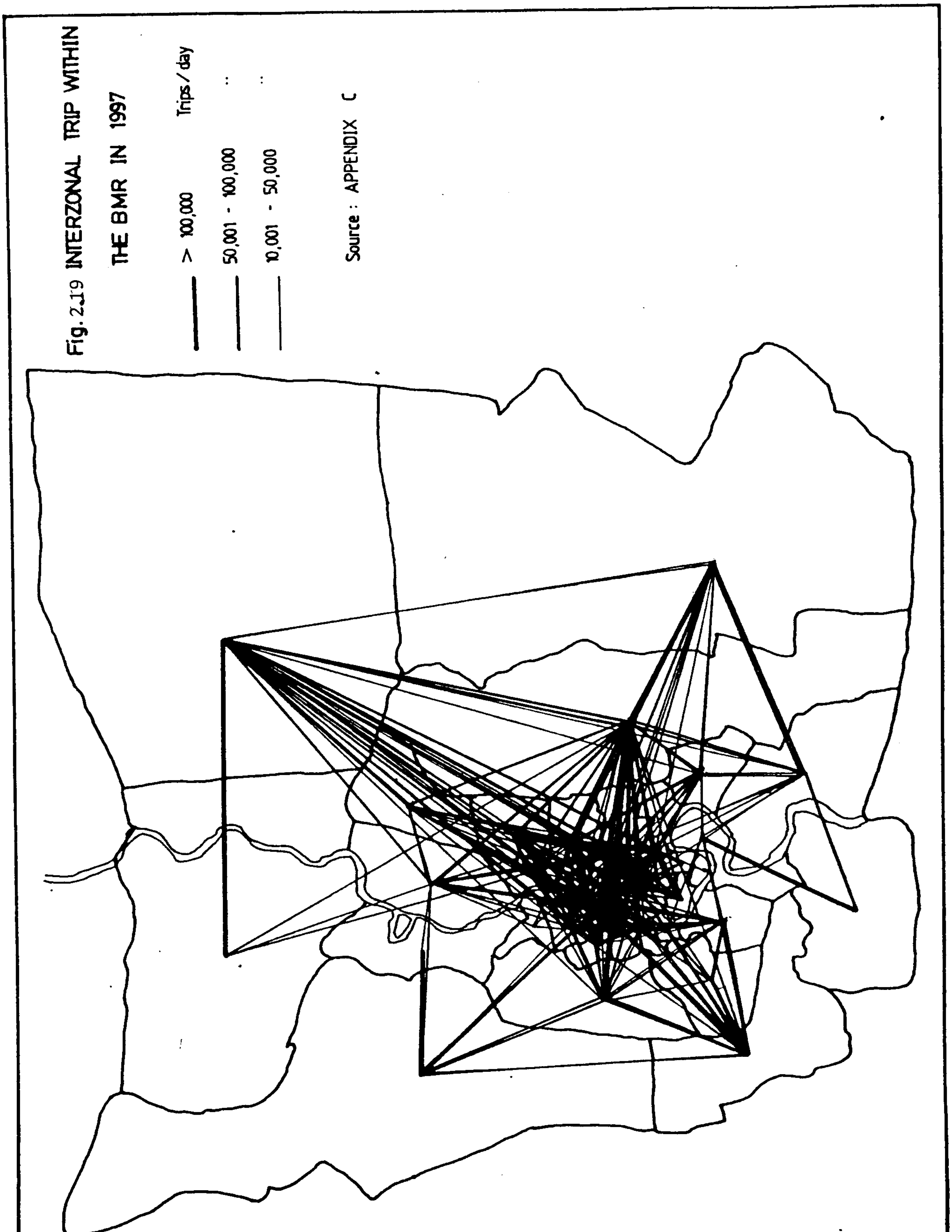


Fig. 2.19 INTERZONAL TRIP WITHIN THE BMR IN 1997

Figures 2.18 and 2.19 illustrate interzonal trips within the BMR for the year 1989 and 1997. The trip data are obtained from the estimate and forecast made by the Traffic and Transportation Research Unit, Chulalongkorn University (1991). To simplify the pre. sentation, only the trip numbers that exceed 10,000 are recorded in the figures.

As shown in Figure 2.18, nearly one-half of the interzonal trips occur within inner Bangkok (within the boundary of the Ratchada Phisek Ring Road). A number of trips also occur between this area and the areas next to it such as Nonthaburi, Pakkret, Don Muang, and Bang Khen in the north; Nong Kham, Taling Chan, Phasi Charoen, and Rat Burana in the west; Pra Padaeng and Samut Prakarn in the south; and Bangkapi and Pra Kanong in the east. The same travel pattern, also applies for the year 1997 (shown in Figure 2.19).

The above result supports the result of the analysis of urban development and trends discussed earlier.

2.14 Project Recommendations

Figures 2.20 and 2.21 present two alternatives for the SRT future commuter train system in the BMR. The first alternative (Figure 2.20) is based on the Hopewell System with recommended extensions of community train from Taling Chan Junction to Salaya, from Po Nimit to Wat Sing, and from Sri Nakarin to Nong Ngu Hao Airport. The western portion of future extensions proposed by the investor are kept intact. We recommend that the eastern portion of such extensions be removed from the scheme since its alignment is too close to the MRTS.

The second alternative (Figure 2.21) is more desirable than the first one. The recommended extensions of community train from the original Hopewell System to Salaya, Wat Sing, and Nong Ngu Hao Airport are the same as in Alternative I. The future extensions proposed by the investor, however, are replaced by a new looped mass rapid transit line. This looped line is the combination of the Hopewell extensions, from Bang Sue to Taling Chan Junction and from Taling Chan Junction to Po Nimit, and the MRTS. The MRTS portion of the looped line starts at Lad Phrao Road, running along Sri Nakarin, Tae Pharak, and Poo Chao Saming Pri Roads, crossing the Chao Phraya River to Suk Sawat Road and ends at Po Nimit. This looped mass rapid transit line would help collect and distribute passengers in the outer city areas more effectively and would help reduce the use of private cars in these areas. In both alternatives, the Makkasan-Maenum Line is excluded since the areas it intends to serve are already served by the other two mass transit systems.

In addition to the BMR mass rapid transit systems, we recommend that the SRT consider the potential express train extension from Don Muang Airport, passing Min Buri to Nong Ngu Hao Airport (Figure 2.22). This potential line would allow passengers to travel between the two airports conveniently, without having to pass through the inner city areas. It could be connected to the so-called "high-speed train" that may in the future link Nong Ngu Hao Airport with the Eastern Seaboard Region. It would help reduce the SRT traffic in the inner areas of Bangkok since the trains from Rangsit and Ayutthaya to Chachoengsao and vice versa no longer have to pass through the city center.

With the implementation of the Hopewell Project, train parking space at Hau Lam Phong will be reduced since most of the land will be developed for commercial purposes. We recommend that the SRT utilize Hua Lam Phong as the central station for mass rapid transit systems, and prepare the new central railway station at Bang Sue where more spaces are available. We also recommend that accesses for regular and freight trains be limited to the new central station. Only commuter and express trains should be allowed to pass through to Hau Lam Phong Central Station and crossing the Chao Phraya River to Bangkok Noi and to Wong Wien Yai.

Car parking spaces would also be required at major stations where private car owners can park their cars and take the community train to work. We recommend that the SRT prepare adequate parking spaces at Bang Sue, Rangsit, Don Muang, Taling Chan, Po Nimit, and Bangkok Noi.

Finally, we recommend that the SRT pay attention to the design of the elevated portion of the Hopewell System, especially when it passes through the inner city areas where its visual impact will be apparent. The scale of the system, especially the height and the width of the expressway portion, should be reduced wherever possible. The alignment of the line should conform the existing road pattern.

For community train outside the BMR, we recommend double-tracking the railways to Ban Phachi Junction, Nakon Pathom, Samut Sakhon, and Chachoengsao (Figure 2.22). Some of these lines are already double-tracked, but the other are not. This would allow commuter passengers from these areas to travel to Bangkok quickly. Combined with the mass rapid transit systems mentioned earlier, people can live outside the metropolitan area and come to work in the inner areas of Bangkok conveniently. This, in turn, would help raise their quality of living and reduce environmental pollution within the BMA.

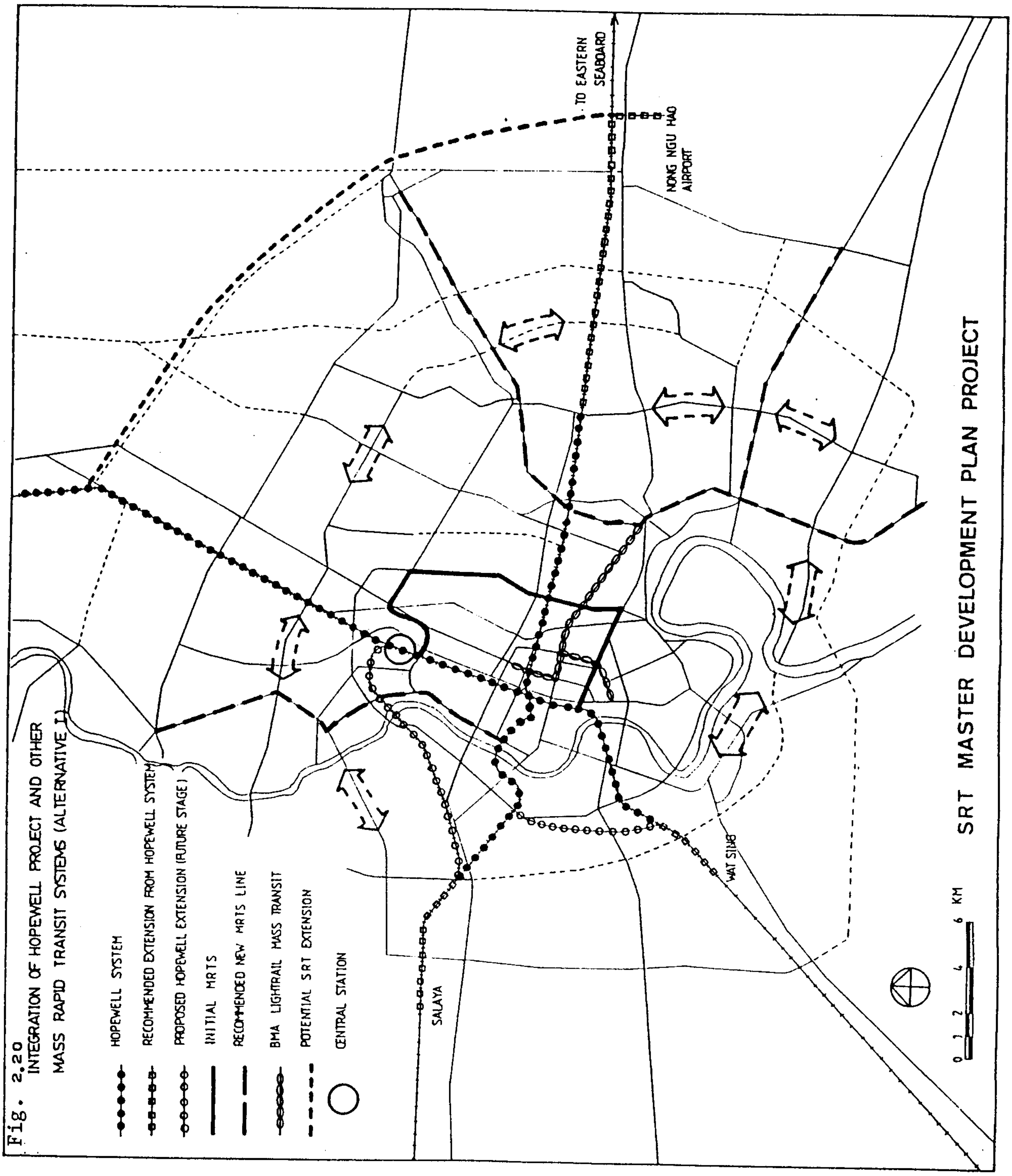


Fig. 2.20 INTEGRATION OF HOPEWELL PROJECT AND OTHER MASS RAPID TRANSIT SYSTEMS (ALTERNATIVE 1)

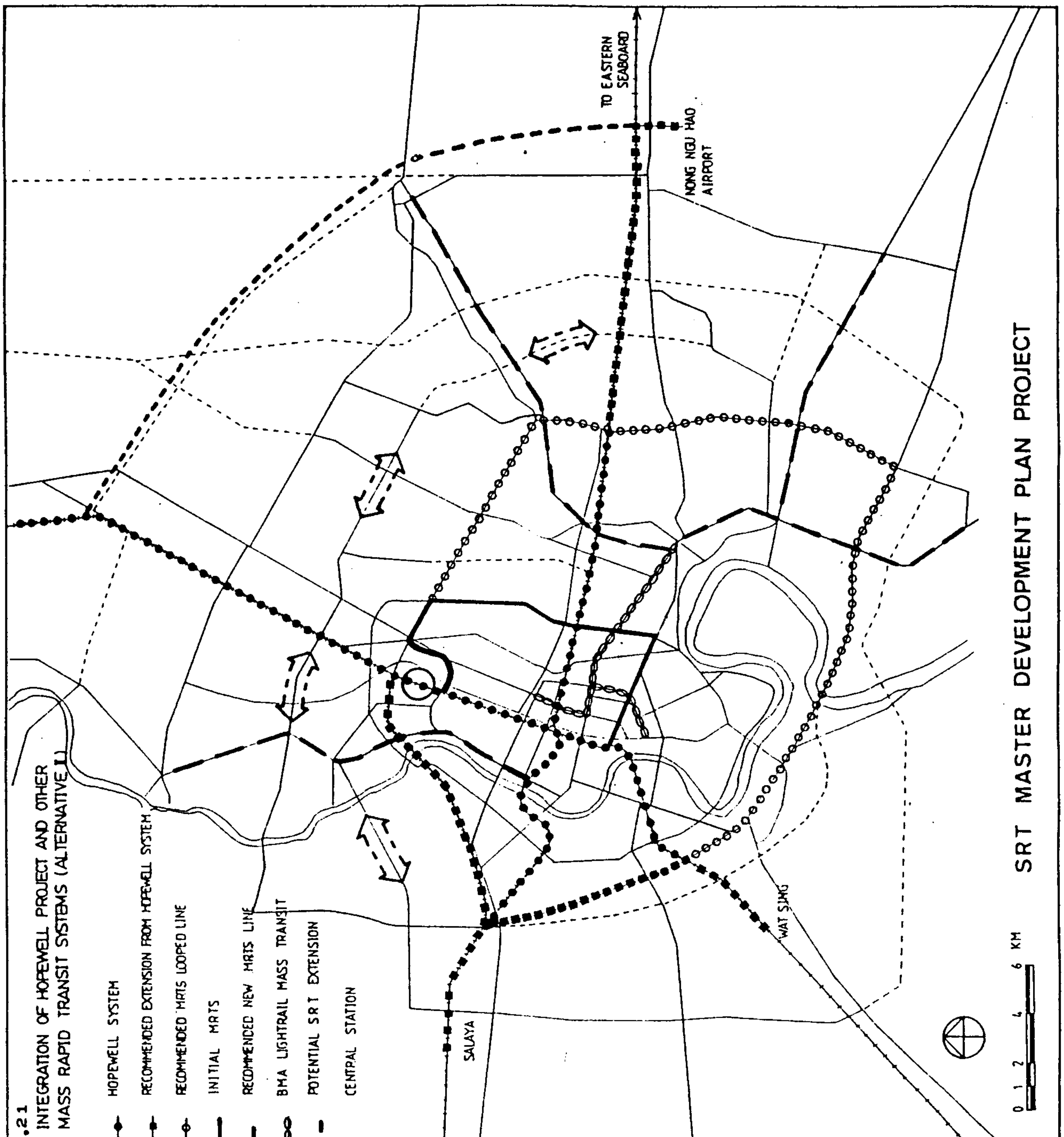
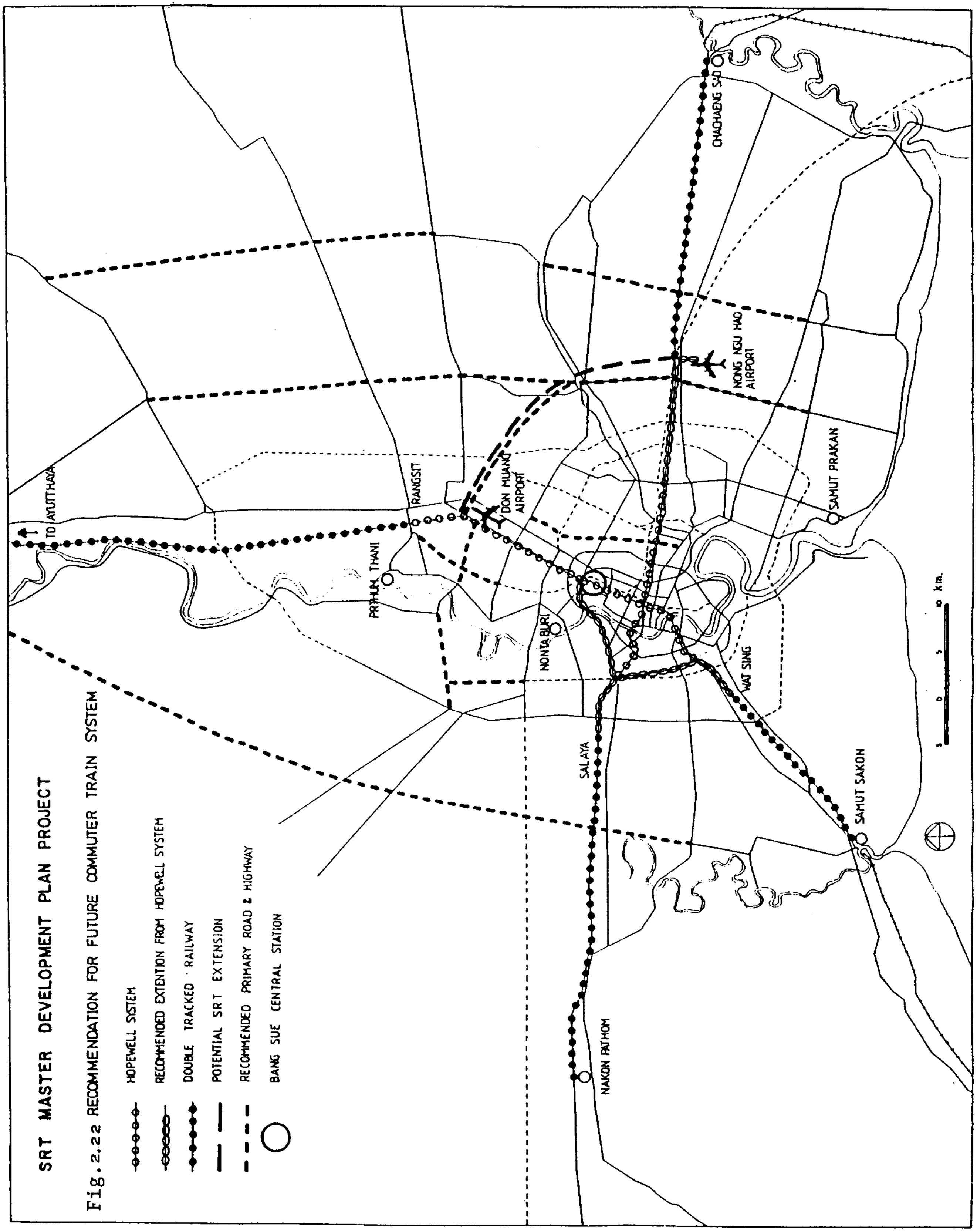


Fig. 2.21
INTEGRATION OF HOPEWELL PROJECT AND OTHER
MASS RAPID TRANSIT SYSTEMS (ALTERNATIVE I)
HOPEWELL SYSTEM
RECOMMENDED EXTENSION FROM HOPEWELL SYSTEM
RECOMMENDED MRTS LOOPED LINE
INITIAL MRTS
RECOMMENDED NEW MRTS LINE
BMA LIGHTRAIL MASS TRANSIT
POTENTIAL SRT EXTENSION
CENTRAL STATION
TO EASTERN SEABOARD
NONG NGU HAO AIRPORT
SALAYA
WAT SING
0 1 2 4 6 KM
SRT MASTER DEVELOPMENT PLAN PROJECT



SRT MASTER DEVELOPMENT PLAN PROJECT

Fig.2.22 RECOMMENDATION FOR FUTURE COMMUTER TRAIN SYSTEM

APPENDIX A
Results of the Commuter Train's Passenger Interviews

1. Sex of respondents				
	Northern	Eastern	Southern	Total
Sex	Line	Line	Line	
	(%)	(%)	(%)	(%)
Male	59.0	53.8	60.0	57.8
Female	41.0	46.2	40.0	42.2
Total	100.0	100.0	100.0	100.0

2. Age group of respondents				
	Northern	Eastern	Southern	Total
Age Group	Line	Line	Line	
	(%)	(%)	(%)	(%)
< 16	1.0	0.0	5.7	1.7
16 - 21	14.0	23.1	25.7	18.7
22 - 35	45.0	44.2	37.1	43.3
36 - 50	24.0	30.8	28.6	26.7
51 - 60	13.0	1.9	0.0	7.5
> 60	3.0	0.0	1.9	2.1
Total	100.0	100.0	100.0	100.0

3. Respondents' level of education				
	Northern	Eastern	Southern	Total
Level of education	Line	Line	Line	
	(%)	(%)	(%)	(%)
Non-educated	1.0	0.0	0.0	0.5
Primary	3.0	1.9	5.7	3.2
Secondary	18.0	21.2	28.6	20.9
Vocational	28.0	25.0	31.4	27.8
Under Graduate	36.0	48.1	25.7	37.5
Graduate of Higher	10.0	3.8	8.6	8.0
No answer	4.0	0.0	0.0	2.1
Total	100.0	100.0	100.0	100.0

4. Ocupation of respondents				
	Northern	Eastern	Southern	Total
Occupation	Line	Line	Line	
	(%)	(%)	(%)	(%)
Government Service	73.0	61.6	51.3	65.8
Student	10.0	25.1	31.4	18.3
Private Hired Employee	8.0	9.5	2.9	7.4
Businessman	4.0	1.9	8.7	4.2
Others	5.0	1.9	5.7	4.3
Total	100.0	100.0	100.0	100.0

5. Income level of respondents				
	Northern	Eastern	Southern	Total
Income (Baht/month)	Line	Line	Line	
	(%)	(%)	(%)	(%)
< 2,000	8.0	11.6	22.8	11.7
2,001 - 5,000	33.0	26.9	37.1	32.1
5,001 - 7,000	15.0	17.3	8.6	14.4
7,001 - 10,000	16.0	19.2	0.0	13.9
10,001 - 15,000	24.0	21.2	28.6	24.1
> 15,001	2.0	3.8	2.9	2.7
No answer	2.0	0.0	0.0	1.1
Total	100.0	100.0	100.0	100.0

6. Traveling purpose of respondents				
	Northern	Eastern	Southern	Total
Purpose	Line	Line	Line	
	(%)	(%)	(%)	(%)
To go home	34.0	46.2	28.6	36.4
To go to work	55.0	28.9	31.3	43.3
To go to school	2.0	15.4	28.6	10.7
To do personal business	0.0	0.0	5.7	1.1
To do business	0.0	3.8	2.9	1.6
To go on vacation	0.0	3.8	0.0	1.1
Others	9.0	1.9	2.9	5.8
Total	100.0	100.0	100.0	100.0

7. Additional means of transportation needed to complete the trip				
	Northern	Eastern	Southern	Total
Additional means of transportation needed	Line	Line	Line	
	(%)	(%)	(%)	(%)
No	37.0	25.0	20.0	30.5
Yes	63.0	75.0	80.0	69.5
Total	100.0	100.0	100.0	100.0

8. Means of transportation used along with train				
	Northern	Eastern	Southern	Total
Means of transportation	Line	Line	Line	
	(%)	(%)	(%)	(%)
Bus	68.8	79.6	48.1	68.4
Motorcycle/Minibus/Tuk Tuk	1.6	15.3	7.4	7.0
Boat	1.6	0.0	0.0	0.7
Bicycle	0.0	2.5	0.0	0.7
Private car	0.0	0.0	7.4	1.6
More than one modes of transportation	12.5	2.5	37.1	13.9
No answer	15.5	0.0	0.0	7.7
Total	100.0	100.0	100.0	100.0

9. Can respondents use other means of transportation instead of train?				
Other means of	Northern	Eastern	Southern	Total
transportation available	Line	Line	Line	
	(%)	(%)	(%)	(%)
No	5.0	0.0	8.6	4.3
Yes	95.0	100.0	91.4	95.7
Total	100.0	100.0	100.0	0.0

10. Means of transportation respondents can use instead of train				
	Northern	Eastern	Southern	Total
Means of transportation	Line	Line	Line	
	(%)	(%)	(%)	(%)
Walking	3.0	0.0	5.7	2.7
Bus	87.0	88.5	68.6	84.0
Car, Taxi	4.0	9.6	14.3	7.5
Others	3.0	1.9	11.4	4.2
No answer	3.0	0.0	0.0	1.6
Total	100.0	100.0	100.0	100.0

11. The reasons for respondents not to take the bus (Multiple selections)				
	Northern	Eastern	Southern	Total
Reasons	Line	Line	Line	
	(%)	(%)	(%)	(%)
Traffic Congestion	82.0	78.8	65.7	78.1
Overcrowding	42.0	46.2	34.3	41.7
Unrebliable time	28.0	42.3	22.9	36.0
No safety	19.0	17.3	20.0	18.7
No bus available	2.0	3.8	14.3	4.8
Others	22.0	25.0	40.0	26.2

12. The reason for respondents to take the train (Multiple selections)				
	Northern	Eastern	Southern	Total
Reason	Line	Line	Line	
	(%)	(%)	(%)	(%)
Cannot use other means of transportation	2.0	3.8	17.1	5.3
Cheaper fare	23.0	23.1	42.9	26.7
Reach destination faster	67.0	69.2	45.7	63.6
Better service	5.0	3.8	14.3	6.4
More Safety	36.0	34.6	42.9	36.9
Available trains at wanted time	24.0	19.2	37.1	25.1
More comfortable	46.0	42.3	57.1	47.1
Others	8.0	11.5	2.9	8.0

13. Suggestions for operational improvement (Multiple selections)				
	Northern	Eastern	Southern	Total
Suggestion	Line	Line	Line	
	(%)	(%)	(%)	(%)
Line	3.0	7.7	8.6	5.3
Station	6.0	9.6	11.4	8.0
Number of wagons	53.0	46.2	57.1	51.9
Ticket system	1.0	1.9	5.7	2.1
Pricing	5.0	7.7	11.4	7.0
Speed	25.0	26.9	34.3	26.2
Frequency	41.0	46.2	54.3	44.4
Others	9.0	5.8	5.7	7.5

14. Suggestions for service improvement (Multiple selections)				
	Northern	Eastern	Southern	Total
Suggestion	Line	Line	Line	
	(%)	(%)	(%)	(%)
Add more wagons during rush hrs	26.0	32.7	22.9	27.3
Keep the train clean	11.0	1.9	31.4	12.3
Keep passengers in line	9.0	0.0	2.9	5.3
Keep the train on time	27.0	28.8	34.3	28.9
Adjust the fare	4.0	7.7	0.0	4.3
Add more stations	4.0	1.9	0.0	2.7
Improve the bogies	5.0	11.5	2.9	6.9
Improve the track	3.0	9.6	8.6	5.9
Others	3.0	7.6	8.6	3.2

15. Average traveling distance from the origin to the railway station (all lines)		
Distance (km.)	Number (prs.)	%
0 - 5	62.0	43.7
6 - 10	34.0	23.9
11 - 15	16.0	11.3
16 - 20	20.0	14.1
> 20	10.0	7.0
Total	142.0	100.0

16. Average traveling distance by train (all lines)		
Distance (km.)	Number (prs.)	%
0 - 5	0.0	0.0
6 - 10	26.0	15.7
11 - 15	40.0	24.1
16 - 20	46.0	27.7
21 - 25	14.0	8.4
26 - 30	6.0	3.6
31 - 35	12.0	7.2
> 35	22.0	13.3
Total	166.0	100.0

17. Average traveling distance from the railway station to the destination (all lines)		
Distance (km.)	Number (prs.)	%
0 - 5	96.0	65.8
6 - 10	26.0	17.8
11 - 15	14.0	9.6
16 - 20	8.0	5.5
> 20	2.0	1.4
Total	146.0	100.0

APPENDIX B
Results of the Bus No.29's Passenger Interviews

				Number	%
1	Sex				
	1.1	Male		66	46.48
	1.2	Female		76	53.52
				142	100
2	Age Group				
	2.1	0-15		1	0.70
	2.2	16-21		24	16.90
	2.3	22-35		79	55.63
	2.4	36-50		29	20.42
	2.5	51-60		6	4.23
	2.6	> 60		3	2.11
				142	100
3	Level of Education				
	3.1	P.1-P.6		17	11.97
	3.2	M.1-M.6		27	19.01
	3.3	Cert.Voc. /Voc.Ed.		32	22.54
	3.4	Undergraduate		47	33.10
	3.5	> Undergraduate		9	6.34
	3.6	Dip.Voc. / Diploma		10	7.04
				142	100
4	Occupation				
	4.1	Government official		19	13.38
	4.2	Employee		86	60.56
	4.3	State Enterprise		8	5.63
	4.4	Student		12	8.45
	4.5	Housewife		9	6.34
	4.6	Doing business		5	3.52
	4.7	No answer		3	2.11
				142	100
5	Income (baht / month)				
	5.1	< 2000		7	4.93
	5.2	2000-5000		57	40.14
	5.3	5001-7000		36	25.35
	5.4	7001-10000		23	16.20
	5.5	10001-15000		12	8.45
	5.6	> 15000		5	3.52
	5.7	No answer		2	1.41
				142	100

				Number	%
6	Destination Location				
	1	Less than 1 kilometre far from railway station		61	42.96
	2	1 - 3 kilometres far from railway station		36	25.35
	3	More than 3 kilometres far from railway station		45	31.69
				142	100
7	Frequency of travelling				
	7.1	> 5 times /week		87	61.27
	7.2	3-5 times /week		36	25.35
	7.3	1-2 times /week		11	7.75
	7.4	1-2 times /month		8	5.63
				142	100
8	Objectives of travelling				
	8.1	To go to work		57	40.14
	8.2	To go back home		64	45.07
	8.3	To go to school		8	5.63
	8.4	To do business		10	7.04
	8.5	To visit friends/ relatives		3	2.11
				142	100
9	By the objectives mentioned in (8), you travel by BMTA's bus....				
	9.1	Back and forth		115	80.99
	9.2	On the going journey			
		On the return journey, by...			
			Train	2	1.41
			Boat	2	1.41
			Taxi	1	0.70
			Private	1	0.70
	9.3	On the return journey			
		On the going journey, by...			
			Train	10	7.04
			Taxi	3	2.11
			Motorcycle taxi	4	2.82
			Private car	1	0.70
	9.4	Private car		3	2.11
				142	100
10	Have you ever travelled by train to the destination identified in (6) ?				
	10.1	Yes		68	47.89
	10.2	No		74	52.11
				142	100

				Number	%
11	What is(are) the reason(s) for you to travel by bus ?				
	11.1	Cannot travel by other mode of transportation		32	16.75
	11.2	Cheap busfare		23	12.04
	11.3	Good services		17	8.90
	11.4	Safety		4	2.09
	11.5	More convenient than ot.mode		101	52.88
	11.6	Other reasons		14	7.33
	11.7	No answer		1	
				191	100
12	What is(are) the reason(s) for you not to travel by train ?				
	12.1	Crowded people		61	24.70
	12.2	No train in wanted period		31	12.55
	12.3	No safety		2	0.81
	12.4	The destination is far from the railway station		58	23.48
	12.5	The trains not on time		45	18.22
	12.6	Inconvenience services		12	4.86
	12.7	Expensive fare		8	3.24
	12.8	Other reasons		29	11.74
	12.9	No answer		1	0.40
				247	100
13	In your opinion, what should be improved for train's services ?				
	13.1	Increase routes		17	5.74
	13.2	Raise rail tracks in urban area		1	0.34
	13.3	Increase number of trains/ bogies		77	26.01
	13.4	Improve / increase station and train-stop		47	15.88
	13.5	Keep the train on time		55	18.58
	13.6	Improve timetable		42	14.19
	13.7	Improve fare rate		3	1.01
	13.8	Improve speed		10	3.38
	13.9	Improve facility inside the trains ; such as...		28	9.46
		cleaniness, seats, time annoucement			
	13.10	Others...		12	4.05
	13.11	No answer		4	1.35
	13.12	Nothing to be improved		3	1.01
				296	100

APPENDIX C

TABLE C.1 INTERZONAL TRIPS WITHIN THE BMR IN 1989 (PERSON / DAY)

O/D	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0	4308	47171	82	230	297	1047	2230	436	797	1266	62	4490
2	146	162625	991	2403	20	23	118	58	3	81	109	9	6
3	72964	45562	297587	48876	7038	696	7803	716	36	223	1491	743	2073
4	19	15249	6493	26382	175	162	957	408	15	3218	632	39	32
5	821	1996	17056	2918	15641	4231	26373	31111	274	12104	436	30	8904
6	2520	5888	4485	6870	11360	67037	69797	34529	4076	28096	9641	990	6412
7	2776	7489	10666	10163	16640	17036	89320	84438	6896	12228	3452	398	4915
8	2138	1647	647	2007	8331	3969	30143	157835	6439	4120	1449	173	327
9	2010	447	136	394	407	2256	10320	29655	16709	16144	12929	408	207
10	405	1276	82	8472	1773	1539	1936	1947	1534	18637	14602	17	15
11	1108	2701	763	2121	106	832	1042	1043	1885	21840	187364	18891	283
12	211	731	1166	482	23	289	362	423	200	87	65987	36964	8
13	28743	993	7972	909	15117	3397	14798	1996	231	168	1899	18	11681
14	6634	6668	9626	20734	9892	2421	3872	6620	1711	3093	966	78	9196
15	11612	4894	13139	20258	20732	15608	13651	26906	7932	13666	1979	157	22343
16	6683	17479	19179	23650	16911	8410	21907	28499	6652	12234	7369	259	12303
17	43	217	1048	314	100	238	208	436	66	282	261	18	1242
18	3750	4968	2482	6304	4922	3131	21712	34016	4666	8960	7901	307	2477
19	422	2040	93	644	279	120	1661	1518	161	623	710	19	632
20	1140	377	1714	298	852	509	3680	4021	179	1027	2600	283	201
21	161	311	273	221	91	70	648	783	943	2200	1665	128	98
22	1203	414	101	362	661	714	794	4113	1057	3151	2329	125	18
23	96	128	44	260	2	30	225	690	9	199	550	18	21
24	13	69	166	146	1	9	32	63	10	225	639	22	31
25	2319	2410	5518	1637	2847	512	2770	2836	725	5103	9084	601	1828
26	1521	0	3100	0	619	414	1166	663	67	684	16671	634	816
27	6063	2632	7406	6228	2108	2211	1750	7121	902	6490	139380	49097	1063
28	1101	9907	5424	12666	9087	3078	9678	19917	1656	31676	5862	377	2114
29	332	464	323	1091	890	325	2294	6592	2511	10143	4434	305	271
30	1187	1665	19483	49	3965	527	3467	3672	471	3148	1931	0	6194
31	12689	1118	6272	9961	6247	6364	13148	11366	2265	2697	13006	108	11793
32	14886	8100	52259	23466	23965	17833	6114	7678	900	2142	13042	892	28677
33	13766	74410	21616	25416	30759	13006	12340	16412	4399	7743	14842	1540	20116
34	37296	11753	130121	92809	10492	38136	34822	31460	1843	13386	32325	4228	27878
35	109682	6219	65214	8509	11467	2500	11618	6808	1162	3322	4881	141	3630
36	5391	22769	9964	95965	28964	6777	1940	3372	332	1633	18613	2426	2168
37	380	244637	3654	3786	1468	965	1564	2659	184	3660	964	61	236
38	666	2420	682	5938	3686	1421	6441	11789	2520	36675	30174	326	822
Attract	362841	673099	772924	470847	283460	218071	430349	683283	80444	289706	636244	120789	194369

O/D	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	3242	3328	239	614	999	2166	2348	617	9748	2326	280	256	136	3
2	94	51	21	106	38	360	28	37	93	160	65	20	0	0
3	6631	5927	921	20627	1054	671	5437	1273	951	3022	10719	1528	428	7
4	2052	1134	185	918	277	665	131	147	442	2172	1158	78	0	1
5	16204	22182	1918	4871	4514	5123	4926	1023	16157	299	100	1056	205	4
6	10897	38143	2690	30062	7622	5947	10416	2113	44580	10931	3058	636	396	14
7	4111	11214	2068	7473	13516	25239	23284	6628	11869	20732	3302	1307	280	3
8	3017	8369	1032	6978	8822	7879	8512	2762	27674	21327	2003	466	74	4
9	4290	13040	1276	3876	6192	4463	2032	16768	36778	1792	2008	733	36	3
10	761	1728	205	1936	796	1637	1103	3617	9968	4041	4368	416	30	2
11	390	349	224	2938	1370	2788	4213	4324	11125	16281	18057	1298	1228	60
12	94	82	28	663	180	256	1533	1065	2062	1478	1762	290	151	78
13	25800	31264	2668	103381	4368	16336	2676	1873	673	4612	6168	2914	453	4
14	73791	11575	1449	36691	841	423	620	1504	1064	1962	1149	742	5	0
15	19967	63176	5792	22901	4136	21780	21677	6047	4107	3967	607	3259	2825	50
16	19021	37737	10490	20930	19641	46561	11159	7852	28686	10101	2031	4121	2084	6
17	1358	458	58	271	107	120	46	46	313	39	11	62	14	0
18	1802	4463	2843	6306	21178	36348	9679	28181	48363	6967	3033	1991	637	10
19	38	1275	342	314	1897	24914	2491	32254	14220	8659	3996	4428	225	5
20	112	2017	196	301	1546	6069	28219	27248	33169	7747	21765	2929	1688	19
21	223	310	93	189	2796	52591	18303	80296	66190	3934	4481	2530	136	4
22	78	141	151	622	1699	11615	11026	31917	106824	6666	7033	1688	47	9
23	24	24	9	15	38	1176	446	344	1018	5964	6270	422	75	0
24	15	3	2	3	27	578	1324	415	1141	6566	6943	560	96	0
25	1238	3968	969	9568	3434	161640	32719	43162	57494	89502	109158	20765	7173	60
26	42	6843	877	2059	2043	12279	37023	4428	3155	28064	33955	17596	38573	122
27	200	15843	324	7881	4071	40403	56254	34110	93671	13284	8179	22064	20172	11906
28	3178	6819	478	8373	3065	6662	1696	2020	14243	63319	11936	1082	1268	5
29	394	6248	139	1049	1257	3893	581	14302	1902	3747	4277	472	29	2
30	15445	4446	482	74849	1520	5727	4137	51728	12468	25687	33212	6652	829	9
31	37101	12826	1396	29140	7110	23348	11337	33667	3809	33521	64778	10199	1106	11
32	70433	25476	5068	34838	9271	40718	76861	37852	17656	8968	11108	14393	2446	66
33	20368	37562	4469	6609	23973	130267	90707	134648	70972	59066	56062	49700	39966	164
34	96332	14565	5639	70646	17861	67818	20039	64977	46466	59255	181322	82999	23310	679
35	8079	4328	312	25827	2759	19648	15689	78091	33612	17519	3243	6920	1222	38
36	13313	12762	3029	2674	11709	13239	2256	9079	9600	6763	8052	9344	12198	1475
37	484	2032	365	1846	627	1762	416	366	1902	7013	696	203	159	1
38	1431	8037	362	3670	2248	5753	3336	10296	19993	17507	6671	896	441	8
Attract	461048	407768	58606	561696	193478	808944	525478	721862	862256	583842	613000	277014	160137	14832

O/D	28	29	30	31	32	33	34	35	36	37	38	Product
1	206	668	248	646	1254	3666	1864	12066	66	658	1017	111293
2	89	24	10	1	17	136	20	23	2	13996	96	182094
3	2134	658	4179	389	6912	4137	7337	14854	447	11819	1194	596762
4	679	290	1	101	531	1233	1104	215	37	2195	1367	70802
5	6667	4669	2114	1040	9266	28355	1531	4476	3263	13466	16980	290325
6	7460	4602	757	2410	14957	31552	15559	2342	719	20404	17187	525956
7	6304	11231	1248	1637	1725	7417	4362	2730	90	10669	24545	465274
8	4565	9418	632	611	878	3233	1837	645	64	7828	17577	364129
9	1918	20506	393	583	401	3074	606	684	36	2766	18594	232536
10	3673	7504	248	67	109	636	391	182	21	4896	23086	121373
11	1028	4923	256	490	1058	1003	965	602	258	2212	26627	343901
12	222	1199	0	13	218	294	602	52	141	474	1634	121375
13	3104	2257	6289	3264	14600	31708	8773	2468	248	3625	8015	374240
14	1453	1222	4888	3753	12792	7690	8829	1792	459	3028	4150	262978
15	4929	24848	2560	2506	9729	29402	3075	1933	274	20591	43630	485500
16	3445	6610	2106	1738	10940	24973	8525	1007	944	19751	15241	496613
17	161	125	917	100	229	76	243	201	8	327	379	10113
18	2892	7996	904	1352	2558	10697	3336	1124	686	6636	15208	323670
19	226	1109	255	218	938	1396	646	416	86	734	1639	111281
20	171	409	297	283	3297	4245	499	818	33	477	1719	161833
21	136	6960	2555	626	1017	2684	849	2624	80	304	4834	232536
22	472	455	307	29	436	1018	413	466	29	838	3384	202291
23	339	125	88	40	23	172	83	78	3	561	701	20228
24	68	149	118	69	32	124	242	16	4	64	262	20227
25	1218	4069	5005	2357	6539	21097	22246	5439	832	2578	7123	657450
26	2771	422	1372	634	3252	39485	7507	1518	3181	4873	8079	283211
27	1969	4236	2024	830	8962	39683	32368	7056	64921	8152	17147	728252
28	62644	11495	366	714	1551	6227	3280	2183	103	112935	96996	536076
29	1651	114960	41	172	248	1027	678	171	24	2689	114823	303441
30	494	381	18967	2079	8462	9226	8884	6750	242	1456	1926	343894
31	3723	4931	6211	4741	39959	39222	19789	6537	318	12301	14616	605731
32	3522	4475	13636	21361	91780	118116	40565	11596	1008	9087	12577	879969
33	10156	17549	18929	11858	71402	175914	45366	10278	4518	13247	26479	1365699
34	16523	17822	32387	20075	80840	121078	293299	39415	64357	28617	33408	1931889
35	4929	3162	10899	2136	11306	14740	21901	48804	2059	11939	13450	596782
36	3664	1775	1870	626	6333	19078	67992	17460	284069	6040	7391	728251
37	6047	1473	103	210	246	610	622	477	14	215296	16074	825968
38	14310	106968	244	464	806	1385	1129	929	137	32172	157106	605733
Attract	187911	413784	142302	89772	424685	805932	636933	208406	423778	604614	778060	16041788

Source : Traffic and Transportation Research Unit, C.U., 1991

APPENDIX C

TABLE C.2 INTERZONAL TRIPS WITHIN THE BMR IN 1997 (PERSON / DAY)

O\D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	Product
1	0	99	24160	7	316	342	904	973	659	642	258	89	7811	1829	2412	3318	96	3369	376	1374	111	968	139	17	849	427	451	419	346	378	4058	1779	9179	5719	77430	367	186	437	152347
2	1991	104861	14301	5384	752	737	2823	719	129	1830	633	360	278	1490	1034	3364	466	3578	1759	459	223	266	252	110	2006	0	167	3954	344	431	289	677	9639	1734	4036	279	111510	1146	284918
3	79796	2336	341489	8314	21273	1797	15103	700	119	403	687	2367	8080	8381	9625	21579	7139	7964	251	7128	613	215	403	1448	11923	3023	2242	7538	763	14308	6482	21973	23085	49912	208391	5625	7488	1150	918127
4	33	1265	12051	7601	858	634	2996	646	81	9393	397	202	204	4195	2960	9270	518	3189	430	277	114	162	489	253	966	0	340	3882	544	5	2714	2732	11130	12151	4880	759	2249	2131	102897
5	445	51	9700	258	23430	6416	25297	15076	460	10824	100	48	17190	10149	17850	29513	840	16101	965	3201	244	1702	20	7	4060	718	635	11672	2684	3588	8594	14598	78411	5162	31116	20331	4234	9066	384302
6	1517	166	2833	674	18901	81087	74363	18586	7605	27905	2421	1736	11612	7580	34097	45974	5755	31285	1270	7515	560	5559	303	227	2734	1539	2389	14506	2909	1427	22116	26172	96912	68261	18086	4978	7118	9119	658324
7	1872	237	7540	1115	29150	27130	106605	50914	12328	13604	961	777	11814	3204	11228	36540	1603	62573	8041	18822	1640	1658	1707	275	6290	1217	508	11654	8024	2636	16824	3381	25519	18297	23612	698	4168	14588	550136
8	1872	68	596	286	20182	8207	46713	123572	17483	5962	536	441	1019	3052	10880	21642	1665	53169	2449	8934	1065	5019	2279	218	2906	416	1024	12912	8747	1457	6822	2230	14443	10007	8118	644	3971	13564	426736
9	1796	19	126	57	1006	4760	16320	23692	46292	23800	4870	1061	659	4429	17299	31328	1101	32053	1415	2178	6196	6806	196	221	4676	202	765	5530	19425	1100	7947	1041	14016	2805	6693	356	1426	14642	309312
10	1040	164	222	3545	12692	9339	8798	4471	12222	70520	15814	125	137	2259	8591	11971	1582	14123	1492	3398	3977	5316	1267	1384	7603	496	1301	29653	20461	1991	2642	812	7031	6256	5998	631	7287	52257	339756
11	1168	133	844	364	307	2072	1944	963	6181	37987	83298	58020	987	475	646	6693	965	5976	1036	5323	2006	2429	2096	2344	9750	8343	17605	3600	5505	845	7868	3241	5396	6327	6785	3124	1361	24739	332525
12	205	33	1178	76	81	618	868	368	603	140	27057	104748	25	106	118	726	202	1208	88	1788	452	416	178	211	2018	948	21138	697	1237	0	192	817	1477	3643	644	1573	287	1315	177023
13	16545	27	4815	85	24050	4618	16073	1027	412	159	481	31	23718	17161	26737	40522	18925	17329	3337	1777	474	80	324	437	11973	1883	841	5771	1373	9630	28648	24429	93124	31412	18219	1639	1209	4066	454913
14	4814	189	7253	2451	19437	4149	4672	3778	3850	3703	302	184	23780	61877	12470	21649	8929	4218	109	452	480	158	173	103	3842	22	64	3407	942	11097	41520	26962	28101	39651	16683	3830	1272	2554	377911
15	7288	144	8651	2074	35957	23130	15160	15096	15433	14149	524	287	49969	14479	49644	103172	4570	17732	4851	18231	1394	534	306	39	14644	11442	8664	9092	16405	8009	23971	17741	94138	12001	15563	1978	7485	24239	864214
16	3349	411	10084	1949	22036	9962	19428	12769	10180	10115	1567	379	21973	11014	28077	141222	3335	66601	8102	8703	1732	2977	618	126	14740	6742	900	6578	3611	3303	13645	15936	63850	25672	8473	5435	5733	6731	583826
17	35	8	879	41	222	445	291	311	137	372	88	41	3537	1255	644	1323	89	191	34	45	18	52	4	1	355	72	79	389	103	2294	1218	532	305	1208	2060	58	152	257	19436
18	2358	147	1637	646	8556	4850	24164	19126	8903	7221	2094	562	5551	1310	4168	41174	1061	92011	7889	7447	7241	6298	458	236	8939	2586	1709	5874	5334	1779	12967	4859	34321	13046	9070	4962	2381	8425	377140
19	477	108	110	119	872	320	3369	1537	565	1163	339	63	2147	50	2144	10982	113	14443	10013	3382	16077	3336	1183	568	35781	1647	1526	827	1332	904	5770	3087	8081	3839	6049	1118	482	1536	143851
20	1399	22	2207	60	2213	1475	7777	4412	681	2079	1345	1014	880	159	3678	11833	117	13105	2644	41517	14719	8432	1161	3294	25664	13377	6699	678	532	1141	4927	11784	26581	3807	12884	461	339	1859	231834
21	239	22	424	53	371	244	1437	1037	4332	8377	1040	654	515	381	663	1910	89	25022	27805	32500	32791	20306	711	819	26752	1287	1855	644	10937	11848	11877	4378	21799	7819	49662	1362	261	6010	321233
22	2802	45	248	137	4251	3924	3274	8564	7633	12105	2288	845	147	205	487	1957	481	27243	9699	30731	32714	61527	1866	2020	28061	701	5939	3552	1124	2238	1042	2948	12092	5989	13606	784	1130	6946	299371
23	254	16	124	113	17	190	1062	1408	72	875	618	136	199	76	94	678	13	199	1113	1428	403	562	1941	2062	8037	1296	171	2917	357	736	1614	182	2342	1383	2651	103	867	1644	38481
24	36	9	471	64	8	57	152	129	86	1008	731	175	300	47	14	155	3	505	556	4306	496	641	2174	2323	10841	1869	129	697	451	1003	2836	256	1717	4080	572	121	86	627	39428
25	2248	109	6808	258	7621	1172	4748	2455	2177	8154	3709	1696	6312	1386	5736	21548	2944	22160	55527	37987	18399	11534	10681	13038	143562	44849	16233	3812	4180	15174	34802	16408	104260	134023	67579	9259	1446	6080	856690
26	939	0	2009	0	1067	604	1276	366	129	599	4341	961	1796	30	5358	16353	404	8717	2692	27411	1203	404	2116	2586	77673	153792	21149	6529	271	2652	8029	6839	124432	28643	12027	22580	1744	3306	545140
27	1068	22	1369	179	1026	920	646	1122	493	1847	10362	25201	661	41	4144	1618	442	4565	2528	12306	1870	3415	286	178	27748	22942	587098	1121	790	1118	2230	4585	35852	35472	15946	111223	626	2862	926040
28	1201	507	6207	2250	27393	7923	18677	19423	6600	57000	2896	1199	8217	4002	11042	14503	2904	23094	2163	2217	970	8218	8429	1606	8422	8924	1613	220707	13297	1249	11876	4918	34653	22250	30542	1288	71356	95158	758882
29	457	30	467	245	3392	1058	5597	8124	10730	23068	2578	1224	1330	627	10740	8417	460	11571	1904	960	8678	643	830	727	4644	284	621	7361	188071	175	3606	993	7220	4964	3019	378	2147	139242	443666
30	1150	85	19605	8	10591	1207	5945	3094	1418	5029	789	0	21369	17292	6396	12251	23061	10173	3000	4804	22056	2502	3037	3968	48003	5182	2375	1648	392	67490	30699	23828	48605	63539	71456	2694	817	1845	523318
31	7528	31	3282	962	10242	7501	13804	6028	4167	2840	3253	186	24936	25436	11296	21642	6496	29142	4916	8062	8796	466	2427	4007	43187	4242	1906	7136	3100	11534	42578	68907	118720	73024	42139	2168	4228	7842	838960
32	6709	103	24719	1723	29854	18962	4877	3063	1258	1593	2478	1171	46388	36685	17048	61547	4994	28470	6613	41522	7509	1648	494	617	46308	7117	8374	6125	2136	19239	146913	120248	271633	113728	67066	5224	2373	4996	1174140
33	6924	1756	11409	2082	42783	15452	10966	6932	6682	6426	3147	2257	36064	11840	28047	64097	1041	83313	23256	84696	29788	7396	3625	3478	178454	129772	23086	16601	9624	29606	80936	104403	451497	141946	66307	26125	3660	11739	1747587
34	16657	246	80960	6752	12961	40225	27526	12584	2562	8664	6066	5502	44378	49204	9652	71601	10036	64468	10718	10729	10807	4206	3232	8486	284613	67206	84834	23846	8444	45281	136687	104963	278922	814860	225825	330409	6687	13161	2892628
35	66812	178	41682	844	18006	3596	12523	3183	2194	3309	1253	251	7864	5687	3918	8393	8003	11611	4290	11383	20936	4241	1303	244	30091	4807	6524	9699	2043	20782	19656	20018	45811	82965	381361	14420	4213	7221	886630
36	1085	218	2108	3148	14996	3221	891	807	207	642	1579	1422	1565	3096	3813	17306	171	18250	948	844	604	408	167	200	13423	15446	83066	2382	377	1178	1615	3120	19687	85112	45048	657123	588	1311	1004888
37	1062	32064	10721	1723	11346	8504	7737	6648	1596	16832	1136	498	2344	1564	8436	25213	1642	12120	1738	1390	460	1101	2393	206	4058	2878	1157	81705	4365	903	8960	1999	7277	9083	17118	443	348701	39607	687771
38	918	159	864	1364	14260	4697	13479	14765	10937	89084	19678	1330	4102	2314	16703	13967	1589	21715	2858	6597	6343	5797	2991	1186	8964	3966	3250	64704	161796	1070	9697	3276	9888	9629	16681	2204	25088	193811	772003
Attract	746083	146079	843180	86999	453693	308355	527095	396226	206748	487436	211374	217111	999677	314365	365622	1017534	119821	865455	218689	426587	284345	172316	62436	59657	1142513	831864	917948	597204	492225	2? 691	780561	677839	2234945	1940918	1809682	1246745	647783	737049	22050678

Source : Traffic and Transportation Research Unit, C.U., 1991

CHAPTER 6

ADAPTING THE RAILWAY TO MEET ITS FUTURE ROLE

Chapters 4 and 5 have indicated the potential for the SRT to expand its role in meeting the future transportation needs of the nation. However, an expanded role for the SRT is only recommended contingent on certain key changes being carried out. Given the SRT's current financial position, these changes are designed to ensure that the SRT will be able to provide future services more efficiently and remain financially viable on a long-term sustainable basis. The key areas addressed in this chapter are: public service obligations (PSO); organizational requirements; technological considerations; business strategies; investment requirements; and, debt burden.

1. PUBLIC SERVICE OBLIGATIONS

1.1 Introduction

One dilemma of railways is the expectation they can offer services for the public good at prices oftentimes short of the cost of providing these services, while at the same time they are criticized for poor financial performance. This condition exists in developed as well as developing economies. Because they are criticized for overall financial performance, there is little incentive to improve efficiency, especially on those services offered which normally should generate profits. The resultant loss of management morale and of public respect only goes to worsen their financial performance.

One method of resolving this dilemma, used in many countries (to varying degrees), is to implement a system of "public service obligations" (PSO's). Such a system recognizes that it is the Government who requires the services for the public good, and therefore the Government should make any relevant decisions concerning the continuance of these services, and it is the Government who rightfully should pay for any losses in providing these services. This requires that each service be considered on its own, which in turn requires that each service be fully costed so that its individual loss be known. If the Government wishes to continue the service, it rightfully should reimburse the Railway for any losses in providing that service. In turn, this means that the Railway no longer can claim losses due to providing such services, and as such must show a profit at year-end (assuming no other direct Government intervention in their operations).

The Government of Thailand has already made a policy decision to effect such a system of Public Services Obligations for the SRT. The Study Team considers this a major and important step in ensuring effective rail services in Thailand into the future. The remainder of this section outlines how such a system should work.[1]

1.2 Government Assistance and SRT

1.2.1 The Existing Pattern of Government Assistance

Over the years since 1974, SRT has received government assistance in one form or another. Initially, when SRT ran into financial difficulty in 1974 the government had agreed to help finance the actual losses as stipulated by the Railway of Thailand Act B.E. 2494 (Section 43). However, the compensation from the central government would be forthcoming only when the Office of the Auditor General had audited the annual financial statement. Thus, the contribution payment to SRT was three years behind the actual losses. With losses suffered for consecutive years as the result of government failure to permit SRT to raise it tariff rates, the financial problems faced by SRT were very acute.

There has been a change in the financial contribution by the government since 1984. The government agreed to an appropriate annual budget to compensate for SRT losses which were projected in the fiscal year in preparation. The annual budget appropriated for SRT losses is shown in Table 1.1.

Another form of financial contribution is the yearly appropriation for tariff discounts granted to certain groups of passengers. These projected compensations appear in the budget requests submitted by relevant agencies in charge of the welfare of the targeted groups. This form of contribution also appears in Table 1.1.

The third item of financial contribution from the government is the capital investment in rail infrastructure of specific lines which have been prompted by government development policy. Most of these lines are in the Eastern Seaboard region. The size of government contribution for each line is also shown in Table 1.1. Interest costs resulting

1. For full details, see Dhiratayakinant (1992).

Table 1.1
Government Assistance to the SRT
Millions Baht

Type of Assistance	1984	1985	1986	1987	1988	1989	1990	1991	1992
1. Chachoengsao-Sattahip Line	240.0	167.3	30.9	39.5					
2. Sattahip-Mab Thapud Line			36.8	17.7		3.5	24.0	112.1	144.2
3. Sriracha-Laem Chabang Line						8.1	63.9	6.0	287.3
4. Rayong-Kaeng Koy Junction Line				1.0	3.0	22.3	99.5	106.4	89.8
5. Bridge Change in the Bangkok Line								40.0	74.0
6. Construction of ICD Rail Station									
at Ladkrabang									764.5
7. Nong Khai-Viengchan Line									22.5
8. General Administration									
- passenger income compensation		115.7	104.7	75.3	59.4	55.4	58.6	61.0	66.6
- rail police expenditure		120.3		66.0	66.5	68.4	72.2	82.0	93.2
- deficit compensation		345.0	887.3	1,028.3	874.1	1,088.9	671.6	800.0	650.0
- compensation for welfare									
fund deficit		85.2							
9. Roadblock Installation Project		4.5			7.7	6.6	4.4	4.5	12.9
10. Debt Administration				198.2	299.2	478.1	457.9	434.1	484.4
- acquisition of locomotives for									
Chachoengsao-Sattahip Line		53.1							
- payment of CFS engineering									
consultancy		1.4							
- acquisition of diesel locomotives		27.7							
Total	240.0	920.2	1,059.7	1,426.0	1,309.9	1,731.3	1,452.1	1,646.1	2,689.4

Source: SRT.

from these investments also receive due government contribution. All auxiliary investments related to these lines (e.g., the purchase of locomotives and rolling stock for newly created lines) are also financed through government assistance.

Another item of government financial contribution is the cost of rail police operation. An annual budget is appropriated for this particular service which was initially financed by the SRT budget.

The financial assistance from the government identified above suggests that some of the financial contributions by the government are clearly identified with the purpose of contribution, for example, the capital investment for construction of certain lines and the annual budgeted expenditure via relevant agencies for price discounts and free travel of certain targeted passenger groups. Though target-oriented, the contribution cannot be channeled to the service to which it should contribute. Not being service oriented, financial performance cannot be appraised for affected services.

Yet other more important contributions are neither target- nor service-oriented. In this category falls the annual budget appropriation for operating losses suffered by SRT. The contributions are not service-oriented. Hence it is impossible to isolate individual services which account for the losses and the magnitude of losses each service sustains. Since the contribution is related to the amount of loss, the need for better cost accounting for the entire operation and for each service is not felt in decision deliberation. Effective cost cutting strategy cannot, as a consequence, be formulated for relevant services.

Moreover, the timing of the contribution has not been worked out to fit the financial predicament of SRT. As a big undertaking with its need for sizable cash, the untimely contribution has added more interest cost to SRT's financial burden. Like any big company which is constantly short of cash, short-term financing, in addition to inefficiencies in staffing and in operation, has unnecessarily added more interest costs to overall financial obligations.

1.2.2 Desirable Pattern of Government Assistance

It has been widely accepted in the public enterprise literature that the objective which a given public enterprise must pursue should be clearly assigned by the government as the principal or sole owner of the enterprise. If a public enterprise is expected to be a profitable entity, it has to be allowed to pursue commercially viable activities based on the guideline of its board of directors. If a public enterprise suffers losses while pursuing its business in this manner, the accountability rests fully on its executives.

If a public enterprise is directed to pursue certain activities not normally adopted in the course of its business or against the inclination of its executive board, these activities must be singled out so that their effects on the overall operating picture of the public enterprise can be effectively identified, and overall management efficiency and accountability can be justly located. Moreover, operational improvement can also be effected more readily.

Though this principle may be widely accepted, it has not readily found its way into the actual operation of public enterprises all over the world. Thailand is no exception. However, a fruitful beginning can, and should, be made in the case of the SRT.

Government assistance should be forthcoming in the case of rail service whenever the sub-services to be rendered are the result of state initiative. In a way this approach has been partially adopted by the government over the years. It can however be improved to make the approach more transparent and service related.

Given all categories of services being offered by SRT presently, there are three principal lines of passenger/freight services that are financial viable based on the nature of scale economy exhibited in the production of rail service. These services are on medium to long distance routes. These routes will obviously connect only cities of reasonable size which can be profitably served on the same single line. These routes originate from Bangkok Metropolis.

From the national standpoint, linking also cities of smaller size to the main line (by way of branch lines) and linking small cities among themselves (by way of local lines) will enhance the overall performance of the economy via an efficient network of rail transport for people and goods. Providing transport linkages among cities and towns throughout Thailand can also be made via a road system. Such a system provides a relevant alternative to be considered.

The case for rail transport in this context is the pollution-free and energy efficient aspects of rail service. The case against it has to do with inflexibility and inconvenience; the service via road transport can be delivered very close to the origin and destination of users. Increasingly, the convenient aspect of road transport is not as attractive in big cities as in the past, because of congestion and various regulations imposed by the cities.

Another shortcoming of rail service is that the minimum scale of operation for profitable service is relatively large. This size is normally larger than the minimum demand for road transport to sustain its viability. Thus the density of passenger travel and freight traffic must be sufficiently high to economically justify rail operations. However, even with low traffic density, it may still be socially profitable to offer such a service for various reasons alluded to earlier. Thus, to the extent that the rail transport of a given section or a given area is clearly superior to the road system, there is every reason for the government to push for the setting up of rail transport.

Linkage of certain cities and towns in provinces may permit transportation of certain groups of people (e.g., students, local farmers, merchants and local citizens) to obtain education or to earn income. There may be no available alternative for this purpose in the absence of rail transport. The government can then be justified in requesting SRT to provide the required transport service for local people. More specifically, government request for the operation of branch lines and local lines may be so justified.

It should immediately be noted that each local line or branch line must be individually justified along the manner noted above before it constitutes a PSO. This point has an important implication for financial assistance from the government. That is to say, not all local lines nor all branch lines can be equally justified when availability of alternative means of transportation is taken into consideration. For certain sections of the network, it may be more economical to provide the transportation service by road. Each local line or branch line cannot be automatically justified as a PSO with implied financial assistance. If it cannot be so justified, the service should be discontinued.

In short, there are bases for government request of the SRT to provide for certain local lines and branch lines. These lines will then constitute PSO's for which some financial assistance must be worked out.

Admittedly, government directive for the provision of a service against SRT's wish may make the service a PSO, and hence implies government financial assistance. But before the government issues such a directive, it should make sure that the proposed service is indeed the most efficient means available.

With rapid expansion of metropolitan cities and their satellite towns, along with the dispersion of population over the area and the separation of work place and residential area, the need for a more efficient system of rapid mass transit has been urgently felt. Commuter trains can, and should, become a part of this rapid mass transit system for a metropolitan area and its vicinity. Commuter train service becomes a competitive alternative to other forms of mass transit because of its strength helping to ease traffic congestion and in generating least pollution to the atmosphere of a metropolis. Reduction of environmental cost to the society (i.e., cost that would have been incurred to remedy the worsening environment because of greater use of motor vehicles) and reduction of congestion costs in the metropolis justify government request of SRT to provide such a service. The request makes the commuter train service a PSO.

Pricing policy for this service imposed by the government to provide low cost city transport for users, the majority of whom are low-income earners, does not by itself make the service "more PSO," but it does influence the manner and the magnitude of the financial support given by the government.

Economic development of an area inevitably requires the existence of a set of complementary services without which the area cannot be economically viable and development can hardly occur. For instance, development of a seaboard region requires the existence of an efficient system of road and rail network and it also requires the establishment of a sufficient number of manufacturing factories to make use of the available services. Government request of SRT to set up a line for such a purpose constitutes a PSO.

Being a PSO it is the responsibility of the government to see to it that such a line can indeed be constructed, and to assume financial responsibility for its construction. PSO's of this nature may usually run into some financial difficulties initially due to its low demand; but if the development planning of the area is efficient, the venture can easily be economically viable in the medium-long term. The issue being raised in this connection involves financial assistance for the early stage of the actual operation.

Financial assistance in the early stage of operation, if such a line suffers losses due to low demand, can be justified because the losses would not have been incurred had the line not been built or the service not been continued. Even though the future demand may be sufficient to make the line profitable over the longer run, the uncertainty of the future, and the certainty of short run losses due to government decisions must be accounted for accordingly.

Commercial operation of an enterprise implies that the undertaking will price its service to recover its cost plus a normal rate of return to its investment. If the cost of providing the service is high, the price to be charged in this case must also be high. Under certain circumstances, charging a high price for a service may not be politically acceptable because consumers of such a service would actively voice their opposition against the higher price. Or users of such a service may be low income citizens, who are deemed to be worthy of assistance. Or the service is a basic input of almost all other goods and services produced in the society. The government may thus request the undertaking to hold down its service price below the true cost of providing it.

In the case of SRT, the request by the government to fix price below the service's full cost with its resulting losses constitutes a manifestation of PSO. The point is that the pricing action has not been voluntarily made by SRT as a commercial undertaking, but the action is obligated by the policy directive of the government. Note that the justification of government intervention in the pricing policy at the enterprise level can be economically acceptable when the rationale is income redistribution. Each targeted group must therefore be justified individually.

Again, under certain circumstances, the decision to give price discount may be justified via income redistribution, but the same group may not be justified to continue receiving price discounts under other circumstances. Similarly, some discount may be appropriate at one time, but it may not be suitable at other times. The extent of price discount may eventually be reduced if not eliminated altogether. In other words, price discount too must be periodically reviewed for probable future changes. However, care must be taken to avoid some manner in which price discount is implemented (e.g., low price across the board) that leads to distortion and inefficient resource utilization.

In operating a particular line, one of the decisions to be made is the number of station-stops along the route. Each stop has its operating cost in addition to the fixed cost of setting up station infrastructure. For each stop the revenue to be generated should cover the cost of operating it. On the basis of this economic reasoning a railway company will stop only at those stations where the actions are deemed profitable.

Therefore, if the government, for whatever reasons it deems relevant, issues an order to SRT to provide a station stop which is not independently made by SRT on commercial principles, the stop should be viewed as a PSO as well. This line of reasoning is consistent with the one used to justify local train service as a PSO.

We have (above) identified certain actions prompted by government policy which have led SRT to offer certain services. These services are known in modern parlance as PSO's. They include the followings:

1) Local train services and branch lines,
2) Commuter train services,
3) Complementary train service and
4) Train service at a discount.

Identifying which is a PSO is but one step in the determination of financial assistance from the government. What is also important is how the financial arrangement should be made that is consistent with the rule of costing and the efficiency principle. The arrangement includes both the appropriate level of service cost and the composition and timing of the payment. This arrangement will be discussed below.

Approaching government financial contribution via identification of PSO's is the most efficient way to enhance the performance of a public enterprise and to increase the degree of accountability on the part of the management. Each PSO is viewed and justified separately. The scope (quantity as well as quality) of each PSO can be specified for delivery at an agreed upon financial contribution and conditions for contribution. The PSO arrangement makes it possible for the arrangement to focus on planning for the efficient delivery of such services. This transparency, both with respect to its obligation to the government (via PSO's) and to the profitability of its commercial ventures, would enhance the overall operational efficiency and the financial performance of the enterprise. As a consequence, performance accountability can be separately assigned, and evaluation made. Some of these points will be further evident when certain aspects of the PSO's are elaborated in the following sections.

1.3 Costing of Government Assistance

1.3.1 Identification of PSO's: Principles

PSO's are services provided for the public at the government's request. These services are not free in the sense that they require resources to produce them. On this basis, it is reasonable that these financial burdens should be borne by the government who requests them. This much should be agreeable to all parties concerned. The relevant questions then become: how are these financial burdens determined and how are they given?

With respect to the rail service of a given PSO line, the cost of operating the line should be borne by the government. And when the service is priced, then the receipt collected should also be given to the government. Thus the net cost of the PSO service is the difference between the actual cost incurred in operating it and the actual revenue collected from the service.

The revenue collected may not be too difficult to compute; determining the cost is not as easy. The total cost of operating the service should be the one to be used in arriving at the difference. Total cost here should consist of the depreciation allowance for the capital investment in the line concerned, including both the infrastructure (rail and station) and rail cars used to carry passengers/freights. Interest cost of these investments should also be part of the total cost.

Then there are also variable costs which are incurred in operating the line. Among them are labor cost (of various skills and expertise), maintenance cost, upkeep of the station, etc. In short, the total cost of operating a line should be whatever cost that is required to operate the line efficiently, lowest unit cost for a given quality of the service. If full cost recovery is the pricing rule, the price charged by a commercial unit should be the level which is equal to the long-run average cost. If the demand falls short of expectation, a loss would be suffered by the undertaking. Even when the full demand is realized, a loss may also be realized if the price charged per trip is lower than that which equates to the long-run average cost. In either case the difference should be made up by government contribution for the operation of the line in question. The rule applies equally well to any PSO line, be it local train service, commuter trains or branch line.

The case of complementary train service for development purposes may be different from the preceding cases which were analyzed under the assumption that the infrastructure has been built. In the case of complementary train service, it is implicit in the argument that the train service would not have been provided at all if not directed by the government.

Initially, the service would be under-consumed by definition, and the variable cost of its operation may not even be recovered. Obviously, the rail company would not continue operating the service in accordance with economic laws. To keep it running in the hope that the demand would finally catch up because of development of other complementary sectors, the loss suffered by the rail company should also be borne by the government for reasons given earlier, in addition to the initial investment cost already borne by the government.

Once the variable cost has been recovered with increased demand, the government is no longer obligated to render support for the service. In the long run, the re-investment of infrastructure fixture should be based on the commercial principle. If it fails to meet the test, it should no longer be operated. If such a situation arises, it also implies that the initial decision of setting-up this particular train service in conjunction with the other complementary industries also fails. There is no reason for continued contribution regardless of the economic outcome.

In this connection it should be noted that if the government should have to invest in rail infrastructure in order to offer local train service and the like, it must shoulder this cost as well. This cost as well as the operating cost should be compared with the cost of alternative ways of providing the same type of transport service before the government decides to stick to this form of PSO.

Price or tariff discount for all passengers/freights or for selected groups for welfare, development, or political purposes, may be initiated under the directive(s) from the government which make rail tariffs below what is considered as full-recovery price, or below what is normally charged for other groups of passengers/freights. The loss suffered by the rail company or the foregone revenue that should normally become a part of its receipts should be borne by the government.

Station stops that are not normally part of the regular scheduled stops of a particular line have been argued earlier as a PSO. If the station stops are in the line that is regarded as a PSO, the entire line, not just a particular station stop, should be viewed accordingly.

However, these station stops may be forced on a normally profitable line. In this case the cost of such stops should be calculated, and the consistency principle argues that this cost should be charged to the government who orders the station stop. At any rate, such stops may actually be very few and the cost involved may be very minor in relation to the cost of the entire operation. In such a case, it may not be economical to bother with the calculation for expected compensation. Moreover, the effects on the potential profit may be very minor. In this case, there need not be any government contribution.

Yet, to prevent the public sector (by way of politicians holding certain administrative posts) from too many uneconomical interference, the standard rule should be that if station stops which would not normally be scheduled lead to a loss (i.e., the administrative cost of station and operating cost of each stop are not recovered by revenue derived from passengers/freights taking advantage of the stop), the rail company is entitled to financial compensation if it demands.

The PSO's noted above are all quite distinct in that each PSO deals with a specific service and/or specific groups. There is one situation in which the nature of government contribution may not be as obvious. This has to do with the additional investment in the overall basic infrastructure (be it rail system, signaling, locomotives, or rail cars). Here the issue is whether government contribution should or should not be forthcoming given the fact that the situation involves no government directive, and other PSO's have already been separately worked out.

Assuming that this new investment for basic infrastructure is principally for commercial services, the justification for new investment must be based on its commercial returns -- its rate of returns in relation to other form of resource utilization. The decision rule in this case is quite obvious, the government should not contribute to SRT's investment in infrastructure.

However, there may be a situation in which government contribution should be forthcoming. To appreciate this situation, it should be noted that the benefit side of the investment decision has two principal components, one being monetary returns and the other non-monetary returns. Monetary returns are mainly associated with revenues to be collected from the services utilizing the new infrastructure. These benefits accrue to SRT. Non-monetary returns are mainly the imputed values of saving from remedial actions to combat against environmental deterioration and other imputed values of life saved and time saved from more use of rail transport. These non-monetary returns are hardly captured by the SRT, although they accrue to the society at large.

Summation of these two principal values may make the new investment very attractive in relation to the expected investment cost, though monetary value of the expect benefits alone results in low rate of returns to this investment. If SRT is left to make this decision, it obviously would not invest, hence no new investment would be forthcoming. To encourage the investment, the government should contribute the equivalence of the non-monetary value to make the investment viable from the perspective of SRT. This encouragement may be interpreted as a desire on the part of the government to see the expansion of this form of service for the good of the society, and the government expresses its desire known to SRT. As such, this form of financial contribution should be regarded as part of the PSO package.

Evidently, this is a special case. It may not often happen, if the commercial service part of SRT has any meaning at all. Thus, the detailed feasibility of such investment must be examined carefully before the decision on government contribution is made. The point presented here is that there may be a situation, subject always to close examination, when some government contribution to SRT's infrastructure investment is justifiable.

The argument presented here is not the same as the one which argues for equalization of government contribution in rail infrastructure because road users are under priced for road consumption while the government finances the construction of road infrastructure. It is argued in this context that the efficient measure is to raise the cost of road users to induce optimal utilization of road transport, and not to increase non-optimal use of both transport modes by inefficient pricing (costing) of both.

Although economic efficiency dictates that actual cost of road service should be fully charged to road users so as not to subsidize them and thus inducing inefficient utilization of roadways. However, increase in road user charge may not (or cannot) be immediately enacted because of political constraints. The imbalance between road and rail transport noted earlier will then continue to exist.

In light of this situation it is thus suggested that SRT should be assisted by the government to correct the imbalance as long as the imbalance exists. But this contribution by the government should be steadily reduced by an equivalent amount collected from the raising of road user charges.

It should be stressed that the first best solution of the imbalance is to eliminate the subsidy by immediately raising the cost of road users. The suggested solution in the preceding paragraph is a second best solution to be implemented while the immediate increase of road transport cost cannot be fully implemented.[2]

1.3.2 SRT Costing System

The principles formulated above offer a general framework within which the actual baht value of the PSO can be calculated. Such principles also make sure that the contribution to be given by the government can be exactly anticipated without further ad hoc policy interference. However, the actual costing of these PSO's cannot be accurately calculated unless the costing of the rail company is well set up.

2. The caveat to all this is that while road user charges for trucks are underpriced, increasing the charges to fully cover costs are unlikely to affect the relative competitive position of rail versus road transport that much. See discussions in Chapter 4.

The original SRT cost accounting system prior to recent improvements was unable to identify the cost of operating specific lines of services. As a consequence, the operating cost of any specific line cannot be accounted for. In conjunction with the inadequate income accounting, the profitability of each line of service cannot be determined even roughly.

The major cost categories grouped by the original cost accounting system are as follows:

1) Costs associated with maintenance of rail infrastructure and other fixtures;
2) Costs associated with rail equipment;
3) Costs associated with manning and operating rail stations and terminals;
4) Other costs; and
5) Central administrative costs.

This categorization lumps labor and non-labor costs under respective groups which together constitute the total operating cost of the entire rail system. Within each group (e.g., costs associated with manning and operating rail stations and terminals), it is impossible to derive the total cost of running a rail station, or the operating cost of various types of services provided by the relevant rail station. Without proper cost assignment, it is obviously difficult to calculate the cost of running a particular type of service, much less a specific line.

Although SRT is able to reclassify its expenditure grouping to include personnel, material and supply, fuel, depreciation, and others, this categorization faces the same problem noted earlier. One may notice the absolute and relative size of each particular cost, but this information cannot facilitate the decision to reduce or to expand the operation of a particular service. Of course, in many cases where the demand for service is so low, a casual glance can yield sufficient information to discontinue the service.

On the income side, the categorization of revenue consists of the following items:

1) Passenger revenue,
2) Passenger tariff compensation (from the government),
3) Parcel and post service revenue,
4) Rentals from on-train service,

5) Rentals from hotel,
6) Freight revenue, and
7) Other revenue.

This categorization is adequate insofar as the size of revenue generated from each specific service is concerned. However, the profitability of each principal service cannot be determined because of gross cost accounting. Within a given service, the revenue generated by each subset of service (e.g., different lines carrying passenger throughout Thailand) cannot obviously be determined.

SRT is well aware of the shortcomings of the present cost accounting system. In 1988, SRT enlisted the expertise of Transmark, a subsidiary of British Rail, to reorganize the cost accounting system which would accurately, to the extent possible, assign cost to the relevant profit centers which are organized by types of service and sub-service. The cost items and assignment rules are patterned after the British Rail system.

Although the perfection of the system is expected to take several years, the output of the new cost accounting system has been produced for fiscal year 1991. It is this output of the new cost accounting system which constitutes the basis for the PSO costing to be presented below.

Before doing so, certain issues of PSO costing related to the treatment of common cost and infrastructure investment should be discussed first.

1.3.3 PSO Costing

Given the availability of a good cost accounting system, there are still a few costing problems that should be reviewed here for further deliberations. One has to do with how infrastructure cost, if any, should be assigned to a particular PSO in light of the fact that rail infrastructure has already existed and a particular PSO is but a part of the larger transport service.

If a new line is created with government directive, needed investment in infrastructure -- the cost of infrastructure and interest cost associated with it -- should be borne by the government. In such a case, the operating cost of this PSO should not include the capital depreciation allowance for rail infrastructure in PSO costing, as it has already been accounted for initially. Of course, maintenance cost of the rail system should be part of the operating cost. However, the investment cost of locomotives and wagons should be part of the operating cost by way of depreciation, unless this investment cost has been financed by the government initially as well.

If the infrastructure has already been invested and financed by SRT, then annual depreciation allowance should be a part of the operating cost of the PSO in question. In this way, infrastructure cost should be taken into account in costing the PSO, which correctly reflects the true cost of providing the relevant PSO.

Nonetheless, the cost of infrastructure and the maintenance cost of a regular non-PSO service should not be an element in the financial assistance provided by the government to SRT. This conclusion should be reasonably clear. Yet it becomes an issue because there has been an argument that while the investment in rail infrastructure and the cost of its maintenance are totally borne by SRT, the same cost items in road transport are not so borne by the operators of trucks and other vehicles, creating an unbalanced basis on costing in the two modes of transportation and in the consequent competitive position.[3]

The situation just referred to may be true in Thailand as in many other countries in which infrastructure contribution has been made by the government to equalize competitive position of alternative transport providers. However, in terms of efficiency of resource utilization the solution to this unequal competitive position among alternative modes of transport should be as follows: those who are found to be subsidized by the public (via undercharged or under-taxed) should be pressed for payment of the full amount of charge or tax so that they will be on the same footing as others, insofar as the social cost of public provision of transport infrastructure is concerned. With full social cost accounted for, each facility will be utilized in such a way to ensure equal marginal returns for all modes of transport.

Another issue is whether or not the entire cost of the service provision (or the difference between the total cost and the revenue actually collected) should be charged to the government in the form of required financial contribution. As has already been noted, the cost of the service provided by government directive should be totally borne by the government. The cost referred to here must be cost that accurately reflects the resources expended in providing the service. This assumption may not be valid to the extent that the cost accounting system still leaves much to be desired. Moreover, the cost may be accurate but inefficiency is predominant, so that the cost could have been reduced.

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3. Again, the impact on the relative competitive positions of road versus rail of under-pricing of road user charges should not be over-estimated (Chapter 4).

While the validity of cost calculation can be improved upon, which takes some time, the financial charge may have to be made much sooner. In such a case, an inaccuracy factor must be worked out that is mutually acceptable and the charge calculated accordingly.

Efficiency in the operation must be induced. Incentives must be given to reduce the cost of operation, hence the price to be charged to the government. How such an incentive structure may be built into the system is an issue to be discussed below.

1.3.4 The Issue and Treatment of Joint Cost

The costing of each individual PSO can in theory be carried out to perfection. Of course, in practice, it is very difficult to determine the actual (i.e. true) cost of providing the PSO in question. Some arbitrary adjustments must be made in costing. The need for these arbitrary cost allocation rules is greater the more extensive the prevalence of joint and common cost. Rail service involves a high proportion of joint and common cost.

There are two principal groups of joint cost in the case of SRT. One type of joint cost is the cost of rail infrastructure (e.g., track, signaling, station, terminal), and the other is the cost of administration and management. The latter is more frequently identified as common cost and indirectly supports the service provided. In contrast, the former are directly related to the supply of the service.

As for the first category of joint cost, the allocation should be proportional to the service provided by the inputs which generate joint cost. To do so it is important to identify the common element or common denominator by which the proportion of service can be established. This is also the so-called unit cost approach to costing.

For example, if the common element in track utilization is ton-kilometer, then the allocation of the joint cost of track utilization should be proportional to ton-kilometers involved in each trip of a particular line. All trips made by all lines will be converted into this common element, and unit cost per ton-kilometer of travel on the track is computed. The assignment of this particular joint cost will be the product of this unit cost and ton-kilometers traveled by a particular line (for the whole year if annual total joint cost is wanted).

All types of joint cost can be allocated in this manner. Even though the choice of common denominator or common element can occasionally be debatable, the allocation is at least objective to the extent that no personal judgment is involved in detailed calculations once the common denominator is chosen. It is the best approach when the relevant information is available.

The apportionment of the second category of joint cost cannot be made in the manner of "unit cost" suggested above. But identification of certain common elements is still needed to allocate this common cost. Generally, "revenue" generated by each particular line or a particular type of service may be used as the basis for cost allocation in the case of "general office cost". That is, the percentage of revenue generated by a particular line of service will be used to apportion the total cost of that specific common cost. For example, if a particular service in question contributes 25% of the total revenue, then 25% of the cost of this second category of common inputs will be charged to the service in question.

The approach adopted for the second category of common cost may not yield precise cost of carrying out the service; it is nevertheless a sound approach. The gain to be made by investing more efforts in coming up with even more precise calculations (i.e. marginal benefit) may not exceed the cost incurred in trying to provide more accurate calculations (i.e. marginal cost).

The allocation basis of joint and common cost cannot be perfect as long as a certain degree of judgment is involved in choosing a common denominator. However, emphasis on perfection is tantamount to an argument for non-action. It is important that the allocation basis be objective enough to be acceptable by concerned parties and policy makers. Of course, if improvements can be made in the future, efforts should be made to induce the improvements.

1.3.5 The Acceptance of the PSO Strategy and Its Cost

Although there is yet no formal PSO system in place between the government and the SRT, an approach similar to the principles inherent in the PSO philosophy has been adopted by the Thai government for many years. To begin with, the government has been making investment on behalf of SRT in rail service prompted by the development policy adopted by the government.

All price discounting for special groups of citizen are compensated for by the government through its annual budgetary mechanism. Similarly, the government is obliged to compensate for the SRT annual deficit, which is the combined result of government directives on the provision of certain lines and rail tariff setting for the whole system (as well as of course the inefficiency that may be inherent in SRT operation).

Implicit in this approach is the principle that rail transport is a public service to be provided by the government and its financial woes must be taken care of by the government. As already discussed, although the PSO philosophy may underline the assistance, the present approach is inefficient. Not least is the lack of a mechanism which can pinpoint the specific sources of financial predicament faced by rail operation.

A more efficient approach is that which identifies the relevant PSO as specifically as possible, so that separate costing of PSO's is possible. Accurate costing of PSO's is predicated on the existence of a costing system of international standard. Fortunately, SRT has, as noted earlier, already installed a new modernized international standard cost accounting system. This new system has generated the cost and income of each profit center for the fiscal year 1991 (which covers the period from October 1, 1990 to September 30, 1991). The cost has been grouped under five categories based on the principal functions performed at SRT namely, civil, mechanical, signaling, traffic and general management.

It should be noted that SRT has altogether 75 profit centers, constituting 44 profit centers catering for freight services and 31 profit centers catering for passenger services and mixed services. Within each cost center (each function) there are secondary cost centers of varying numbers. Cost items (cost account numbers) of each secondary cost center are allocated to all relevant profit centers on a basis (a rule) which is worked out and accepted by the task force responsible for the system. All allocated cost items for each secondary cost center is then totaled. The total cost of each secondary cost center is thus arrived at, and summation of the cost of all secondary cost centers under one cost center constitutes the specific function (i.e. one cost center). The adopted approach to each cost item under a secondary cost center reflects the accepted practice of international standard given the availability of needed data. Thus, the resulting cost figures are more accurate than what have been presented in all earlier official SRT documents.

The services related to PSO's comprise altogether 14 profit centers, regrouped as 3 broad types of PSO's namely, (1) Bangkok commuter service, (2) rural commuter service, and (3) mixed train service. Each broad group of services consists of several lines; 85 lines for Bangkok commuter service (including 34 lines Mae Klong-Bangkok commuter service), 63 lines for rural commuter service (including 8 Mae Klong rural commuter service), and 24 mixed train service.

The cost of operating these PSO's is presented in Table 1.2 together with their respected income. In making projections of the PSO payments, we have taken the case in which the share of the SRT in land person movement is held fixed as in 1990. From the analyses in Chapter 4, we can derive the expected growth in BMR commuting person trips and rural commuting person trips. This is given in Table 1.3, which assumes that the growth in BMR PSO commuting is at the same rate as that for inter-provincial travel within the BMR from the fixed share case in Chapter 4, and the growth in rural PSO commuting is the same as that for inter-provincial person movements within the North, Northeast, and Southern regions.

Table 1.2
The Financial Situation of PSO Operation 1991
Million Baht

PSO	Income	Outlays	Profit (Loss)
Bangkok Commuter, Total	103.7	269.4	(165.7)
Rural Commuter, Total	113.3	659.6	(546.3)
Mixed Train, Total	13.1	121.0	(107.9)
Grand Total	230.1	1050.0	(819.9)

Source: SRT.

Table 1.3
Average Annual Growth of PSO Passengers
Based On Fixed 1990 Rail Share

	BMR	RURAL
1991-96	10.14%	4.16%
1996-2001	9.24%	4.32%
2001-06	8.30%	4.60%
2006-11	7.54%	5.38%

From the assumed growth in person trips, one can make projections on revenues and expenditures on PSO lines. This is given in Table 1.4, which gives the projections from 1992 to 2011. Here it is assumed that fares on PSO lines will remain constant in real terms, starting from 1993. With the assumed 5 percent inflation rate throughout the projection period, this means that fares are assumed to increase 5 percent annually in nominal terms. On the cost side, it is assumed that the SRT becomes more efficient over time. Per person unit cost of providing PSO services is assumed to decline by 1.5 percent in real terms annually. Thus, with the assumed 5 percent inflation rate, unit cost of PSO services is assumed to increase by 3.5 percent per annum in nominal terms.

It can be seen from Table 1.4 that PSO payments are expected to increase from about 820 million baht in 1991 to about 3,750 million baht in 2011, representing an average increase of about 7.9 percent per annum. Given the growth in PSO traffic and inflation, these figures depend crucially on the fare growth and productivity increases. If fares can increase in real terms, and productivity gains are larger, then the PSO payments will not increase so rapidly. On the other hand, if the government is not willing to put up fares, then the PSO payments will have to be much greater than the figures in Table 1.4, unless some of the current PSO services are terminated.

In Table 1.5, two other cases of PSO costing are given. In the first case it is assumed that fares decline in real terms by 3 percent per annum (or increase by 2% per annum in nominal terms), with productivity gains as in the base case of Table 1.4. In the second case, fares remain constant in real terms as in the base case, but there is assumed to be no efficiency gains, so that unit cost increases 5% per annum along with inflation. In both these cases, the PSO cost to the government goes up. In the first case, the cost increases to 4,580 millions baht by 2011, compared to about 3,750 millions baht in the base case. In the second case, with no productivity gains, the PSO cost becomes even larger, increasing to 5,575 millions baht by 2011. These cases show the importance of realistic fare increase, and productivity gains to the cost of PSO services.

As noted earlier, one can always question the perfect accuracy of the PSO costing, especially of the base year on which the PSO costs of other years are estimated. The costing of these PSO lines cannot be individualized in all aspects noted in the conceptual discussion of PSO costing; it is, however, the best and the most accurate figures to date.

Table 1.4
Projected PSO Payment by the Government 1992-2011
Millions Baht

Items	Actual	Projected									
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1. PSO Revenue/1											
Bangkok Commuter, total/2	103.7	114.2	131.5	151.4	174.3	200.7	229.3	262.0	299.3	341.9	390.6
Rural Commuter, total/3	113.3	118.0	128.8	140.6	153.5	167.6	183.2	200.3	218.9	239.4	261.7
Mixed Train, total/4	13.1	13.6	14.9	16.3	17.8	19.4	21.2	23.2	25.3	27.7	30.3
Grand total	230.1	245.9	275.2	308.3	345.6	387.7	433.7	485.4	543.5	608.9	682.5
2. PSO Outlays/5											
Bangkok Commuter, total	269.4	306.1	347.9	395.3	449.2	510.5	575.6	648.9	731.6	824.8	929.8
Rural Commuter, total	659.6	710.1	764.6	823.2	886.3	954.2	1,028.8	1,109.2	1,195.9	1,289.4	1,390.3
Mixed Train, total	121.0	130.3	140.3	151.0	162.6	175.0	188.7	203.5	219.4	236.5	255.0
Grand total	1,050.0	1,146.6	1,252.7	1,369.5	1,498.1	1,639.7	1,793.1	1,961.6	2,146.9	2,350.8	2,575.1
3. PSO Payment											
(PSO Cost to the Gov.)	819.9	900.7	977.5	1,061.2	1,152.5	1,252.0	1,359.4	1,476.2	1,603.4	1,741.9	1,892.7

Source : SRT for Actual

Notes:
1. Assume that fares increases by 5% per annum from 1993 in line with inflation rate.
2. Assume same growth as in Table 1.3 for Bangkok Commuter.
3. Assume same growth as in Table 1.3 for Rural Commuter.
4. Assume same growth as Rural Commuter.
5. Assume that the SRT can reduce real cost per passenger by 1.5% per year (efficiency gain) so costs per unit increases by 3.5% per annum (inflation at 5%)

Table 1.4 (Continued)
Projected PSO Payment by the Government 1992-2011
Millions Baht

Items										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1. PSO Revenue/1										
Bangkok Commuter, total/2	442.5	501.3	568.0	643.5	729.1	820.5	923.4	1,039.2	1,169.5	1,316.1
Rural Commuter, total/3	286.8	314.3	344.5	377.5	413.8	456.7	504.1	556.4	614.2	677.9
Mixed Train, total/4	33.2	36.3	39.8	43.7	47.8	52.8	58.3	64.3	71.0	78.4
Grand total	762.4	852.0	952.3	1,064.7	1,190.7	1,330.0	1,485.8	1,659.9	1,854.6	2,072.4
2. PSO Outlays/5										
Bangkok Commuter, total	1,039.6	1,123.7	1,163.1	1,203.8	1,245.9	1,383.4	1,536.1	1,705.7	1,893.9	2,103.0
Rural Commuter, total	1,502.9	1,624.6	1,756.1	1,898.4	2,052.1	2,234.3	2,432.7	2,648.7	2,883.8	3,139.8
Mixed Train, total	275.7	298.0	322.2	348.2	376.4	409.9	446.3	485.9	529.0	576.0
Grand total	2,818.1	3,046.3	3,241.4	3,450.4	3,674.5	4,027.6	4,415.0	4,840.2	5,306.7	5,818.8
3. PSO Payment										
(PSO Cost to the Gov.)	2,055.7	2,194.3	2,289.1	2,385.7	2,483.7	2,697.5	2,929.2	3,180.3	3,452.1	3,746.4

Notes:
1. Assume that fares increases by 5% per annum from 1993 in line with inflation rate.
2. Assume same growth as in table 1.3 for Bangkok Commuter.
3. Assume same growth as in table 1.3 for Rural Commuter.
4. Assume same growth as Rural Commuter.
5. Assume that the SRT can reduce real cost per passenger by 1.5% per year (efficiency gain) so costs per unit increases by 4% per annum (inflation at 5%)

Table 1.5
Alternative PSO Scenarios (Million Baht)

	1991			2001			2011		
	Revenue	Outlays	Cost	Revenue	Outlays	Cost	Revenue	Outlays	Cost
Base Case	230	1,050	820	682	2,575	1,893	2,072	5,819	3,746
Case 1	230	1,050	820	535	2,575	2,040	1,238	5,819	4,580
Case 2	230	1,050	820	682	2,950	2,267	2,072	7,647	5,575

Note: Base Case is as in Table 1.4. Case 1 assumes that fares declines 3% per annum in real terms (increasing 2% per annum in nominal terms), with productivity gains as in the base case. Case 2 assumes that there is no productivity gains, but fares remain constant in real terms as in the base case.

It is interesting to note that PSO costing was attempted earlier by a ministerial task force based on the previous cost accounting system. The previously projected PSO cost for the year 1991 and the present actual PSO cost are both presented in Table 1.6. The former registers slightly higher outlays incurred in offering PSO's. However, the PSO cost to the government is lower because the projected revenue from PSO's exceeds the revenue actually collected from operating PSO's in the same year. Note also that the new projected PSO cost based on the actual PSO cost for the year 1992 far exceeds that previously projected. The comparison conveys an important message that the PSO cost to the government will keep going up and increase rapidly if these PSO's generate very low revenue because of low fares for these services, while associated outlays in operating these PSO's keep rising, even at a slow rate. If the government is unwilling to pay for the ever rising cost of PSO's, it must not insist on having SRT offering all PSO's, or it needs to review the tariff setting policy.

1.3.6 Total PSO cost to the Government

In addition to the PSO's noted above it has also been suggested that the service offered on the development lines (in the Eastern Seaboard) as part of the development program (of the Eastern Region) should be subsidized during the early stage of operation, when the potential demand for service has yet to be realized. The estimated cost of this particular PSO for the period 1992-1996 is shown in Table 1.7.

Table 1.6
Comparison of PSO Costing for 1991-1993 (Million Baht)

PSO	Projected 1991 1	Actual 1991 2	1992 Based on 1	1992 Based on 2	1993 Based on 1	1993 Based on 2
PSO income	574.6	230.1	586.3	245.9	598.5	275.2
PSO outlays	1,085.8	1,050.0	1,129.5	1,146.6	1,174.1	1,252.7
PSO cost to the Government	511.2	819.9	543.2	900.7	575.6	977.5

Source: 1. Ministry of Finance, 2. From Table 1.4.

Table 1.7
Projected Government Cost for Development of Lines 1992-1996 (Million Baht)

	Actual	Projected				
PSO						
	1991	1992	1993	1994	1995	1996
Development Lines						
Income						
Deep-sea Container-Trainload	54.1	58.5	63.1	68.2	73.7	79.5
LPG Gas-Trainload	26.8	28.9	31.3	33.8	36.5	39.4
Outlay						
Deep-sea Container-Trainload	57.8	61.3	65.0	68.9	73.0	77.4
LPG Gas-Trainload	29.2	31.0	32.8	34.8	36.9	39.1
Cost to the Government						
Deep-sea Container-Trainload	3.7	2.8	1.9	0.7	0.0	0.0
LPG Gas-Trainload	2.4	2.1	1.5	1.0	0.4	0.0
Total	6.1	4.9	3.4	1.7	0.4	0.0

1. Assuming annual growth of 8%
2. Assuming an increase of 6% per annum
Source: SRT for 1991 Actual.

Table 1.8
Projected Government Payment of Price Discounting 1992-1996
Million Baht

	Actual	Budgeted	Projected *			
	1991	1992	1993	1994	1995	1996
Price Discount	61,022	66,590	72,583	79,115	86,235	93,996

* based on 9% annual rate of growth (for the years 1991-1992).
Source: 1991 figures from SRT, 1992 figures from SRT Budget Submission document 1993

Price discounts which are given in conjunction with government welfare policy for certain groups of citizens is also considered as part of the PSO's in this report. Table 1.8 shows the estimated cost of price discount given by SRT in response to government policy for the period 1992-1996.

It would also be proposed that part of the total debt presently shouldered by SRT can be traced to the delay in government compensation of annual loss suffered by SRT. The lag pattern of the subsidy over the past 10 years is shown in Table 1.9. The reason for this conclusion is that if the subsidy had been paid on time, then there would not be any need for SRT to incur interest cost to cover its financial shortfall in its day-to-day operations. The official lag for the subsidy payment should be one fiscal year. That is the loss incurred in year 0 would be submitted for subsidy in year 1. Any payment beyond year 1 constitutes delay which forces SRT to cover its cash short-fall with short-term borrowing. Table 1.10 estimates the interest cost of the shortfall for a period of 10 years. This interest cost could have been saved if the government had paid its subsidy on time. It therefore constitutes a subsidy to be paid to SRT by the government. Instead of payment in one lump-sum, this amount of debt subsidy may be spread over the next 5 years (1992-1996). It constitutes an addition to the annual PSO cost to the government.

The total amount of annual payment by the government to SRT over the next 5 years due to the adoption of the PSO strategy is shown in Table 1.11. This schedule assumes that the debt subsidy is spread over the next 5 years. Table 1.11 also shows another schedule of the PSO payment by the government when the debt subsidy is assumed to be paid in one lump-sum.

Table 1.9
Actual Government Subsidies for SRT Losses
Millions Baht

1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
221.8	>>>>>>>	>>>>>>>	>>>>>>>	221.8							
	382.4	>>>>>>>	>>>>>>>	382.4							
		331.3	>>>>>>>	283.2	42.2						
			1,074.2	>>>>>>>	473.8	300.0	300.0				
				1,034.9	506.3	>>>>>>>	528.6				
					985.7	574.1	>>>>>>>	411.6			
						550.1	260.0	>>>>>>>	290.1		
							592.0	260.0	332.0		
								795.3	178.0	479.2	138.2
									779.0	170.8	608.2

Source: SRT
Amounts underlined indicate the fiscal year in which the SRT loss occurred
Amounts not underlined indicate in which fiscal year the corresponding subsidy(ies) were paid to the SRT by the Government.

Table 1.10
Estimated Interest Cost Incurred by SRT
Due to Late Payment of Subsidy (Million Baht)

Fiscal Year	Loss Suffered	Interest Cost
1982	221.8	66.4
1983	382.4	76.5
1984	331.3	38.0
1985	1,074.2	197.5
1986	1,034.9	105.7
1987	985.7	82.3
1988	550.1	58.0
1989	592.0	33.2
1990	795.3	75.6
1991	779.0	60.8
Total	6,746.7	794.0

Note: Interest assumed at 10% per annum.

Table 1.11
Projected Cost of the PSO Package 1992-1996
Million Baht

	Actual			Projected		
PSO's						
	1991	1992	1993	1994	1995	1996
Regular PSO services	819.9	900.7	977.5	1,061.2	1,152.5	1,252.0
Development lines	6.1	4.8	3.4	1.7	0.4	
Price discount	61.0	66.6	72.6	79.1	86.7	94.0
Debt subsidy (1)		158.8	158.8	158.8	158.8	158.8
Total PSO cost to the	887.0	1,130.9	1,212.3	1,300.8	1,398.4	1,504.8
Government (1)						
Debt subsidy (2)		793.9				
Total PSO cost to the	886.9	1,766.0	1,053.5	1,142.0	1,239.6	1,346.0
Government (2)						

(1) Spread debt subsidy equally over 5 years.
(2) Debt subsidy is assumed to be paid in one year 1992.

1.4 PSO's and Operational Efficiency

1.4.1 PSO's and Improvement in Operation

Identification of PSO's to be carried out by SRT represents one big step towards long-term improvement in SRT total operation. The financial assistance associated with PSO's conveys the "contracting out" approach to service provision. That is, SRT delivers the requested service at a price to be paid (in part) by the government who demands it. Alternatively, the government, instead of providing the service itself, contracts SRT to provide the relevant service at an agreed-upon price.

The price charged would be the lowest if there is competitive bidding among potential providers of the service. However, in the case of SRT, which is a monopoly, there is an inherent issue of monopoly rent as well as operational inefficiency to be dealt with. Would the price charged to the government for the requested PSO actually be the lowest price? In other words, would the service be operated most efficiently? Is there any mechanism by which a monopoly is forced to operate most efficiently and not to incorporate its monopoly rent into the price of the service?

These are the relevant issues to be borne in mind. Accepting PSO does not necessarily mean that the government should accept the price charged by SRT without demanding that SRT itself must constantly strive to offer its services most efficiently. Constant improvement in its operation should be expected and, indeed, demanded.

1.4.2 Discontinuation of PSO's

PSO's should not be a permanent fixture of rail transport. Rail transport of a particular form and/or in one particular locality is considered necessary only to the extent that there is no alternative that can provide the same service at a lower cost, and the cost of the chosen alternative (hence PSO) is not too unreasonably high. Unless the PSO in question meets these requirements, that PSO should not be adopted or be continued (if already existing). Thus, PSO's are not something that must be permanently provided for.

One approach to make the operation of any PSO most efficient is the condition that it be reviewed yearly or at short intervals. If a more efficient alternative is available, the PSO in question will be discontinued. By operating the relevant PSO most efficiently, its continued availability is more assured.

Of course, from the standpoint of SRT, the availability of any PSO is not the issue. By definition, PSO is the type of service that would not have been provided if SRT must make its own decision based on commercial principles. If the government does decide to discontinue the PSO in question, so much the better for SRT. This line of reasoning is well accepted.

Yet, operating the service more efficiently and eventually generating more revenue than the cost incurred should become the principles governing SRT operation. Such expectation is probably achievable, because SRT must also operate its other commercial services most efficiently as its financial viability is at stake. If it tries to do so with its commercial services, how could it, or why should it, fail to do so with the PSO services?

The discrepancy in the operational principle can be easily detected if such a situation exists. The cost accounting system will convey gross inefficiency in the operation of PSO.

Categorization of PSO in the manner previously noted for the determination of relevant financial contribution by the government is much more efficient than straight financing of SRT's annual deficit. The government, in cooperation with SRT, can detect the principal source(s) of financial drain. Individualized PSO can be reexamined for its viability as a public service, and a decision to discontinue a particular PSO can be efficiently made.

1.4.3 Improved Efficiency and PSO: Implication on PSO Costing

If inefficiency of PSO operation can be identified through the cost accounting system, then it is possible to suggest improvement in the operation. Improved operation usually implies reduction in the cost of providing PSO (actual cost reduction and/or quality improvement). It helps to reduce the financial burden borne by the government. Reduction of this financial burden should be the aim of the government-SRT relationship.

Given the present stage of SRT development, it is highly probable that whatever the cost of providing a particular PSO is, this cost can be further reduced. It can be done either by improving the operation or by increasing demand for the service. The net result is the reduction of the difference between the actual cost of operation and the revenue actually collected. For the government, this will lead to a reduction in the cost of providing that particular PSO. The financial contribution made by the government is reduced by a corresponding amount.

The issue in this connection is how to induce cost savings efficiency in the PSO operation when the benefit of cost reduction would not accrue to SRT. Although it can be stipulated in the government-SRT contractual arrangement that SRT must reduce its cost by a certain percentage point for its handing of PSO's (either by reduction of PSO operating cost and/or increase in PSO revenue). Yet this requirement would not be effective unless penalty and reward are part of the package.

Examples of penalty clauses may be as follows. When the PSO philosophy is adopted, SRT should be able to improve its operational efficiency for the commercial as well as the PSO services. If no efficiency gain is reported within a period of (say) 5 years, privatization of SRT, in whole or in part, may be contemplated. Details of the privatization strategy may be worked out so that gradually the whole SRT will be streamlined with the private sector sharing a bigger part of the rail business and may eventually take over the whole rail business.

Similarly, if the efficiency gained is reported in the commercial sector of SRT operation but no satisfactory progress in efficiency for PSO operation is observed, then the government may privatize these PSO services, with the hope that private entrepreneurs could do better. This may be a way to prevent SRT taking advantage of the government from PSO operations. Another way would be some agreement that if SRT fails to reduce its PSO cost (i.e., the PSO price tag chargeable to the government) by an agreed-upon percentage, the PSO contribution by the government may be reduced by a certain percentage.

Reward structures can also be built in to the PSO agreement. If, for example, SRT can reduce PSO costs by more than some agreed upon amount, the PSO contribution could, if that is agreeable, be increased by (e.g.) half the amount of the additional cost reduction. This approach conveys that cost savings actually realized would be shared equally by the two contracting parties. Unless such a system is instituted, it is quite difficult to induce more efficient performance, particularly at the initial stage of cost accounting improvement.

An alternative approach is to compute the percentage of the shortfall against the revenue actually collected for a selected base year, and government contribution will be equal to the value of that percentage times the revenue collected in the respective year. This percentage would be reviewed periodically. Such an approach can be viewed as reasonable only for the first two years while waiting for a better and more exact cost accounting. The fixed percentage applied in a later year will induce more efficient operation from the demand side, not the cost side of the provision. The more revenue collected, the greater will be the value of PSO. Long-term use of this approach may cost the government more, because revenue actually collected may be greater than the operating cost if efficiency on the production side is also affected and taken into account.

Ultimately the standard accounting system should be utilized for valuing each PSO and contribution made accordingly and in the manner proposed earlier.

2. ORGANIZATIONAL REQUIREMENTS

2.1 Present SRT Organization

The current SRT departmental organization is shown in Figure 2.1. This organization structure is departmentalized along the line of its prime objective designated de jure by putting greater emphasis on operation of daily services associated with delivery of passengers and freight. The marketing function necessary for growth in revenue is not emphasized in the organizational status. The positioning of divisions in the right department is problematic in the existing structure. The horizontal departmentation and divisionalization is a mixture of characteristics of functions, geography, and processes of service delivery. Project organizations are frequently set up to carry out special tasks.

The hierarchical chain of the SRT is "top down", descending from the General Manager on the top level to Deputy General Managers, Assistant General Managers, Department Directors, Bureau Directors, Division Heads and Section Heads. Generally, unity of command at the SRT is achieved by the set targets authorized and controlled by the General Manager, but it also depends upon the management and leadership style of each General Manager. However, SRT's span of control is rather long and centralized around the General Manager. The General Manager delegates authority to each of the three Deputy General Managers. In the same manner, Deputy General Managers assume their authorities by assigning tasks to their subordinates descending along the hierarchical chain. Such a type and extent of authority delegation makes communication between each level of the chain too slow to achieve efficient and effective management. It reflects a usual bureaucratic culture normal to the Thai bureaucracy in general.

STATE RAILWAY OF THAILAND

Current Departmental Organization

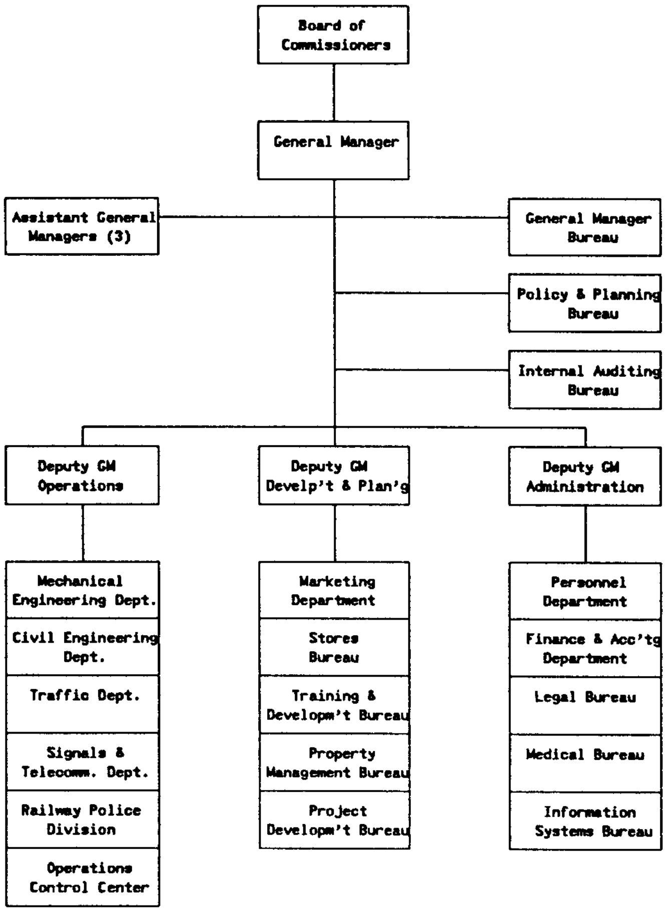

FIGURE 2–1

As far as the issue of centralization and decentralization is concerned, the SRT stands in between the two poles, but puts greater emphasis on centralization. The power of decision-making and command is centralized by the General Manager. On the other side, tasks and responsibilities are not only decentralized from the top to the lowest levels, but also to regional branches all over the country. Regional offices carry out the tasks and responsibilities with bounded autonomy. They will report back to the Bangkok office only on technical and policy issues. The decentralization of tasks and responsibilities to the lower levels and regional offices has been achieved through authority delegation clearly specified in job descriptions for each SRT official down to the level of section head.

In principle, there are 5 types of mechanisms for coordination in an organization. They are mutual adjustment, direct supervision, standardization of work processes, standardization of work outputs, and standardization of work skills. In general, coordination of work in the SRT, especially under the operations function must be strictly achieved because of the necessity to operate trains in a safe manner. Therefore, the SRT has to apply mixed methods of standardization of work processes and standardization of work outputs together. However, where the market demand for passenger and freight services is concerned, like anywhere in the Thai bureaucracy in general, coordination between transportation supply on the one hand and market demand on the other hand is a thorny subject. Under the "Vicious Circle of Loss" that gives rise to scarce resources, the SRT faces difficulty in providing sufficient passenger and freight cars to meet market demand. As a consequence, the SRT losses revenue by approximately 15 percent. Besides, constraint to coordinate work on this particular issue may result from the prevailing culture embedded in the SRT. That is an "Engineering or Railway Culture" which exerts greater importance on only running trains on the basis of designated schedule and available resources. Moreover, concentration of manpower in the operation function, approximately 93.5 percent, quantitatively displays an imbalance of bargaining power in the SRT.

Fitting the individual (personnel management) in the SRT's organization structure has a dual nature -- there are both problems and potential. In the first place, problems exists in the SRT's division of labor and manpower. In some departments or divisions, there is insufficient manpower to cope with the work load, especially the operating core in the regional offices. There is a problem of manpower enlargement. In the second place, there is a problem of recruiting qualified manpower with certain educational background and experience, for example business administration, etc. This is a problem of putting the right man in the right job. In the third place, personnel management and promotion in the SRT are still under the influence of patron-client culture and political pressure, which may create an uncomfortable and discouraging working atmosphere. In the fourth place, there is a problem of brain drain, especially of those with engineering and computer backgrounds. In the fifth place, there is no formal evaluation of work performance for the SRT's officials as well as efficient methods of work motivation. In the sixth place, lacking a relevant philosophy of personnel management, for instance, management by objective, setting up a sound career path for officials from below to the top, management of the SRT's organization lacks full efficiency and effectiveness, and to some extent is incapable of utilizing its manpower to the greatest capacity and potential. This may in part be the result of the impact of having large numbers of personnel management rules and regulations to intensively control work processes.

However, on the other side of the same coin, the SRT has good job descriptions for its officials down to the level of section heads, and a clear salary structure. The existence of good job descriptions and a clear salary structure does help to reflect organizational progress, but this needs to be coupled with a good evaluation and merit system.

In summary, the analysis of SRT's organization structure and scope of operations above displays excellent potentials for the future. It possesses inherent capacity for organizational development. Although problems and constraints of efficient and effective management are present, they are not too problematic because the SRT's organization has been quite adaptive internally. It is for the next step necessary to investigate other external and internal issues, especially the legal and policy environment under which SRT operates, in order to relevantly identify the most crucial issues as a basis for SRT's organizational development.

2.2 SRT Legal and Policy Environment

The SRT has carried out its functions under the governance of the State Railway of Thailand Act of B.E. 2494 along with the Railway and Highway Provision Act of B.E. 2464. These two Acts, especially the first one, lay out the organization establishment, fund and reserve, supervision, control, management and organization superstructure of the SRT, and its relationship with the government and others. Analysis of several titles of the SRT Act of B.E. 2494 indicates that this law lays out broad opportunities for political intervention from outside in the context of general administration and personnel management, including investment projects which require Cabinet approval for budgets. If the SRT has to be modified or changed into a commercially oriented organization in order to sufficiently survive and efficiently cope with market challenge, several titles of this Act will have to be modified and changed. Besides the above-mentioned laws, the SRT has to operate under, or subject to control and coordination with other government agencies by other laws. They are the Budget Act of B.E. 2502, National Economic and Social Development Act of B.E. 2521, Budgetary Method Act of B.E. 2502, Auditor-General Act of B.E. 2522, Government Organization Establishment Act of B.E. 2496, Qualification Standard for Public Enterprises' Committee and Officials Act of B.E. 2518, Public Enterprises Accounting and Finance Rule of B.E. 2520, Public Enterprises' Capital Investment Budget Rule of B.E. 2522, Traffic Act of B.E. 2522, Public Enterprises Relation Act of B.E. 2534, and Prime Ministerial Rule for Privatization of Public Undertakings, B.E. 2534.

Recently, proposed by the Ministry of Finance, the Cabinet has decided on and approved the principles of "Being Good Public Enterprises." The rationale behind this Cabinet decision is to improve management principles, supervision and control of public enterprises by focusing on decentralization of administration to public enterprises.

It is evident that there are a large number of laws governing the operations of the SRT. There are several outside agencies to supervise, control, and coordinate the SRT. For instance, the Ministry of Communication formulates commercial policies, the Office of the National Economic and Social Development Board determines investment budget in accordance with the National Plan, and the Ministry of Finance functions to supervise financial management on the basis of efficiency and economy. These three superior government agencies intensively apply the principle of direct control which frequently causes misunderstanding, unawareness, and incapability to operate effectively. In the case of the Ministry of Finance, formerly the SRT had to propose financial procedures to them for approval. This also included the interpretation of the organization and manpower, since it involved a great deal of expenditure and had a lot of impact on the SRT's finance. This detailed and strict control created the above-mentioned problems and was realized by the Ministry of Finance. Gradually it has changed the control principle and attempted to introduce new procedures in order to facilitate strength and success of all public enterprises towards self-reliant development under the scheme of "Being Good Public Enterprises" mentioned above.

There are 5 variables under this scheme as follows. Firstly, in regard to the rate of delivering revenue to the government, public enterprises that are not limited companies such as the SRT must be capable of returning revenue representing 30 percent of their net profit. Secondly, the rate of return on assets has to be above or not less than 6 percent. Thirdly, the rate of expenditure per capita to total expenditure has to be no more than 20 percent without depreciation value. Fourthly, growth rate of production should be no less than 2 percent per year. And lastly, privatization or private participation in the enterprises has to be under appropriate rates which are subject to the determination of the Ministry of Finance. Whenever any public enterprise meets the above principles, and once approved by the Cabinet, such public enterprises will be granted greater management authority, and the Ministry of Finance will relax several control procedures. These are financial rules, manpower, structure and salary rate, welfare and other fringe benefits. Therefore, any public enterprises can apply to participate in this "Being Good Public Enterprise" project. It is ironic, however, that in at least the case of the SRT, the rewards are necessary first before the conditions can be met.

Since its establishment in B.E. 2494, there has not been any important amendment of the SRT Act. The only important change in the law is recent, but the subject matter does not deal with the improvement of organization structure and management principle to allow the SRT to cope with environmental and market challenges. The first amended point is to give more authority for the SRT to deal with trespassers of the SRT's properties. The second is to allow SRT to undertake joint ventures by making use of the SRT's properties and other activities. This second point is designated by the Prime Ministerial Rule of B.E. 2534, that allows the private sector to participate in public enterprises. The latter point seems to give some hope to the SRT in the light of how to add value to its properties and services. However, in regard to its organization structure and management, it is still problematic if there is no amendment to the SRT Act and development of its management accordingly, and especially when there is a need for the SRT to develop into a business-like organization in the future in order to be self-sufficient and survive in the changing environment.

From the analysis of the SRT Act of B.E. 2494 in the light of transforming the SRT into more of a business organization, there are at least 7 titles that need to be amended. The rationale behind these are:

1) To increase the autonomy of the SRT board (Title 8),
2) To widen opportunities for the SRT to undertake non-rail business (Titles 9, 13 and 43),
3) To facilitate private participation in the SRT's business (Title 19),
4) To prevent political intervention and increase autonomy in

undertaking business (Title 21),
5) To prevent empire building in the SRT (Title 28).

If these Titles are not appropriately amended, it will be difficult if not impossible for the SRT of the future to play the commercially viable role in the Thai economy which is now desired by the Government.

2.3 Recommended Organizational Changes

Over the years, several changes have been made to the SRT's organization structure. It would serve no purpose here to evaluate these changes, but it is noted that change seems to be relatively easy to effect. Providing of course that change is well planned and for a good purpose, it is encouraging that such change has taken place. Especially in the changing transportation market in Thailand, the SRT's organization structure must be dynamic and able to adapt to changing conditions.

The following changes are recommended for immediate consideration. They reflect the organizational needs resulting from the recommendations in this report. The discussion is divided into 3 organizational areas: Operations & Maintenance, Marketing and Personnel.

2.3.1 Operations & Maintenance

In Chapter 2 of this report, we showed that the SRT has been relatively effective in its ability to operate trains and maintain property. During a 20 year period of cash shortages, there has been steady increases in the number of passengers and freight tonnage transported, and average train speeds increased. There have been some difficulties in maintaining a satisfactory level of on-time performance, but these are seen as being related to the condition of resources (especially the advanced age of locomotives), rather than a reflection on organizational capabilities. As a result, we have no reason to suggest any major changes to the SRT organization for operations and maintenance. A couple of philosophical points need to be considered, however.

The current level of decentralization between Head Office and Districts appears to be satisfactory. To the extent possible, decision making capability on daily operations should be at the local level. There are exceptions to this, however. One concerns the assignment of diesel locomotives. With the exception of yard engines, the SRT should consider centralizing this function. Locomotive needs, especially related to freight services, change geographically mainly due to the season. Also, locomotive scheduled maintenance periods can be better planned on a global basis in consideration of system-wide availability requirements. Most railroads have found it to be a more effective way to control these expensive assets by centralized control. In the same way, other expensive assets that need to be shared, should be centrally controlled.

As mentioned above, decisions related to daily operations should, to the extent possible, be made at the District level. As a general rule, the function of the Head Office is to set policy and standards, and to carry out strategic planning. With the advent of better communications equipment and improved management information systems, it will become possible to allow for more and more local decision making without the Head Office losing overall control. In this light, there is a need to develop better information systems related to budgeting and expenditure control. The current system of accounts is not conducive to effective management control, and the current reporting is not timely enough. The Head Office must monitor the performance of the field management, and performance information (especially related to financial control) must be timely enough to allow for corrective action as soon as a problem occurs.

Lastly, we consider an organizational issue concerning the autonomy of the three main operating departments -- Traffic, Civil Engineering and Mechanical Engineering. Historically in most railways, these three departments have developed as very autonomous entities, who see their duties as not requiring significant coordination with the other two. This is also the case at the SRT. Generally this premise is true, because their specific objectives are not the same (e.g. run trains, maintain equipment, maintain infrastructure). There are overlaps between these objectives, however, at which point the objectives may be in conflict. For example, maintaining track at the highest efficiency is in conflict with running trains, especially on lines near capacity. As the SRT further develops, these conflicts will become more severe (to expand our example above, as the Civil Engineering Department moves more to automation of track maintenance in order to gain cost efficiencies as well as improved track structure, they will require lengthier uninterrupted periods of track time to use the machines, thus interfering more with train operations). There are many examples where the objectives of these three departments may come into conflict.

Because of these conflicts, there needs to be an ever-increasing amount of cooperation between these departments. Also, in cases where the Departments themselves cannot resolve the conflicts, there needs to be a management "referee" at a level not too high in the organization to preclude him from becoming involved. Therefore, it will become more and more important that these three Departments in the future report to a common position, not too highly placed within the organization. (For example, it has been proposed to add another Deputy General Manager (DGM), with one DGM responsible for Traffic, and another responsible for the two Engineering Departments. According to the principle above, this would be counter-productive, because it would push the position of commonality between the three departments to the level of the General Manager.)

2.3.2 Marketing

In order to become a commercially oriented enterprise, the SRT will have to increase the size and importance of its marketing organization. Furthermore, there is required a basic change in the philosophy of executive management. We shall discuss this philosophical change first.

The public, and therefore the Government, sometimes feel that as owners of the railway, they should receive from it the services they want, at the prices they would like to pay. It is in this light that the SRT of today is judged by almost all concerned (with the notable exception of the Ministry of Finance). As in other countries, this has led to railway services that may not be required, and service prices that are too low to sustain the services. The result is the requirement for annual subsidies to cover operating losses. The size of these subsidies usually do not allow for required levels of new investment, resulting in a gradual deterioration of railway resources. This deterioration leads to further growth in the cost of operations, leading to ever-increasing subsidy requirements.

Due to this cycle of subsidy requirements, the public in fact is not achieving its desire for low railway transportation costs. It is they, in the end, who must pay the subsidies. In fact, the current cost (fares plus subsidies) of railway operation to the public is higher than necessary, because the current system of subsidies does not lead to management preoccupation with efficiency of operations. It is for this reason that a system of PSO's, as defined in the previous section, is in the public's best interests. Once such a system is established, however, it remains necessary for SRT Management, at all levels, to become commercially oriented. This requires attention to markets, and their development. As such, the marketing organization becomes one, if not the most, important function within the railway.

It will be proposed below where the marketing organization should fit in within the overall organization. The marketing organization itself must be dynamic, with skilled managers and analysts. It must be responsive to customers' needs, which means it needs to be decentralized to some extent. It must be able to work with customers in developing transportation solutions, rather than act as a sales agency for services developed internally. It needs to be organized in such a way as to develop specialists in the lines of business of its major customers (e.g. for freight marketing, the Marketing Department might have Managers for each major commodity group). It needs to be strongly involved in the railway's planning processes. It needs to have available reliable information systems, including historic data required to develop transportation trends. It needs to have an accurate system for developing costs.

All of the items above, and many more, need to be considered in defining a logical organization for the marketing function within the SRT. Such an analysis is beyond the practical limits of this study, but it is strongly recommended that the SRT carry out such a study immediately. In the course of that study, the SRT might consider visiting several successful railways (freight and passenger) throughout the world, to obtain first hand knowledge of how their marketing functions are organized, and what are the strengths and weaknesses of that organization.

2.3.3 Personnel

To become a commercially successful enterprise, and maintain that success over the next 20 years, it is necessary for the SRT to be very competitive. It is for this reason that we have emphasized above the need for increased marketing skills. There is another area of competition, however, which will become more and more critical -- competition for skilled personnel. This is especially true for management personnel. The SRT already has a significant problem in retaining good management staff, partly due to low salary levels and partly due to a morale problem. Both issues will be considered here.

The issue of salaries does not require in-depth analysis. Although SRT labor salary levels are competitive, management salary levels are not. The SRT cannot achieve the levels of success envisaged by this report unless it has dynamic, qualified and motivated management staff. This is not possible unless salary levels are competitive with outside industry. It is a fundamental point, therefore, that management salary levels will need to be increased in general. The most efficient way to achieve this is to allow the SRT to set its own salaries, without Government interference. The possible exception to this is the salaries of senior executives, which may be set by the Ministry of Transport and Communications. Failure to pay management staff competitive salaries will ensure that many of the benefits that might otherwise be achieved by restructuring cannot be realized.

STATE RAILWAY OF THAILAND

Proposed Departmental Organization

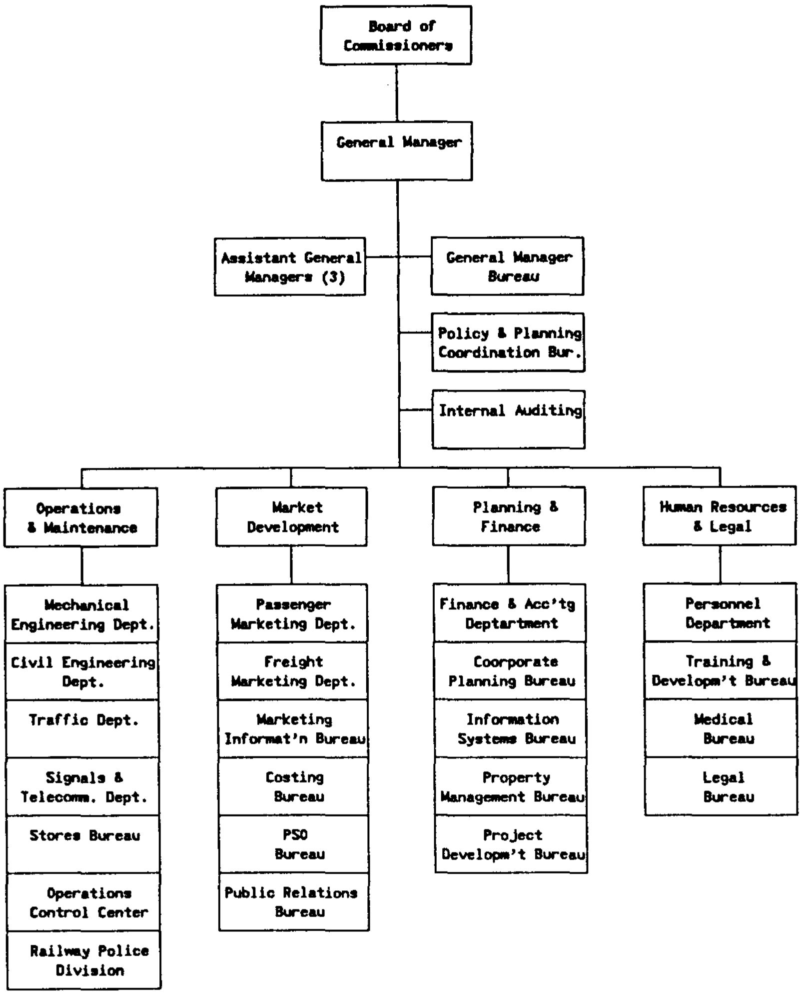

FIGURE 2–2

Motivation is not provided by salaries alone, however. The management of human resources is a very specialized field, involving organizational and individual career planning, clear definitions of authorities and responsibilities, a system of performance appraisal (including merit increases in salaries), and management skills training. As with the Marketing function, it is recommended that the SRT review the human resources management organizations and systems of other, successful railways. This should take place immediately after the problem of salary levels discussed above is resolved, and should be followed by a technical assistance program to define the new SRT personnel organization, and develop the necessary systems.

2.4 Proposed Departmental Organization

In order to structure the SRT for its role of the future, we have outlined above 2 management functions that need to be enlarged and put in a position of prominence in the organization. These are Marketing and Personnel. The Departmental Organization chart in Figure 2.2 shows how these 2 functions could be included. Due to the resultant increase in work load, an additional Deputy General Manager has been added to the organization. This in turn puts increased demand on the General Manager, but it is felt that many of the routine functions at the General Manager level associated with the 4 Deputy's areas of responsibility can be delegated to the numerous staff positions already attached to the General Manager.

In creating the new organization, it has been recommended that the SRT study similar organizations in other railways. It is further recommended that SRT seek technical assistance for this work, to assist in defining the organization in detail, and in developing the various systems that will be required. The proposed organization shown in Figure 2.2 is therefore an example only, and will more than likely be modified as a result of this further study by the SRT. Our chart indicates, however, the level of importance that marketing and personnel need to be given in the organization.

3. TECHNOLOGY CONSIDERATIONS

3.1 Definition and Role of Technology

Technology is generally defined as the know-how which enables the transformation from the inputs to the outputs in a manufacturing process.[4] A railway organization is a service organization which sells the service of transportation as its product. Manufacturing activities, although they exist, are not deemed to be its core activity. Therefore, the definition of technology is hereby broadened to embrace all scientific know-hows which enable an activity or a function. By this definition, technology permeates all departments, divisions, and functions of the railway organization, though at different levels of intensity. For the purposes here, we will concentrate on the departments mostly affected by technology, namely, the Traffic Department, and the three engineering departments - the Mechanical Engineering Department, the Civil Engineering Department and the Signaling and Communication Department. All four departments are usually under the Deputy General Manager or Vice- President for Operations.

The image of a railway as a technology-based organization was well-entrenched in the early days where civil engineers built tracks and mechanical engineers drove the locomotives to explore undeveloped parts of the country. Today, the railway organization has developed into a complex business entity which becomes more and more market and demand driven like any other business undertaking. The Marketing Department generates business by offering the right product at the right price in the right place, or by creating new services through promotion. To define its present and future services, the Marketing Department has to work closely with other departments, particularly the Traffic Department. The Traffic Department, in turn, runs trains with the support of the three engineering departments.

The role of technology in railway organizations is therefore primarily to enable efficient and effective operation of services by reducing cost, ensuring safety, and saving energy. It should be noted that the role of technology is to provide a supportive role to business rather than vice verse. However, this does not exclude the possibility of a new technology bringing in new business, as clearly demonstrated in the case of high-speed trains at present and magnetically-levitated trains in the future.

3.2 Categories of Technology

3.2.1 Traffic Department

The main function of the Traffic Department is to operate train services by balancing the market demand as determined by the Marketing Department and the supply avail-

4. TDRI(1989).

able from three engineering departments. The level of support depends on the number and performance of trains available from the Mechanical Engineering Department, the capacity and integrity of tracks under the responsibility of the Civil Engineering Department, and the signaling and communication systems managed by the Signaling and Communication Department to enhance operational efficiency and safety.

Based on the supply and demand constraints, the Traffic Department draws up train charts, sets train schedules so that tickets may be sold to passengers and freight be handled. It handles coaches and wagons at terminals by classifying and blocking, and by making up trains with the purpose of optimum utilization of locomotives and maximum utilization of coaches and wagons. Most railways have computerized the Seat Ticketing and Reservation System (STARS) to make maximum utilization of seats, and the Operation Control System (OCS) to know the physical location of all the rolling stock. The train traffic is controlled through various dispatching centers which can be either computer-aided dispatching, Centralized Traffic Control (CTC), or manual dispatching using voice communication and/or visual guides. In addition, status displays, data read-outs and other modern pieces of management information gear are used to ensure smooth operations. The system is really tested when problems which threaten to disturb the scheduled operation arise, when rescheduling is required, or when the opportunity for improved services occurs.

Apart from managing train traffic and solving current problems, the Traffic Department usually has a planning division to work out future schedules and operating practices that will most efficiently make use of available resources to produce the best services.

3.2.2 Mechanical Engineering Department

The Mechanical Engineering (ME) Department is responsible for the procurement, maintenance, repair, and rehabilitation of all motive power and rolling stock, i.e. locomotives, wagons and coaches, and the management of locomotive drivers. Therefore, it must cooperate closely with the Traffic Department. In keeping this equipment in good operating condition, the tasks of the ME Department vary from routine inspection and on-spot minor repairs to major overhauling and rebuilding. Although most of the equipment is bought from manufacturers, the Department typically has strong design and industrial engineering staffs to develop specifications for equipment and procedures for their servicing and maintenance. Quite often, all the maintenance records are computerized to ensure proper maintenance of thousands of pieces of equipment so that maximum utilization and minimum on-duty failures can be realized.

Most ME Departments have centralized workshop facilities capable of major locomotive overhauling and car rebuilding and upgrading. Some railways build some of their cars. Others manufacture some specialized, but used in large quantity, items like brake shoes.

3.2.3 Civil Engineering Department

The Civil Engineering Department is in charge of construction and maintenance of tracks, bridges and buildings. Many railways have their own survey teams for new tracks, while their construction is often left to contractors. Though the structure of the tracks looks simple enough, however, to maintain thousands of kilometers of these tracks in the precise alignment required with the lowest cost is quite an arduous task.

Traditionally, each stretch of track is regularly maintained by a small track crew. However, in many countries the whole process of track maintenance is now heavily mechanized, not only to save labor cost and to ensure least service interruption time but also to upgrade the roadbed in order to reduce subsequent maintenance costs. Similarly, speedy maintenance and replacement schemes have also been devised for bridges.

Furthermore, the advent of the computer has drastically changed the way people work. A track geometry car with on-board computer can measure the position, curvature and smoothness of the two rails and the cross-level gauge and alignment of the track as the car travels rapidly over the line, and provides an analog plot for evaluating and correcting deviations from standard, as well as digital data which can be used in statistical analyses as a basis for longer-term system-wide scheduling and planning of track maintenance. This is much more than the track crews can do with gauge rods and leveling meters. In many countries track maintenance activities are computerized. On at least one railway, for example, the Management Information System controls the track maintenance activity like a production activity. Every morning, a worker can get a printout from the computer about what he has to do and what materials, equipment and manpower are required and available to do the job.

3.2.4 Signaling and Communication Department

Signal systems are not only the basic tools for safety but also effectively used to increase the efficiency of train operation and the capacity of a line in handling traffic, while maintaining the standard safety rules to prevent rear-end, side-on and head-on collisions. For light traffic, manual block signaling is generally sufficient. Token boxes are still in use in many countries. However, each block where only one train may be in is the distance between stations which can be quite long. To reduce the length of the block in order to allow more traffic, automatic block signaling (ABS) in which the track circuit determines the presence or absence of a train is used. There are electric interlocking relays to assure that a block is clear before another train can be allowed to enter it. For heavy traffic on single-track lines or congested sections of multi-track routes, centralized traffic control (CTC) is often used so that a dispatcher can control hundreds of kilometers of track from a panel in his office. Single-track with CTC is considered to have about 70 percent of the traffic handling capability of ABS double track. The ultimate of traffic control is computerized traffic control where the entire railway can be controlled from one room by a powerful computer. However, for safety reasons, the automatic train operation (ATO) is still separate from the function of automatic train control (ATC) which includes acceleration, deceleration and speed controls and automatic train stop (ATS). Other signaling devices are road crossing protection and safety detectors like wayside hot box detectors.

The use of a centralized computer for both operational and business aspects by railway organizations has dramatically increased the demand for communications in the last two decades. Large railway organizations may require an equivalent of 1,200 voice circuits to carry their long-haul communication load, which is about evenly divided between voice and digital traffic. However, other modes of radio communications have also been used in most railway organizations to support train crew management.

3.2.5 Impact of Computer Information Technology

The advance of computer technology has greatly altered the work of many businesses. Computers are no longer restricted to the electronic data processing (EDP) department which processes payrolls and accounting, but computer terminals appear on every desk to integrate the business of the whole organization. For railways, there is no exception. Apart from using computers in a number of specialized applications, e.g. CTC, OCS, STARS, etc., many different parts of the railway organization (operations, sales, accounting, purchasing and materials management, personnel, maintenance) are now computerized. From a large number of terminals in different locations, data can be entered, processed and displayed. There is also another level of data aggregation often across departmental lines to present a more holistic view of the current situation to managers -- the so-called management information system (MIS).

3.3 Technological Capabilities of the SRT

In this section, we will try to fit the SRT into a theoretical framework called technological capabilities. This framework was previously developed by TDRI to assess the technological capability of Thai manufacturing industries.[5] We shall see that with very slight modifications of definitions, it can also be used to describe the technological capability of a service organization, in this case the SRT, satisfactorily.

Technological capabilities may be taken as the ability to perform technological activities or activities which systematically utilize knowledge in transforming inputs (resources) into outputs (products) according to a certain production process. Technological capability may be categorized into the following four major types as follows:

1) Acquisitive technological capability,
2) Operative technological capability,
3) Adaptive technological capability, and
4) Innovative technological capability.

By acquisitive technological capability, we refer to the organization's ability to search, negotiate, and procure relevant technologies, as well as to transfer operational know-how, and install and start-up operation.

By operative technological capability, we assess the degree of efficient operation and utilization of manpower and any other physical facilities, as well as maintenance, skill development, management, planning, and quality control.

Adaptive technological capability includes the ability to acquire know-how, digest technology, and perform minor product and process modifications.

Innovative technological capability involves such activities as carrying out in-house research and development (R&D), radical product and process modifications, radical changes in operation, and achieving new product or process inventions.

The four technological capabilities are related but play different roles in an organization. A technology is first acquired, then operated and later on adapted to improve

5. TDRI (1989).

upon the operative capability. The innovative capability represents new ways of cost reduction and/or service differentiation which will also affect other capabilities. The operative capability is the one which can be directly observed by its customers or by other people outside the organization. An improvement in operative capability will require good acquisitive capability in acquiring technologies from outside the organization and good adaptive capability in making incremental improvements.

3.3.1 Acquisitive Technological Capability

Technology generally enters the SRT through its personnel via the acquisition of new equipment, materials and services. We have determined that SRT can search for sources of relevant technologies, can assess their appropriateness, and can negotiate reasonable terms and conditions. SRT is known to issue stringent specifications for equipment and material requirements. However, in the Government procurement process, there are rather rigid guidelines to make the process time consuming. The technologies associated with operation know-hows of new equipment are generally transferred according to the terms of the purchase contract which usually requests training on operation. New equipment is often installed and started-up by contractors but SRT can operate them satisfactorily. The item on plant lay-out/design is not applicable here, but the Civil Engineering Department is capable of designing tracks, concrete sleepers, bridges and buildings. However, many purchases are done on a piece meal basis. Some are initiated by foreign consultants through various assistance schemes, others by SRT staff at the departmental level, oftentimes without an overall integrated plan on what SRT would like to achieve in the long run.

3.3.2 Operative Technological Capability

The SRT can operate and maintain the railway with very good technical competency taking into account the lack of budget to upgrade the tracks and to buy new motive power and rolling stock.

Training or manpower development is perhaps the most lacking. SRT trains about 15% of its work force a year, typically on five-day courses at its Training Center, but all attendees are junior staff. There are other training programs provided by contractors on newly purchased equipment for operation and first-line maintenance; however, these programs are insufficient for second-line maintenance personnel who have to develop their skills on-the-job by themselves. Other programs, seminars, study tours, further education for all levels of staff puts the total training budget at about 20 million baht per year which is very small indeed in comparison to the size of the organization. Even in its Five-Year Corporate Plan (1992-1996), SRT only pledges to spend 0.2% of expenditure or 0.34% of personnel cost on training. In contrast, the Electricity Generating Authority of Thailand and the Telephone Organization of Thailand both spend about 2% of personnel cost on manpower development. Like other governmental agencies, SRT only recruits new graduates who essentially have to develop their skill and learn their experience in the organization. With the current technical manpower shortage in Thailand, SRT also experiences shortages in all professional fields.

SRT personnel have adequate skills in carrying out basic technical activities which are acquired through on-the-job training. They can weld rails, make turn-outs, overhaul locomotive engines, rebuild coaches, install new air brakes, cast brake shoes, machine wheels, change wheel rims, etc., though some of these operations need to be reviewed for economical and technical appropriateness.

SRT is organized and managed along Thai civil service traditions despite the fact that it has been a state enterprise since 1951. SRT is deprived of the opportunity to become modernized when it began accumulating deficits in the 1970's. Though its labor salaries are higher than those of the civil service, its problems are typically not too much different. There is little communication or exchange of personnel between departments, recommendations from the bottom often fall on deaf ears, policy shifts with change of top management, etc.

3.3.3 Adaptive Technological Capability

SRT has no problems in knowledge acquisition and technology digestion of conventional civil engineering, mechanical engineering and electrical engineering technologies if sufficient time is allowed for knowledge and technology diffusion. Newer electronic technologies will take some time and will need more training on the basics to achieve a higher level of appreciation. Examples of minor product modifications are hand held electric tampers for ballast, track motor cars, gauge rods and leveling meters. As for minor process modifications, three very good examples are the Train Scheduling Improvement Using Microcomputers Project in the Car Control Division of the Traffic Department, which will use modems to link microcomputers in all divisions and can print train diagrams to assist dispatchers in making decisions, the Material and Equipment Inventory Control Scheme of the Civil Engineering Department, which reports only moving parts through diskette exchange, and the Maintenance Scheduling Program of the Mechanical Engineering Department.

3.3.4 Innovative Technological Capability

As SRT is struggling to reduce budget deficits and to provide the best services under many constraints, we do not expect SRT to spend a lot of effort in research and development, radical product modifications, major process changes, or new inventions. However, in the future, when SRT will move to a higher level of technical competency, it may consider setting up a unit called "Engineering and Research" to look after tests for safety, quality control, and experiments on new technologies. It should be reminded here that this is not to invent any new equipment or to create an innovative technological capability. Rather, it is to enhance the operative capability by enforcing technical standards in SRT, and to improve the adaptive capability as well as the acquisitive capability by cultivating a group of personnel specializing in advanced railway technologies to provide SRT with long-term technical support, including planning, system design and technology evaluation.

3.3.5 Comments on Technological Capability

From the above sections, we may say that SRT has reasonable acquisitive and operative capabilities, some adaptive capability, and very little innovative capability. There are no reasons to be alarmed over the deficiency of adaptive and innovative capabilities at present. A service organization, or in fact any organization, only needs acquisitive and operative capabilities to operate well and provide good service, if all the technologies are available in the market at reasonably low prices. This situation is true for the SRT, which can choose a large variety of technologies from more advanced countries to satisfy its developmental needs. However, the problem here is not the assessment of individual technology under consideration but rather the ability to foresee the impact of such technology introduction into the total system a few years from now. In other words, SRT needs a more systematic method of technology acquisition guided by an indigenous operative philosophy to ensure a more effective operative capability improvement. Once a technology is fully operated, any further improvement will require adaptation which has the inherent advantages of shorter lead-time, more enhancement of indigenous capability, and better compatibility to existing systems.

In the future, SRT will have to operate in a more competitive environment. Here, innovation will be a crucial element which determines competitive advantage. Innovations are more likely to be in the area of services rather than in hardware.

3.4 New Technology Requirements

New technology is introduced into an organization to increase profit. If the SRT is to become commercially viable, that rule will also apply to it. The increased profits may be due to new lines of business, higher productivity, cost savings, etc. The key to the introduction of any new technology on the SRT is therefore a full feasibility study showing adequate financial returns to the railway for investing in the technology. Such detailed studies are beyond the scope of this study, and we therefore cannot make specific recommendations on new technologies that should be acquired. We shall, however, make pertinent comments on some major new technologies that will be considered over the study time-frame.

It is not difficult to propose a long list of technologies be they hardware, software, or systems for SRT. Many are already hinted at above. SRT is implementing STARS, CTC, and OCS. It has the possibility of using some form of computer-aided dispatching and computer programs for train scheduling in the near future. The average age of diesel locomotives is approaching 25 years and some new ones will be needed soon to reduce in-service failures. To handle freight more efficiently, some specialized rolling stock will have to be acquired; such as hopper cars to handle bulk agricultural commodities and solid fuel, and Trailer on Flat Car (TOFC) or piggy back to handle intermodal traffic. These specialized rolling stock will involve special freight handling equipment and facilities at train stations. The Mechanical Engineering Department will probably need some train performance simulators and computerized engine monitoring systems. The Civil Engineering Department would like to upgrade the track and roadbed to eliminate rail breakages, to support higher speed trains and, most importantly, to arrive at minimum cost for investment and maintenance over a long period of time.

The Signaling and Telecommunications Department would like to have its system automated and computerized. SRT still has no automatic train protection which includes ATC and ATS. The list can go on and on. Furthermore, in the course of the study, a number of issues perceived to be technological ones did arise, namely, double tracking, electrification, standard rail gauge, and high speed train services.

3.4.1 Double tracking

A particular stretch of rail track may be reaching its capacity, resulting in frequent delays to trains. A number of data such as train frequency over the time of the day, train speeds, distance between trains, location of the congestion, etc. should be looked into to find the best remedy. Some of these remedies could be train rescheduling to avoid peak traffic, decreasing the distance between trains by providing better signaling and communications, altering train speeds to shift peak locations, installing more frequent or longer passing sidings, increasing maximum axle load on the track to allow heavier and therefore less number of trains, and even discontinue some train services that are not economically viable. All these remedies should be explored before adopting the most expensive solution of double tracking. Even then, it probably makes sense to double track stretch by stretch starting from the most congested ones. However, to facilitate the decision making process for double tracking, some agreed formula based on SRT's experience should be developed. The formula should not be much more complicated than that of the Japanese National Railway which takes 80 trains a day as the capacity of a single track.

3.4.2 Electrification

Electric trains have the advantage of less pollution, greater starting tractive effort and faster acceleration. One locomotive can haul a lot more weight. But it also represents a very high initial investment on the infrastructure which must be justified by the frequency of usage. This means that electric trains are more easily justifiable as suburban commuters in areas surrounding Bangkok and on main routes between big cities.

3.4.3 Standard Gauge rail

At present, SRT uses Meter Gauge rail (1.0 meter) over the whole country. Proponents of Standard Gauge rail (1.435 meter) cite more comfortable ride, faster speed on curves, and possible connection with China as main reasons for the conversion. To make such a decision, calculations on capital investments required for all new infrastructure and motive power and rolling stock must be made to see how the SRT can finance them. Lost service during construction and conversion needs also to be considered as a financial loss. Sufficient benefits, both tangible and intangible, must be derived from such conversion to justify the investment. Others point out that, with better maintained track, Meter Gauge rail can have a maximum speed of 160 km./hr., with an average speed of 120 km/hr., which should be sufficient for most of the rail transport requirements in the foreseeable future. However, if a future situation calls for true high speed train services (200-300 kph.), track of standard gauge would be appropriate. Unless the SRT was willing to discontinue slower services (e.g. freight or 3rd Class passenger), however, a dedicated track for high speed services would be required. This is because it is normally not effective to operate slower speed trains on the same line as very high speed trains. Unless a decision were made to have the only train services in Thailand as very high speed passenger, we can foresee no condition that would justify conversion of gauge on existing lines.

3.4.4 High Speed Train Services

A high speed train project should have separate rails which may well be Standard Gauge. Separate rails are required because operating high speed services is not conducive to also running slower speed services intermixed. The cost justification of high speed service must therefore include the full cost of the dedicated infrastructure. On the question of whether SRT has the technological capability to run high speed trains, the answer is "yes" given adequate time and resources in planning and training. In any case, SRT is certainly better qualified than any other public agencies which have never had any experience with rail transport.

It should be reminded that all the above mentioned technologies and many others are good technologies that have worked in many countries around the world, and they undoubtedly can be applied to improve the performance of SRT. Some are indispensable for the SRT to continue. Some are essential for upgrading SRT's operation. However, any introduction of new technology by SRT must firstly be justified on a cost return basis. Secondly, it must be remembered that a railway is a complex system with a large number of interrelated components. The merit of each technology should be evaluated as to its effect on the whole system rather than individually. It is, therefore, helpful for top managers to have a holistic view of the system through a management information system (MIS) and develop a philosophy or "ways of doing things" for SRT.

3.5 Information Technology

While refraining from recommending any new technologies to SRT by arguing that each introduction warrants a feasibility study to determine its cost effectiveness and to evaluate its effect on the whole system rather than its individual merit, we think that SRT cannot avoid further embracing a generic technology to keep pace with other sectors of the economy. That technology is the information technology (IT) which is the integration of computer technology to store, process and retrieve needed information and the telecommunications technology to gather and disseminate information. As a transportation service organization, the "handling" of information is just as important as the handling of passengers and freight.

At present, SRT has two Prime 6150 minicomputers to operate the STARS and OCS systems. There is another computer to do batch processing. Stand alone personal computers (PC's) are estimated at between 50 to 100 for its 25,000 workers. This is about the national average of 3 PC's per 1,000 workers, but much below the 12 diversely different public sector organizations' average of 27 per 1,000 and the 13 rather advanced private companies' average of 240. In the near future, with the completion of STARS and OCS, SRT will have some two hundred microcomputers linked in a country wide network through the COM-LINK optical fiber optics system.

With COM-LINK, STARS and OCS, SRT has the possibility to "leap-frog" into the information age within a rather short period of time (say about five years). The major ingredient for the success of this scheme is of course human resource development. A large number of personnel in SRT must be trained on information systems technology to be convinced of its potential and be proficient in its utilization. The second requirement is a sizable investment in computer hardware, software and communications network to make it available to more SRT users. In acquiring hardware, however, great care must be taken to ensure compatibility of software systems with other computers and with new generations of computers as they become available.

The promotion of IT in SRT can bring about many improvements. However, carefully planned implementation steps must be laid out. First, it is essential to have the active support and participation of top management as well as workers to lessen resistance to change, and to avoid IT being negatively portrayed as "labor saving". Second, planning must ensure "interconnectivity" and "interoperability" of all systems throughout the SRT, such that data once entered can be manipulated electronically by any authorized user without having to go through some intermediate manual steps as in the case of "islands of computerization".

To feel the impact of IT on productivity, we have to go beyond "doing the same with less" such as using a microcomputer simply for word processing or Lotus 1-2-3. At the minimum, IT should be able to "do better with less" by improving existing works and services like inventory control or maintenance scheduling with stand alone units. With the systems described in previous paragraphs in place, it can significantly improve productivity and generate new services; for examples, OCS to make optimum utilization of rolling stock, and STARS to provide convenience to passengers as well as increase revenue for SRT. It is not too difficult to imagine a track crew walking along tracks near Sungai Kolok to punch in track condition data on his digital mobile communicator. The information is sent to the regional computing center or the central computing center in

Bangkok, processed and transformed into a job order. Bigger pay-off, however, is possible when all this information is integrated, manipulated and presented in various forms for strategic management. When top managers are supported by such a wealth of information at appropriate levels of aggregation, they can give quick response to opportunities in the marketplace, avert incoming threats, and plan strategically. Various simulations or "what if" scenarios can be run on computers to aid decision making. For example, what is the impact of increasing Second Class passenger fare by 10 stangs per kilometer?.

With this background, we make the case that to ensure long-run success, the SRT must pay close attention to the development of IT in the short-run. The MIS Department already possesses the core of a professional IT development team, but this must be expanded. Of perhaps greater importance is the need to develop IT know-how within the various SRT Departments.

4. BUSINESS STRATEGIES

4.1 General

Business strategies must be developed as a continuing requirement for carrying out business by the SRT. These strategies communicate the direction of work throughout the organization. These strategies must be based on goals which are realistically achievable within the short-run. Although the time frame of this study is the long term, goals must be set within the short term if they are to receive the attention they deserve. These short term strategies must point in the direction of long term planning, however. They must also remain dynamic, in order that adjustments or corrections can be made based on long term objectives. These strategies will include:

a) Implementation of full PSO system,
b) Abandonment of services not covering costs (after PSO services are defined),
c) Implementation of an investment strategy fully related to positive return on all investment, and
d) Timely and accurate assessment of results.

In defining specific business policies which leads to the establishment of strategies, three important questions must be addressed:

a) Should tariffs be at market or cost, or should PSO subsidies apply?
b) Will the service be maintained in perpetuity (implying the need to recoup full replacement costs), or is the service to be phased out over a period of time (such as the life of existing equipment?
c) How will infrastructure costs be handled where resources are shared by more than one service?

It is apparent from the work of this study that the main lines of business for the SRT of the future should be (at the least):

Freight Services, with a priority on bulk commodities in car-loads over medium to long distance (including container services),

Inter-City Passenger Services, comprising express services between major population centers (e.g. "rapid" and "express" trains),

Passenger Services with Frequent Stops, which would normally be PSO services for lower class passengers,

Commuter Services, also normally PSO services, and defined here as services in the Bangkok area to transport passengers on a daily basis between their places of work and home, and

Real Estate Development, the management and accounting for which must be completely separate from the other services.

Each of the above markets must be operated as a separate, commercial enterprise. Specific requirements must be developed for each service type (and in time for subdivisions of these service types). Services which can cover their variable costs plus an appropriate level of financial and overhead costs (including PSO services) should be targeted.

As a general principle, the tariffs for these services must at least fully reflect the short-run variable costs (labor, materials, fuel, maintenance, etc., plus a contribution to administrative and financial costs). For most services, these costs are readily calculable. For long-term variable costs, however, there are two important refinements which must be made.

The first consideration is whether tariffs must reflect the full cost of providing equipment replacements through periodic depreciation allowances based on current replacement value. If, however, there is no intention to continue the service beyond the life of existing assets employed, depreciation can be based upon "book value" of assets used. In this latter case, there is no need to include replacement costs.

The second consideration concerns the costs of maintaining the infrastructure. Typically, these costs are allocated to the services representing the "prime-users" of the assets. Other (non-prime) users pay a usage fee equal only to the avoidable costs associated with their incremental usage (i.e. those costs which would not occur except for their use of the common infrastructure assets).

4.2 Freight Strategy

The primary strategic objective for freight services must be to apply commercially sound tariffs which recover full costs. There may be exceptions, but each must be fully justified, and each must at least recover marginal costs. (An exception may be "back haul" services, where there is a predominance of shipping in one direction, with freight equipment otherwise returning empty.) For large customers, the SRT should attempt to contract for specific volumes and services, in order to permit better planning of resources over time.

Railways in general are most competitive with other modes of transport on medium to long haul of bulk commodities. For shorter distances or lessor loading, the greater flexibility of trucking services (with smaller pay-load requirements and easier access to customer locations) provides that mode with increased advantages over rail. A priority strategic target for marketing of SRT freight services should therefore be medium-long haul bulk commodities where possible. As suggested in the analysis of the future role of rail transport in freight in Chapter 4, the four current main freight commodities of the SRT -- rice and rice products, petroleum and petroleum products, cement, and containers -- have much potential for the future (especially for the latter three product groups). Other freight items may also develop into significant markets for the SRT, such as appliances, vehicles, coal and lignite etc.

Rail has been known to provide safe transportation of commodities. However, the track records of its service reliability have not been very impressive. Customers have commonly complained that they could not get access to freight cars, or if they could, the deliveries of goods were always late. The interviews of SRT customers have revealed that the problems of rail freight service are common across different kinds of freight. To correct these problems will require the restructuring of the overall rail operating system. The common rail freight service problems can be summarized as follows.

1. There are not enough freight cars. Small customers have difficulty getting access to freight cars. This is particularly true for customers wishing to transport agricultural products including paddy and rice. The requests for service have to be made at the local railway stations, but the waiting time could be very long making the customers turn to other modes of transportation. Even large customers also have similar problems in that they could not get enough freight cars for their goods, or the waiting times are long. Most oil companies said they would like to be allocated more carriages so they could install tankers.

2. There are not enough locomotives for freight service. This has resulted in the amount of freight service being reduced to the minimum. Oil and cement companies are pressing the SRT for more freight services, but the SRT has not been able to comply. Apparently, passenger services have received higher priority than freight in term of allocation of more locomotives and the condition of these locomotives.

3. The turn around times of freight service are slow. This is because of heavy traffic on key SRT routes, and freight services receiving low track clearance priority compared to passenger trains. This has resulted in freight deliveries being late. The conditions of locomotives for freight trains are often old, and the mechanical failure of freight locomotives en route are common, making freight deliveries unreliable. The rush hour curfew in Bangkok has made the problems worse for freight service, because this has limited the number of trains that can leave or enter Bangkok.

4. Most under-carriages being used by SRT are old, having low axle loads and low pay loads. This has resulted in a low capacity of freight trains which typically have net freight tonnage of only 1,000 tons per train. As a result, unit costs of freight transportation are high.

5. Rail road tracks in mountainous areas usually have steep grades because they were built a long time ago using poor technology. For example, SRT needs to use twin

locomotives to pull freight trains between Silaat and Lampang. This has resulted in high operating cost of freight transportation and slow turn around time.

In the future, for the SRT to exploit the large potential in the freight market, these problems need to be addressed, and reliability of service needs to be emphasized. Bulk commodity shipments generally are a component of the overall production capability. Therefore, if the transport capability is disrupted, the overall production system is disrupted. The cost of these disruptions is often greater than the extra cost of shipping by truck. It is imperative then that such services be reliable on a daily basis. Where disruptions may become unavoidable (such as in the case of major infrastructure repair work), the customer must be well informed of the disruptions, and all efforts must be made to ensure minimal consequence to the customer by such disruptions. For each major customer, service targets should be developed and closely monitored.

In developing customer-specific strategies for bulk commodity and container markets, the SRT must take advantage of proven ways of increasing railway efficiencies. This includes working out with the customer the best method of material handling at either end of the rail shipping line. Resources available to the customer from the SRT should not only include motive power, rolling stock, infrastructure (and the operation thereof), but also human planning resources for their overall transportation needs.

4.3 Inter-City Passenger Services

Our studies have shown that there will be significant continued growth in the passenger market over the next 20 years, especially in the Central Region of Thailand. At the same time, we feel it possible and desirable that the SRT capture a greater share of the inter-city passenger market than at present (Chapters 3 and 4). This can be accomplished mainly through improved service and performance.

SRT inter-city passenger services should concentrate on express services with stops at major population centers only. This, along with the double-tracking program (Section 6.5 below) and improved track conditions, will allow for considerably reduced travel times by rail. The National Economic and Social Development Board (NESDB) have commissioned a study to assess the potential for high speed train services in Thailand. The results of that study should contribute further to SRT passenger service planning. For example, if the study suggests that train services on the Northern line should be high speed as defined by the capabilities of the current (conventional) railway system, then we can foresee the advent of conventional passenger trains running at speeds up to 160 kph., between Bangkok and Chiang Mai. In this example, the transit time might be reduced to approximately 10 hours. This not only would provide the SRT with a competitive edge, but would allow for significantly improved equipment utilization as a result of the ability to run equipment return movements within 24 hours.

In marketing these inter-city passenger services, the SRT should embark on a major program to improve the appearance, cleanliness and comfort of passenger coaches. In doing so, a greater emphasis on differentiation between service classes should be introduced. The objective here is to make 1st and 2nd class travel appear as advantageous as possible over 3rd class service, as an encouragement to the public to pay the premium fares.

4.4 Passenger Services with Frequent Stops

These services are normally operated at a loss, and in the case of the SRT of the future would normally be operated under the policy of PSO's. In developing the cost of these services for PSO purposes, care must be taken to include any significant lost opportunity costs. For example, running such services makes it more difficult to maintain performance targets of the more lucrative express long distance services.

As a general rule, passenger services with frequent stops are not major revenue earners for railways, and even with PSO subsidies, the SRT should generally discourage such services unless they are imposed upon the SRT by the government. There may be exceptions, however, and these must be identified by detailed analyses. Where a population center has a small demand for inter-city passenger service, the government should carry out an analysis to determine whether trains or buses are economically best suited to carry out such service. In many cases the bus will be the preferred alternative, and as a result train service should be phased out. Where a passenger at such a small center wishes to travel long distance, the bus network might provide a convenient feeder service to the nearest large railway station in a larger population center.

4.5 Real Estate Development

The SRT should continue to exploit, perhaps on a more vigorous basis, the revenue potential from its vast real estate holdings. There is a need to further study all SRT properties, to determine status vis a vis SRT railway operations. Land which is currently in railway service should be identified, and classified according to whether this land may be released from railway service in the short, medium to long term. Land which is currently not in railway service should similarly be classified as to its potentially required railway use within the short, medium or long term. With this data, general policies for land rental, lease or joint venture development should be developed, followed by site specific policies. In addition, land areas which appear to be required in perpetuity for railway use should be studied for possible additional usage (e.g. pipe lines along the right-of-way), or where the land value is high the financial feasibility of moving the railway requirement to another location should be considered.

In developing excess land strategies, preference should be given to land usage that would enhance SRT railway revenues. For example, development of an industrial estate along-side the SRT line would be preferred over a golf course development. In any case, it is imperative that, if real estate development and concessions are carried out, then they should be done along fully commercial lines to maximize the returns to the SRT.

It must be stressed, however, that revenues from land development should not be allowed to cloud the true financial position of railway operations. The efficiencies aimed at through such policies as PSO's could easily be lost, with land revenues in fact providing a hidden subsidy to railway operations. Land revenues can be incorporated at the annual corporate accounting level, but never integrated within the railway operation. In order to help achieve this, and to prevent diversion of railway management attention to non-railway business, the land development organization should be run by real estate professionals, reporting to the highest levels within the SRT (i.e. General Manager or Board of Commissioners Chairman).

5. INVESTMENT REQUIREMENTS

5.1 Introduction

This Section develops a general investment plan for the SRT, covering a 20-year period commencing 1992. This investment plan reflects requirements associated with the major strategic plans developed herein. It addresses transitional needs of the SRT, commencing with investments designed to ensure continued operation of the SRT, while adjusting investment strategy over the 20-year time frame to achieve the desired restructuring.

As with any long-range plan, this investment plan becomes more general the farther into the future it is projected. The assumptions employed in developing the plan should prove quite accurate in the short range, but will decrease in accuracy over the long range. For this reason, any long term plan must be dynamic, with constant reviews and adjustments made.

In some cases, this plan ignores specific investment in new projects aimed at new services or cost efficiencies. These are projects which require financial feasibility studies, and which should be carried out only if shown as financially advantageous. Such feasibility studies lie outside the scope of the current study. An example is the electrification of trackage within the Bangkok area.

The 20-year investment plan has been developed in two Phases. Phase I is concerned with developing a plan based on the status quo, where status quo is defined as the existing SRT structure and general business policies. The plan thusly developed forms the basis for Phase II, where the plan is modified to reflect the new directions recommended for the SRT.

Developing the Phase I investment plan requires several steps. First is the determination of the level of investment made by the SRT in the recent past. These historic investments are then projected over 20 years. Finally, each of the major elements of investment are studied individually (still in consideration of the status quo as defined above), with a view to negating the effects of past deferred maintenance or investment. The objective of this final step in Phase I is to ensure that the SRT has available to it the necessary equipment and infrastructure to compete fairly with its competitors, and to minimize long-term costs by ensuring timely investments.

The investment plan thereby developed in Phase I becomes simply a base line for Phase II development. Phase II is the key component to this process, wherein the status quo is converted to the needs for the restructured SRT. In this Phase, investments are added in a way to facilitate the conversion of the SRT of today to the recommended SRT of tomorrow.

5.2 Historic Investments

The level of investment over the past 5 years (1987 through 1991) has been studied. Investments prior to this period were not considered for two reasons. Firstly, the SRT records are such that investments by year are maintained according to several different budget types. To ascertain the actual investments in any particular year, it is necessary to know which budgets were associated with that year, and sum the investments from each. Under this procedure, given the time constraint, it was impractical to delve into history beyond 5 years.

Furthermore, if it were the case that the general level of investment was quite different prior to 1987 than the average over the past 5 years, a much greater emphasis would have to be placed on the more recent history. For such general investments, the deterioration of assets over time lessens the effect of the investment made a long time back. The effect of any specific investment which has a long economic life is accounted for in the following steps, wherein the condition of present assets is used to modify the investment projections based on the 5-year history.

Table 5.1 shows SRT investments over the past 5 years ("1987-91 Actual"). During this period, the average annual investment was the equivalent of 1,100 million Baht. It can be seen from Table 5.1, however, that there was significant variance in the level of annual investment over the 5-year period.

Figure 5.1 (1987-91 Actual) shows a breakdown of these 5-year investments by major investment type. Based on the experience of other railways in the world, Figure 5.1 shows a potentially serious adverse trend. It appears that (for at least 5 years) the SRT has been investing an inordinate amount of money into equipment as compared to the fixed plant (Mechanical Engineering versus Civil Engineering). Furthermore, Table 5.1 shows that of this amount for equipment, only an insignificant amount was invested in new locomotives. This is at a time when the SRT locomotive fleet is at an advanced average age. It would appear that in an attempt to maximize immediate revenues, the SRT has been recently channeling most of its investment into new passenger coaches and (to a much lessor extent) new freight wagons, to the detriment of investment in locomotive power and fixed plant.

5.3 Planned Investments

Before proceeding with the investment projections, it is interesting here to review the SRT's planned investments under the 7th National Development Plan (1992-1996). These are shown in Table 5.2. This is a preliminary plan, not yet approved by the Government. It must be noted that it is not possible to make an accurate comparison between Table 5.1 (actual investments 1987-1991), and Table 5.2 (planned investments 1992-1996). Even when approved, the actual level of investment normally falls considerably short of the Development Plan. This is because the SRT must compete with other State Agencies, on a project by project basis, for foreign currency funding from a fixed budget, regardless of approved projects in the National Plan. Furthermore, the SRT often cannot carry out approved projects because of its own inability to generate enough local currency to satisfy investment need (because SRT experiences an annual financial loss, and is subsidized by the amount of that loss only, it only has extra local funds available from the amount of asset depreciation). In addition, the historic investments shown in Table 5.1 include not only those from the concurrent 6th Development Plan, but also carry-overs from previous Development Plans. The planned investments in Table 5.2 are from the preliminary 7th Development Plan, and there will also be carry-overs from previous Plans.

The main purpose in highlighting the preliminary 7th Plan here is to compare the breakdown of planned investments with that of the previous 5 years (see Figure 5.1). It can be seen that the ratio of investment in motive power and rolling stock versus fixed plant has improved. Furthermore, from Table 5.2 it can be seen that in the 7th Plan, the amount of investment in locomotive power is significantly higher than in the previous 5 years.

5.4 Status Quo Projection Adjustments

We shall commence developing the "status quo" 20 year investment plan (Table 5.4) by using a straight line projection of the average actual annual investments (1987-1991). In cases where the actual investment item (1987-1991) was a special project which would not continue for the 20-year time-frame (e.g. air brake conversion), the investment levels are not changed but the item identification is changed to "Special Project". This is to allow for a contingency to cover other special projects over the period. Furthermore, a review of SRT records and discussions with SRT staff has indicated that certain elements require increased investment over time if rail operations are to continue on a competitive basis (observing the status quo as to SRT structure and policies). These are noted below. Table 5.4 gives the status quo investment plan in constant 1991 Baht.

5.4.1 Track

Table 5.3 displays the type and general condition of track elements. Of immediate concern is the condition of rail. The majority of main line trackage is 70 lb./yd. rail, which is in excess of 20 years old and in poor condition. The incidence of rail failures (broken rails) is high. The SRT is experiencing more than one such failure per day on this rail. As a matter of urgent safety, this rail should be replaced as soon as possible. This involves some 1,100 kms. of track. The SRT intends to replace the 70 lb. rail with

Table 5.1
State Railway Of Thailand Investment Program, Historic
(Actual investments; millions Baht)

	1987	1988	1989	1990	1991
CIVIL ENGINEERING					
Replace rail & weld	12.24	12.67	27.52	23.09	38.65
Replace sleepers	107.92	107.38	124.09	42.08	294.72
Replace timber bridges	26.24	20.44	18.48	30.05	24.62
Steel bridges	24.66	10.91	14.44	4.60	10.34
Stations and yards	0.00	0.06	0.77	6.57	7.64
Double tracking	0.00	0.00	0.00	0.00	1.54
Sidings	15.76	2.62	3.82	3.39	3.05
New line construction	19.67	11.31	12.21	10.18	130.14
Equipment & workshop	0.63	0.10	0.47	1.39	6.13
Sub-Total	207.12	165.49	201.80	121.35	516.83
MECH.ENGINEERING					
New locomotives	0.18	0.01	0.00	0.02	0.03
New DRC's	0.14	0.00	0.00	0.00	0.00
New passenger coaches	324.14	895.14	80.95	720.56	616.36
New coach construction	26.00	0.00	0.00	0.00	0.00
New freight wagons	0.09	0.88	46.06	11.61	0.88
Renovate DRC's	0.00	0.00	12.79	3.52	262.99
Workshop improvements	17.74	62.03	31.81	6.08	3.05
New breakdown cranes	0.03	0.00	0.00	0.04	15.16
Air brake conversion	24.10	7.11	4.94	5.40	15.87
Sub-Total	392.42	965.17	176.55	747.23	914.34
SIGNALS & TELECOM.					
Improve telecom.	2.70	19.08	17.17	63.05	23.24
Improve signals	9.38	11.03	184.99	380.50	427.05
Sub-Total	12.08	30.11	202.16	443.55	450.29
TOTAL	611.62	1,160.77	580.51	1,312.13	1,881.46

Table 5.2
State Railway of Thailand 7th Development Plan Preliminary Program
(Million Baht)

Project	1992	1993	1994	1995	1996
SIGNALLING AND TELECOMS.					
Installation of Colour light CTC and ABS (Nakohn Pathom-Ratchaburi)	-	-	59.58	119.15	238.31
Sub-Total	0.00	0.00	59.58	119.15	238.31
TRACK, BRIDGES & YARDS					
Rail replacement & Rail welding	302.72	333.35	962.18	1719.74	1868.01
Sleepers	178.00	182.00	184.00	187.00	189.00
Replacement of timber bridges	47.84	93.75	81.25	77.02	69.12
Replacement of Steel and girders bridges	-	40.84	22.64	49.02	11.50
Re-structuring of bridges to take for container traffic	-	-	7.14	-	-
Re-alignment of curves	-	-	4.00	3.00	3.00
Improvement of slope stability of railway embankment	-	26.00	64.50	-	-
Improvement of level crossing	-	1.00	129.00	349.50	129.00
Improvement of Northeastern lines	-	421.00	184.00	-	-
Sub-Total	528.56	1097.94	1638.71	2385.28	2269.63
LOCOMOTIVE AND ROLLING STOCK					
Diesel locomotives with spare parts	367.00	3.00	2273.20	474.10	1657.50
Passenger coaches	-	177.92	2087.25	2175.90	1567.90
Freight Cars	12.60	157.55	323.13	31.69	-
Conversion of electrical system of passenger coaches	-	153.35	129.45	129.45	129.45
Conversion of air brake system of locomotives & freight cars	-	617.73	72.20	18.03	18.07
Renovation of Wagons from oil-tank wagons to container flat wagons	-	0.36	2.31	4.88	0.51
Installation of air-conditioner on third class passenger coaches	-	156.10	108.00	108.00	108.00
Improvement of Krupp locomotives	-	167.56	14.61	0.92	0.92
Construction of a Carriage Repair Shop and procurement of machine tools	-	193.51	100.89	-	-
Sub-Total	379.60	1627.08	5111.04	2942.97	3482.35
INSTRUMENT AND SHOP IMPROVEMENT					
Track maintenance equipment	-	20.00	78.30	85.70	-
Civil Engineering Depot Improvement	-	6.50	111.67	66.94	-
Equipment for bridge construction and maintenance	-	110.50	35.71	4.80	-
Improvement of Mechnical Engineering Depot	-	412.14	67.21	38.34	31.90
Sub-Total	0.00	549.14	292.89	195.78	31.90

Table 5.2 (Continued)
State Railway of Thailand 7th Development Plan Preliminary Program
(Million Baht)

Project	1992	1993	1994	1995	1996
TRACK CONSTRUCTION					
Construction of additional line Rangsit - Ban Phachi	-	-	20.00	107.00	578.00
Doubling of track,Ban Pachin-Kaeng Khoi-Map Kabao	-	-	22.00	310.00	550.00
Doubling of track,Ban Phachi-Lop Buri	-	-	10.00	16.00	387.00
Doubling of track,Makkasan-Chachoengsao	-	-	18.00	84.00	386.00
Construction of long loop in the Northern Line, Northeastern Line and South Line	-	-	144.00	1346.00	1850.00
Feasibility study of new lines in the Northeastern Region	-	12.00	4.00	-	-
Sub-Total	0.00	12.00	218.00	1863.00	3751.00
OTHERS					
Procurement of Office automation equipment	-	-	42.00	18.00	-
Sub-Total	0.00	0.00	42.00	18.00	0.00
TOTAL	908.16	3286.16	7362.22	7524.18	9773.19

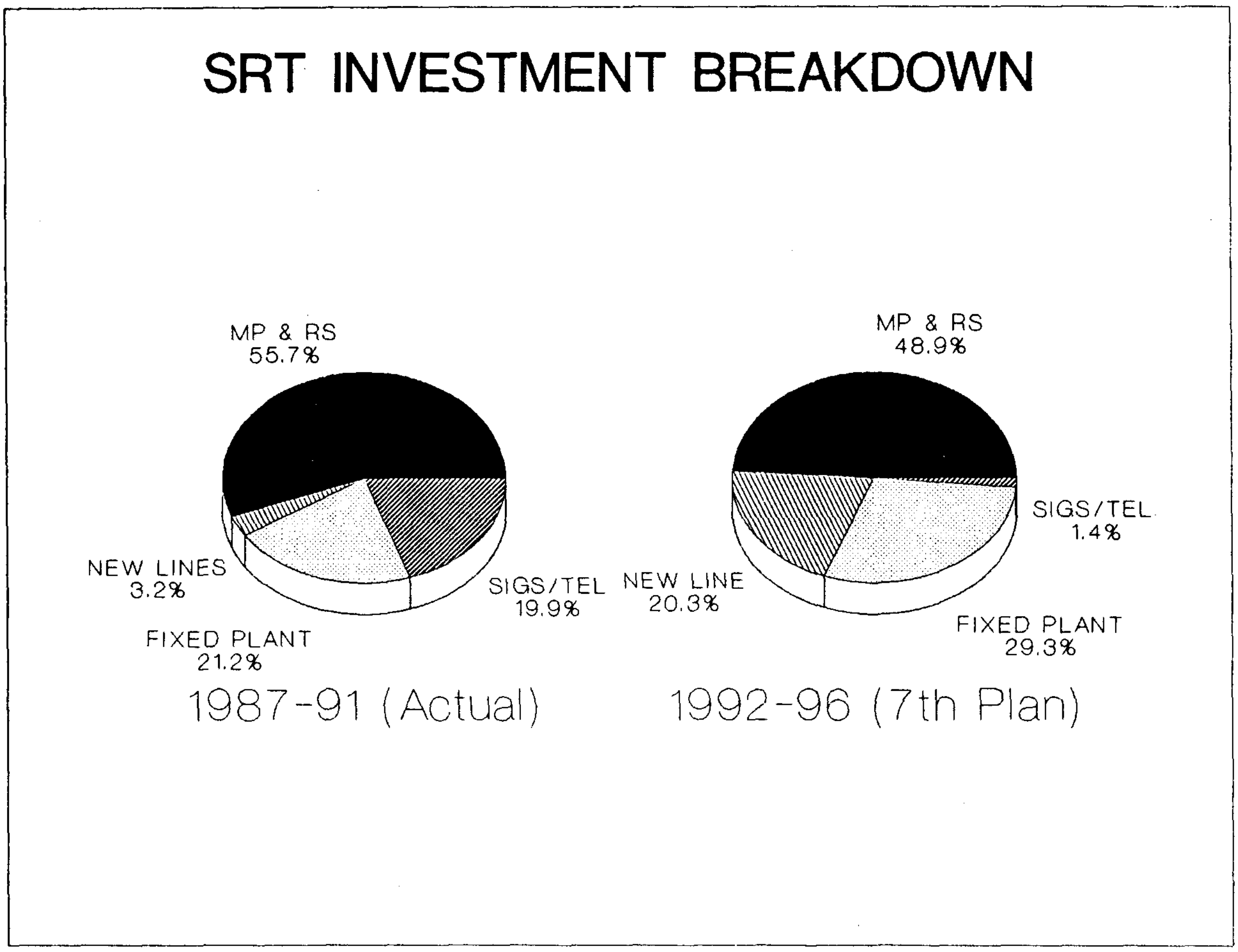
SRT INVESTMENT BREAKDOWN
MP & RS
55.7%
NEW LINES
3.2%
FIXED PLANT
21.2%
SIGS/TEL
19.9%
1987-91 (Actual)
MP & RS
48.9%
SIGS/TEL
1.4%
NEW LINE
20.3%
FIXED PLANT
29.3%
1992-96 (7th Plan)

Figure 5-1

Table 5.3
State Railway Of Thailand Track Condition

Item	Type	Distance (Km.)	Service Condition	Quality Condition
1. Rail	50#/YD.	37.931	Age more than 60 yrs. Fair	Fair
	60#/YD.	58.518	Age more than 60 yrs. Bad	Should be changed
	70#/YD.	392.011	Age more than 40 yrs. Fair	Fair
		1078.522	Age 21-30 yrs. Bad	Should be changed
		1449.467	Age 31-40 yrs. Fair	Fair
		24.690	Age more than 40 yrs.	
	80#/YD.	9.883	Age 0-10 yrs. Best	Best
		410.877	Age 11-20 yrs. Good	End. Dip, Should be changed
		386.262	Age more than 20 yrs. Fair	Fair
	Others	161.700	Age more than 40 yrs. Fair	Fair
2. Sleeper	Wooden		Age 0-10 yrs. Fair	Fair
		1573.716	Age more than 10 yrs. Fair-Bad	Should be changed to concrete sleeper
	Duo-Concrete	353.764	Age 11-20 yrs. Fair	Fair
		174.154	Age more than 20 yrs. Fair	Fair
	Mono-Concrete	397.311	Age 0-10 yrs. Good	Good
3. Ballast	Granite	2589.859	Age 0-10 yrs. Good	Good
	Limestone	1420.002	Age 11-20 yrs. Fair	Fair
			Age more than 20 yrs. Bad	Should be ballast cleaning
4. Roadbed	Embankment	2954.517	Good Condition 1200 Km.	Good
			Fair 1185 Km.	Fair
			Bad Condition 570 Km.	
	Cutting	1055.344	Good 565 Km.	Good
			Fair 500 Km.	Fair
5. Drainage	Concrete Lining	154.053	Good	Good
	Earth Ditch	491.528	Bad Condition	Should be improved to be concrete lining

Table 5.4
State Railway of Thailand "Status Quo" Investment Plan
Adjusted projection of 5 year actual investments (1987-1991)
in constant 1991 Baht (millions Baht)

	Ave.*	1992	1993	1994	1995	1996	1997	1998	1999	2000
CIVIL ENGINEERING										
Replace rail & weld	24.9	1,724.9	1,724.9	1,724.9	1,724.9	1,724.9	1,154.9	584.9	584.9	584.9
Replace sleepers	148.3	148.3	148.3	148.3	148.3	148.3	148.3	148.3	148.3	148.3
Replace timber bridges	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9
Steel bridges	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Stations and yards	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Double tracking	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Sidings	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
New line construction	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5
Equip. & Buildings	1.8	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
Sub-Total	265.5	2,037.0	2,037.0	2,037.0	2,037.0	2,037.0	1,467.0	897.0	897.0	897.0
MECH.ENGINEERING										
New locomotives	0.1	367.0	3.0	2,273.2	474.1	1,657.5	650.0	650.0	650.0	650.0
New DRC's	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New passenger coaches	588.6	588.6	588.6	588.6	588.6	588.6	588.6	588.6	588.6	588.6
New coach construction	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
New freight wagons	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Sub-Total	608.4	975.3	611.3	2,881.5	1,082.4	2,265.8	1,258.3	1,258.3	1,258.3	1,258.3
SIGNALS & TELECOM.										
Improve telecom.	27.2	27.2	27.2	27.2	27.2	27.2	6.8	6.8	6.8	6.8
Improve signals	213.5	213.5	213.5	213.5	213.5	213.5	53.4	53.4	53.4	53.4
Sub-Total	240.7	240.7	240.7	240.7	240.7	240.7	60.2	60.2	60.2	60.2
SPECIAL PROJECTS	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7
TOTAL	1,215.3	3,353.7	2,989.7	5,259.9	3,460.8	4,644.2	2,886.2	2,316.2	2,316.2	2,316.2

* Ave. is 5-year average actual expenditures (Table 5.1), where each year averaged is first brought to 1991 constant Baht.

Table 5.4 (Continued)
State Railway of Thailand "Status Quo" Investment Plan
Adjusted projection of 5 year actual investments (1987-1991)
in constant 1991 Baht (millions Baht)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CIVIL ENGINEERING											
Replace rail & weld	584.9	584.9	584.9	584.9	584.9	584.9	584.9	584.9	584.9	584.9	584.9
Replace sleepers	148.3	148.3	148.3	148.3	148.3	148.3	148.3	148.3	148.3	148.3	148.3
Replace timber bridges	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9
Steel bridges	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Stations and yards	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Double tracking	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Sidings	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
New line construction	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5
Equip. & Buildings	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3
Sub-Total	897.0	897.0	897.0	897.0	897.0	897.0	897.0	897.0	897.0	897.0	897.0
MECH.ENGINEERING											
New locomotives	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0
New DRC's	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New passenger coaches	588.6	588.6	588.6	588.6	588.6	588.6	588.6	588.6	588.6	588.6	588.6
New coach construction	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
New freight wagons	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Sub-Total	1,258.3	1,258.3	1,258.3	1,258.3	1,258.3	1,258.3	1,258.3	1,258.3	1,258.3	1,258.3	1,258.3
SIGNALS & TELECOM.											
Improve telecom.	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Improve signals	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4	53.4
Sub-Total	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2
SPECIAL PROJECTS	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7	100.7
TOTAL	2,316.2	2,316.2	2,316.2	2,316.2	2,316.2	2,316.2	2,316.2	2,316.2	2,316.2	2,316.2	2,316.2

new 100 lb. rail. The additional cost is justified economically by increased rail life and decreased maintenance requirements. Furthermore, this same 1,100 kms. of track requires sleeper replacement, work on the ballast section, and some subgrade repairs. The cost of rehabilitation is approximately 8.5 million Baht per km. Rehabilitation of 1,100 kms. of track has been added to the investment plan (adjusted), at the rate of 200 kms./year.

Other than this track rehabilitation requirement, the level of investment in track is left the same as at present, with one exception. The lack of rail replacement, resulting in the current urgent replacement situation, must be corrected. As a very general rule, it is estimated that rail should be replaced at the rate of 3% per year. This roughly translates to an annual requirement of 140 kms. rail replacement, at an estimated cost of 4.0 million Baht per km. The resultant amount of 560 million Baht per year has been added to the investment plan, commencing upon completion of the track rehabilitation work outlined above.

5.4.2 Buildings

Over the 20-year Plan time frame, it is estimated that 30% of the SRT shops and depots (based on floor area) will require replacement. The total cost will be approximately 130 million Baht. In addition, approximately 50% of the present employee housing will require replacement, at a total cost of approximately 1,300 million Baht. The sum of these 2 investment requirements (1,430 million Baht) has been added to the investment plan spread over 20 years at an annual rate of about 73 million Baht.

5.4.3 Signals & Telecommunications

As can be seen from Figure 5.1, major investments have been made in signaling and telecommunications systems over the past 5 years. These expenditures have been carried over on the "Status Quo" projection (Table 5.4). It is not considered necessary, however, to continue this high level of investment into the future based on this "status quo" scenario. Accordingly, this investment item is reduced by 75% on the adjusted Status Quo plan.

5.4.4 Locomotives

The average age of the SRT diesel locomotive fleet is 20.4 years. Investments in new locomotives over the past 5 years has been almost negligible. As a result, the average

age of the fleet is relatively high and continues to grow. Not only are the maintenance costs high, the SRT is experiencing an abnormal number of locomotive breakdowns. As a result, the SRT is seeking approval to purchase 76 new locomotives in the 7th Development Plan, along with some additional locomotives already contracted for. The Status Quo investment plan is changed to reflect (for the first 5 years) the same level of investment in locomotives as developed for the 7th Development Plan. Thereafter, in order to maintain an average fleet age of less than 20 years, it will be necessary to invest in approximately 10 new locomotives per year (status quo), at a cost of approximately 65 million Baht each. This investment amount is shown in the revised Status Quo investment plan.

5.4.5 Wagons and Coaches

The most recent level of expenditure in new wagons and coaches is considered appropriate to be projected in the Status Quo investment plan.

5.5 Investment Plan

We shall now estimate SRT investment requirements over a 20 year time-frame, based on the overall findings of this study. Using Table 5.4 as a base, we shall modify the investment requirements to reflect the new direction of the SRT. The new investment plan is shown in Table 5.5.

In the limited context of this study, it would be impossible to cost all investment items on the SRT vis a vis the new levels of business anticipated, or in fact to itemize each investment requirement specifically related to these new business levels. Even if such a degree of accuracy were possible, it would not be warranted when compared to the high level of estimation required in developing future transport demand and any changes in the modal splits to meet this demand. Therefore we have taken a simplistic approach, wherein (for the most part) we have inflated the status quo plan as developed above to account for the anticipated increased levels of business. We are confident that our approach shows an order of magnitude of investment requirements that is conducive to long range planning of investment requirements needed to achieve the potential increase in commercial activity for the SRT which we have identified.

5.5.1 Double Tracking

The Government has announced a plan to double track the entire length of the

SRT trackage, at an estimated cost of 80 billion Baht. From the analysis in Chapter 4, it is clear that the railway should have a more important role in the nation's transportation in the future. Thus, the double tracking plan is not inconsistent with the future rail transportation picture. However, the time frame for double tracking and priority sections for double tracking should be based on the pattern of future traffic demand as indicated in Chapter 4. Thus, we would encourage the SRT to carry out full financial feasibility studies for double tracking on various sections of track. For the purpose of developing the investment plan here, we shall assume that this double tracking investment will be carried out. We have included this in Table 5.5 starting in 1995, at equal installments (in real terms) for the remainder of the 20-year plan. (Note that, because of inflation, the total amount of money spent on double tracking is expected to be far greater than 80 billion Baht).

5.5.2 Other Investments for Increased Capacity

From our demand projections, we shall assume that over the 20-year time-frame, the land transport demand (both passenger and freight) will increase 4 folds (as suggested in Chapter 4). We shall further assume that with the organizational changes we have recommended, the SRT can achieve a 50% greater share of the land transport demand (passenger and freight) compared to the current situation. This results in increased business of 6 fold. With the exception of the double tracking requirement mentioned above, we feel that approximately 66.6% of this increase can be absorbed with the present assets (as adjusted in Table 5.4). This can be achieved through increased efficiencies (related to structural changes), utilization of current excess capacities, and increased capability introduced through double tracking. As a result, we shall inflate some of the investment requirements related to the mechanical engineering components of investment and new line constructions shown in Table 5.4 by 2 fold. Although individual investment items would vary as to inflation requirements, the result in total is considered to be reasonably accurate. All of these changes are incorporated in the investment plan in Table 5.5, which is given in current prices assuming 5% annual inflation.

6. DEBT BURDEN

Once the system of Public Service obligations (Section 1) has been fully implemented, the Government should no longer be involved with any losses suffered by the SRT as the latter (via its executive board and management team) runs its business.

Table 5.5
State Railway of Thailand Investment Plan
(Millions Baht, Current Prices Assuming 5% Inflation)

	1992	1993	1994	1995	1996	1997	1998	1999	2000
CIVIL ENGINEERING									
Replace rail & weld	1,808.9	1,899.4	1,994.4	2,094.1	2,198.8	1,935.4	823.0	864.2	907.4
Replace sleepers	155.7	163.5	171.7	180.3	189.3	198.7	208.7	219.1	230.1
Replace timber bridges	28.2	29.7	31.1	32.7	34.3	36.0	37.9	39.7	41.7
Steel bridges	15.8	16.5	17.4	18.2	19.1	20.1	21.1	22.2	23.3
Stations and yards	6.5	6.8	7.2	7.5	7.9	8.3	8.7	9.2	9.6
Double tracking	0.6	0.7	0.7	5,720.2	6,006.2	6,306.5	6,621.8	6,952.9	7,300.6
Sidings	14.1	14.8	15.5	16.3	17.1	18.0	18.9	19.8	20.8
New line construction	80.9	84.9	89.1	93.6	98.3	103.2	108.3	113.8	119.5
Equip. & Buildings	77.0	80.8	84.9	89.1	93.6	98.2	103.1	108.3	113.7
Sub-Total	2,187.7	2,297.1	2,411.9	8,252.0	8,664.5	8,724.4	7,951.5	8,349.1	8,766.6
MECH.ENGINEERING									
New locomotives	385.4	3.3	2,631.5	576.3	2,115.4	1,742.1	1,829.2	1,920.7	2,016.7
New DRC's	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New passenger coaches	553.8	1,297.9	1,362.8	1,430.9	1,502.4	1,577.6	1,656.4	1,739.3	1,826.2
New coach construction	5.5	14.1	14.8	15.6	16.3	17.2	18.0	18.9	19.9
New freight wagons	12.5	29.3	30.8	32.3	33.9	35.6	37.4	39.3	41.3
Sub-Total	957.1	1,344.6	4,039.9	2,055.1	3,668.2	3,372.5	3,541.1	3,718.2	3,904.1
SIGNALS & TELECOM.									
Improve telecom.	28.6	30.0	31.5	33.1	34.7	9.1	9.6	10.0	10.5
Improve signals	224.2	235.4	247.2	259.5	272.5	71.6	75.1	78.9	82.8
Sub-Total	252.7	265.4	278.6	292.6	307.2	80.7	84.7	88.9	93.4
SPECIAL PROJECTS	211.5	222.0	233.1	244.8	257.0	269.9	283.4	297.6	312.4
TOTAL	3,609.0	4,129.1	6,963.6	10,844.4	12,897.0	12,447.5	11,860.7	12,453.8	13,076.5

Table 5.5 (Continued)
State Railway of Thailand Investment Plan
(Millions Baht, Current Prices Assuming 5% Inflation)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CIVIL ENGINEERING											
Replace rail & weld	952.7	1,000.4	1,050.4	1,102.9	1,158.1	1,216.0	1,276.8	1,340.6	1,407.6	1,478.0	1,551.9
Replace sleepers	241.6	253.6	266.3	279.6	293.6	308.3	323.7	339.9	356.9	374.7	393.5
Replace timber bridges	43.8	46.0	48.3	50.7	53.3	55.9	58.7	61.7	64.7	68.0	71.4
Steel bridges	24.4	25.7	26.9	28.3	29.7	31.2	32.7	34.4	36.1	37.9	39.8
Stations and yards	10.1	10.6	11.1	11.7	12.3	12.9	13.5	14.2	14.9	15.7	16.5
Double tracking	7,665.6	8,048.9	8,451.3	8,873.9	9,317.6	9,783.4	10,272.6	10,786.2	11,325.6	11,891.8	12,486.4
Sidings	21.8	22.9	24.1	25.3	26.5	27.9	29.3	30.7	32.2	33.9	35.6
New line construction	125.4	131.7	138.3	145.2	152.5	160.1	168.1	176.5	185.3	194.6	204.3
Equip. & Buildings	119.4	125.4	131.6	138.2	145.1	152.4	160.0	168.0	176.4	185.2	194.5
Sub-Total	9,204.9	9,665.1	10,148.4	10,655.8	11,188.6	11,748.0	12,335.4	12,952.2	13,599.8	14,279.8	14,993.8
MECH.ENGINEERING											
New locomotives	2,117.6	2,223.4	2,334.6	2,451.3	2,573.9	2,702.6	2,837.7	2,979.6	3,128.6	3,285.0	3,449.3
New DRC's	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New passenger coaches	1,917.5	2,013.4	2,114.1	2,219.8	2,330.8	2,447.3	2,569.7	2,698.2	2,833.1	2,974.7	3,123.5
New coach construction	20.8	21.9	23.0	24.1	25.3	26.6	27.9	29.3	30.8	32.3	34.0
New freight wagons	43.3	45.5	47.8	50.2	52.7	55.3	58.1	61.0	64.0	67.2	70.6
Sub-Total	4,099.3	4,304.2	4,519.5	4,745.4	4,982.7	5,231.8	5,493.4	5,768.1	6,056.5	6,359.3	6,677.3
SIGNALS & TELECOM.											
Improve telecom.	11.1	11.6	12.2	12.8	13.5	14.1	14.8	15.6	16.4	17.2	18.0
Improve signals	87.0	91.3	95.9	100.7	105.7	111.0	116.6	122.4	128.5	134.9	141.7
Sub-Total	98.1	103.0	108.1	113.5	119.2	125.2	131.4	138.0	144.9	152.1	159.7
SPECIAL PROJECTS	328.1	344.5	361.7	379.8	398.8	418.7	439.6	461.6	484.7	508.9	534.4
TOTAL	13,730.3	14,416.8	15,137.6	15,894.5	16,689.2	17,523.7	18,399.9	19,319.9	20,285.9	21,300.2	22,365.2

In fact, if SRT profits in any year are larger than required for re-investment, the surplus should revert back to the Government as the sole share holder. If, however, losses should occur, the management team must be held fully accountable.

However, there is one issue in the present context that needs to be resolved. How should the debts presently shouldered by the SRT be handled? These debts are the result of past loss-ridden operations. Although the Government has implicitly taken full responsibility for SRT losses in the form of annual budget allocations, the payment arrangement itself imposes interest costs on the SRT, increasing the total SRT debt in the process.

As noted in Section 1 above, Government financing of the SRT deficit has been based more or less on the PSO concept without actually realizing it nor fully accepting it in the manner adopted in other countries. If it can reasonably be assumed that the PSO concept had been fully implemented say 10 years earlier, how would the SRT financial situation be different than at present? That is, how much would the PSO's have cost the Government each year for the whole period in question?

The difference between this figure and the actual contribution made by the Government, plus the interest costs borne by the SRT as a result of the delay in payment of these contributions, should be treated as the amount the SRT should have received if restructuring had taken place earlier. The amount so calculated, plus interest, should represent the current contribution to be made by the Government towards the present debt situation faced by the SRT.

It is not suggested here that the Government should accept full responsibility for all debts presently shouldered by the SRT. This certainly would be unfair to the Government, as a part of these debts (i.e. losses suffered annually by the SRT) is the result of SRT inefficiencies. The SRT should live with its own inefficiencies, and try to reduce these with maximum effort.

With the PSO strategies to be adopted in the very near future, the remaining SRT debt (after the special financial compensation proposed above in this sub-section) should continue to be borne by the SRT. The SRT should be able to efficiently clear away the debt to be incurred annually. If this burden were to prove too great, however, (as would be the case if it resulted in non-competitive pricing), it is suggested that the SRT offset some of its current debt by sale of lands to the Government.

By law, any lands owned by the SRT that are not required (now or in the future) by the SRT, revert back automatically to Government ownership. Land sales to offset debt burden would therefore be land not currently required, but where a requirement is seen in the future. In selling this land, therefore, the SRT is in effect increasing its debt, because it will be required to buy back similar land portions at some time in the future. We therefore recommend current land sales to the Government to a level only to offset current debt amounts which cannot be met. If this situation arises, the Government should cooperate fully, and purchase back land at fair prices.

CHAPTER 7

ACTION PLANS

As discussed in Chapter 1, the railway's problems worldwide from the past and at present are the consequences of many decades of unclear policies and objectives and inefficiencies. In Thailand, the SRT's past and present experiences exhibit many features of the problems that have faced, or are still being faced by, railways through out the world. Unclear policy objectives and the failure to separate the railway's responsibility from that of the government concerning the provision of social services have resulted in a vicious cycle of loss, increasing debt, deferred maintenance, increasing age of rolling stock, and low employee morale. Yet, from this study, it seems clear that the railway has an important role to play to serve the nation's transportation needs. In fact, increasing negative externalities associated with other modes of transport point to the need to increase the railways role substantially in the future. The challenges for the SRT and the government to bring this about are great, though not insurmountable given the encouraging experiences of many countries in the world that have seriously tried to tackle similar problems. There is no quick fix, however. In many countries, such as Great Britain, Japan and the United States, reform has taken many years to become effective, and the process is still continuing. Thus, bringing about the required changes to the SRT should be regarded as a dynamic process, with a considerable amount of trail and error. While this study has analyzed and suggested the potential of the railway to serve the nation's transportation needs and the necessities of making critical changes to the environment under which the SRT operates and internal changes within the SRT itself, the study is but a small first step along the road to effective reform and re-positioning. While all solutions may not be clearly perceived at the present time, this should not be allowed to become excuses for a do-nothing "status-quo" approach. This may turn out in the end to be the worse possible course of action (or non-action). Experiences in many countries suggest that the transition of the railway problem from one which seems to be controllable to a critical situation requiring serious surgery is shorter than one might imagine. The vicious circle of loss and increasing debt generates a snow-balling effect that can grow exponentially and quickly becomes out of control.

Because the problems with the SRT are not yet at the critical level, implementing the needed solutions should be much easier than if the problems were already critical.

However, as already suggested, a business-as-usual attitude on the part of the government and the SRT will not solve the problem. These will not go away by themselves without some serious attempts to make changes, even though attempted solutions may need monitoring and modifications as time goes along. This chapter suggests some courses of action that could be initiated in the process of finding appropriate solutions.

1. GETTING POLITICAL CONSENSUS AND COMMITMENT

In the course of carrying out this study, it became quite clear to the research team that there is a wide-spread lack of understanding of the predicaments facing the SRT. Allocating the blame for the problem on SRT's inefficiencies is the usual reaction of diverse groups of people, including government officials, technocrats, and politicians. If these types of beliefs persist, bringing about necessary changes will continue to become very difficult. To bring about effective reform, it is necessary that a political consensus be developed on the real nature of the SRT's problems and the need to promote more use of the railway. This will not happen automatically, however. The SRT needs to develop an effective strategy to bring it about. Components of such a strategy may include the followings.

1.1 Active and Continual Dissemination

This study, as well as many others available around the world, provides analyses and arguments that could be used to generate a better understanding of the railway's problems and potentials, and develop a consensus on the need to make required changes. It is up to the SRT to actively make use of such findings through dissemination programs targeted at a broad range of people; from politicians, government agencies, technocrats, academicians, and, equally as important as these groups if not more so, the general public.

The current socio-economic situations in Thailand should help the SRT considerably in its dissemination objectives.

- The transport sector is in a state of considerable chaos, with serious congestion problems on the roads.
- Increasing awareness and concerns over environmental problems, with more and more active groups willing to lobby for the cause of a better environment, and with government

commitment to improve the environment appearing to become stronger and stronger.

- Concerns over the current account deficit (or saving-investment gap) is related to increasing energy consumption and imports, thus highlighting the benefit of rail fuel efficiency.

1.2 Develop a Professional Public Relations Plan

In achieving effective dissemination, the SRT may need to utilize professional public relations agencies to develop a PR Plan. As with many activities, effective dissemination requires specialized and professional know-hows, which may not exist within the SRT itself. Given the current predicaments of the SRT and the need to bring about appropriate changes, an effective PR Plan is a necessary component of the SRT's operational plans.

1.3 Develop Show-Case Services

All the PR in the world will not be very effective, if the perception persists that the SRT has no worthwhile products to sell. Given the current structure of SRT operations, it is not surprising that the common perception of the SRT is that it is a provider of low grade and low quality services (over 90% of passengers carried are 3rd class, and a preponderance of old and dirty freight wagons). Some show-case services providing quality and reliability (both for passengers and freights) should be developed to demonstrate that the SRT is able to provide such services if given the chance through appropriate reforms. On such services, the SRT should work closely with the potential customers to fully serve their needs, including before- and after-rail services to provide convenient connections to other modes of transport.

2. IMPLEMENTATION OF THE PSO SYSTEM

As already discussed and analyzed in the previous chapters, this is considered to be a crucial step in the effective reform of the railway. Such a PSO system should be implemented as soon as possible. It will lead to many benefits:-

- Clear division of responsibilities between the government and

the SRT on social services,
- Incentives for full commercial operations on non-PSO services,
- Full accountability of the SRT management for the future financial position of the SRT,
- Possibility for transforming the SRT into the "Good Public Enterprise" status of the Ministry of Finance, with the attendant greater autonomy and self-reliance, and
- Increased employee morale.

Given the importance of the implementation of the PSO, it is suggested that implementation should start without having to wait for all parties to agree that all the details of the system are perfect. Waiting to develop the perfect system is likely to lead to non-action. As long as some reasonable system can be developed, implementation should start. The system will need to be monitored and fine-tuned in any case. Some suggested areas for review for future modifications that could be carried out as the PSO is implemented includes.

1. Review of the PSOs involving branch lines, mixed trains, and local train service. Detailed study should be launched within two years of implementing the PSO strategy to determine the possibility of alternative means of providing the same types of transport services presently provided by branch line and local train services. Given the current system of the road network and the development of provincial bus transport, it may be more efficient to provide transport of low density traffic via roadway in light of its relative smaller scale of operation, flexibility in scheduling, and convenience in delivering the service. The proposed study may eventually lead to the phasing out of certain PSOs at greater savings to the government, and increased opportunity for the SRT to concentrate its available limited resources on commercial undertakings.

2. The system of cost accounting presently installed can be used in the initial implementation to the PSO system. However, the system should be improved to enhance economic decision making. The eventual accounting system should enable the SRT to distinguish variable cost from fixed cost in operating a given line (or a given category of service).[1] The distinction facilitates the decision to continue or to discontinue the service in question, be it a PSO or non-PSO service. Such decision should periodically be made for all existing services and lines. It is suggested that the improvement to the cost

1. The current Transmark system is unable to do so directly. See Bevis (1992).

accounting system be integrated into the Transmark system recently installed, and carried out in parallel with the perfection of the Transmark system. It should be available for use within two years.

3. Annual process for PSO negotiations should be established. Given the fiscal year of the SRT which begins on October 1, and ends on September 30 of the following year, the negotiation schedule could be as follows:

- i) SRT's submission of PSO contribution from the government on January 1,
- ii) Government examination of past records and new proposal by "the public enterprise office" of the central government in conjunction with the SRT February 15,
- iii) Negotiation of the two parties February 16 - March 15,
- iv) Finalization of the PSO agreement and scheduled financial contribution not later than March 31, and
- v) PSO contributions from the government to the SRT, starting not later than October 1.

4. The PSO strategy should be subject to biannual review. The review may lead to cost reduction and revenue improvement in PSO service provision, or even termination of some PSO services if the government should so decide. Regular periodic review is necessary in such relationship so that both parties will be alert to possible changes for better arrangements.

3. GOVERNMENT-SRT CONTRACTUAL AGREEMENTS

The PSO system is just one aspect of a re-definition of the relationship between the government and SRT. As the PSO is implemented, the government and SRT should begin to discuss and reach agreements on the broader aspects of their relationships. The aim would be to develop commitments that each side will carry out in the process of reform. The process should lead to the development of the "Contract Plan," "Management Plan" and the "Enabling Actions Plan" (as suggested in Huff and Thompson, 1990).

3.1 The Contract Plan

The contract plan is a formal ratification by the SRT and the Government of their respective obligations. It is not a really a plan but rather an implementing or "agreed actions" document. It clarifies the authority and responsibility of the SRT, stipulates the performance levels expected of the railway, specifies the commitments to be undertaken by the Government, and establishes a time period for the duration of the contract (possibly 3-5 years).

There are a number of steps involved in the contract planning process.

First step: Adoption and affirmation of the mission statement and objectives for the railway enterprise, including that implicit in the PSO implementation.

Second step: Delineation of the railway's authority to make decisions which control the fulfillment of its responsibilities crucial to the successful operation of an efficient provider of PSO services, and a competitive, profit-making enterprise on non-PSO operations. Among the types of SRT authority that could be listed and described in the contract plan are the followings:

- Freedom to set and change prices on its commercial (non-PSO) freight and passenger services, to negotiate confidential contract rates with freight customers, and to market services as it sees fit.
- Freedom to engage in commercial ancillary services with its assets.
- Freedom to enter into contractual arrangements with private sector companies to obtain services that it needs, and to offer new joint and cooperative logistics services to customers.
- Freedom to alter the physical size of the railway system and the size and composition of its fleet of locomotives and other equipment.
- Freedom to cease railway services that do not meet commercial objectives, and for which the Government does not choose to provide PSO financial support.
- Freedom to borrow funds.

Third step: Establishment of the railway's performance standards.

Some performance standards would be part of the PSO agreement for the efficient provisions of PSO services. However, once the PSO is in place, and the SRT is expected to be commercially viable in its non-PSO operations, the eventual aim should be to transform the SRT into a "Good Public Enterprise," according to the Ministry of Finance classification. This would qualify it for much greater autonomy in operational policies, including personnel policy. To qualify for the "Good Public Enterprise" status, a number of criteria have to be met, such as that the rate of return on assets should be at least 6%, or that the growth in output should be more than 2% per annum. These various targets should be worked out between the SRT and the Ministry of Finance.

Fourth step: Proposals of railway commitments in return for its broader and clearer authority, including possibly the followings:

- Aggressive and professional efforts to meet the performance standards, such as the financial targets or agreed upon quality of service.
- Effective management of operations, such as efficient labor force size and working conditions, professionally managed procurements, and efficient acquisition and use of capital resources, however derived.
- Mutually advantageous relationship with customers, i.e. quality services at competitive rates for commercial customers, and fully satisfactory delivery of services to social service customers.
- Monopoly positions, if any, will not be abused.
- Forthright and transparent relationship with the government, including accurate financial and operational information as necessary to verify performance against standards or targets, good faith projections of costs and revenues for supported services, and accurate estimates of capital requirements.
- Fair and responsible relationship with the workforce, including pay, conditions of work, and incentives (both for labor and management).

Fifth Step: Consideration of Government's Commitments including some or all of the following:

- Deregulation of rates and fares, service levels, and decisions to allow abandonment of rail plants and services that are not supported by the PSO agreement.
- Changes in government policy toward non-rail modes of transportation in terms of economic regulation, taxation, promotion, safety, etc.
- Capital investment payments in the railway (amount and schedule).
- Payment of PSO operating subsidies for supported services.
- Definition of procedures for assuring timely payment by government ministries for charges owed to the railway.
- Removal of railway personnel from Civil Service Jurisdiction, and assumption of unfunded Civil Service pension liabilities.
- Formal authorization for the railway to obtain goods and services from private contractors, to enter into cooperative arrangements with third party transportation companies and logistics services providers, and to use its assets freely for commercial purposes (leasing space, selling or developing its real estate, etc.).

Sixth Step: Consideration of contingency provisions by identifying the procedures to be used in the event of a major failure, either in meeting the terms of the document or due to some external event which renders it necessary.

3.2 The Management Plan

The management plan is an internal document prepared by and for the SRT. In it, the activity plans according to future rail strategy, and the performance commitments by the SRT in the Contract Plan are converted into detailed operational targets for each of the SRT's departments.

Normally the management plan will have a three to five year planning horizon, and includes a number of steps.

First Step: Establishment of the organizational framework for converting to a commercial mode of operation. Changes similar to the lines suggested in Chapter 6 may be planned.

Second Step: Determination of the SRT's pricing and marketing policies for its non-PSO modes of operations taking into account the potential markets in the future.

Third step: Specification of responsibilities for each department and the managers who direct them, and performance goals. These should include:

- Revenue targets, based on assessments of demand, expected pricing behavior, and costs. The objective is not gross revenue per se, but revenue which makes a contribution to net income. The obvious corollary is that traffic carried below cost should either receive a tariff increase or be phased out. These targets are directly related to the railway's objectives for levels of profitability or return on investment for particular commercial sectors/services.
- Forecasts of outputs, along with cost estimates at each level of output.
- Cost reduction targets (or Increased output per unit of cost).
- Basic performance indices, e.g. percent of trains on time, percent of locomotives available for service, percent utilization of wagons, meeting current maintenance of way (MOW) schedules and reducing deferred MOW, percent of revenue collected (where passenger fare fraud is an issue), and efficiency measures for Government-supported services provided under PSO contract. Because of the railway's newness in operating like a commercial company, these targets should be open to continual review and revisions in the light of experience, but appropriate performance indicators are a critical element of successful management.
- Other performance commitments, such as completion of scheduled investment programs within allocated budget and on time, attaining various productivity targets, recruitment or training objectives, motivating the work force, achieving greater value in the utilization of railway assets (leasing station space, developing real estate, etc.), enlisting new customers, building customer satisfaction, devising new marketable service offerings, and any other key targets for which a particular department is responsible.

3.3 The Enabling Actions Plan

The Contract Plan provides a comprehensive listing of the obligations which the Government has agreed to fulfill. The enabling actions plan takes that list and develops the program of specific steps which must be taken to enable the Government to make good on each of its promises, and enable the railway to begin operating as a truly commercial enterprise.

The enabling action plan could contain the following components.

- Necessary new legislation and amendment or repeal of existing legislation must be identified and a plan for achieving the necessary enactments established. Some of the required changes were suggested in Chapter 6.[2] With respect to regulations, a schedule would be arranged for the issuance of needed new regulations, or the cancellation, amendment, or waiver of old ones as required to meet obligations agreed to by the Government in the contract plan.
- Similarly, any necessary policy or administrative directives would be drafted and issued to the relevant government departments.
- The enabling actions plan would also arrange for the implementation of agreed upon changes in the organization of government agencies and the removal of the railway from the strict central control.
- Any new funding authority needed by the Government would be sought and provisions made for the allocation in the national budget.

Specifically, prompt formulation of an enabling actions plan is important to the success of the restructured SRT, because the longer legal, legislative, regulatory, and other administrative obstacles delay the efficient commencement of operation of the SRT as a commercial enterprise the lesser are its chances for success in ending the vicious circle of problems that afflicts the SRT today.

2. See also Permtanjit (1993).

Table 4.1
Summary of SRT Investment Plan

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Double Tracking	0.6	0.7	0.7	5,720.2	6,006.2	6,306.5	6,621.8	6,952.9	7,300.6	7,665.6
Tracks/Bridges	2,110.1	2,215.6	2,326.4	2,442.7	2,564.8	2,319.7	1,226.6	1,287.9	1,352.3	1,419.9
Buildings	77.0	80.8	84.9	89.1	93.6	98.2	103.1	108.3	113.7	119.4
MP&RS	957.1	1,344.6	4,039.9	2,055.1	3,668.2	3,372.5	3,541.1	3,718.2	3,904.1	4,099.3
Signals/Telecom	252.7	265.4	278.6	292.6	307.2	80.7	84.7	88.9	93.4	98.1
Special Projects	211.5	222.0	233.1	244.8	257.0	269.9	283.4	297.6	312.4	328.1
Total	3,609.0	4,129.1	6,963.6	10,844.4	12,897.0	12,447.5	11,860.7	12,453.8	13,076.5	13,730.3
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Double Tracking	8,048.9	8,451.3	8,873.9	9,317.6	9,783.4	10,272.6	10,786.2	11,325.6	11,891.8	12,486.4
Tracks/Bridges	1,490.9	1,565.4	1,643.7	1,725.9	1,812.2	1,902.8	1,998.0	2,097.8	2,202.7	2,312.9
Buildings	125.4	131.6	138.2	145.1	152.4	160.0	168.0	176.4	185.2	194.5
MP&RS	4,304.2	4,519.5	4,745.4	4,982.7	5,231.8	5,493.4	5,768.1	6,056.5	6,359.3	6,677.3
Signals/Telecom	103.0	108.1	113.5	119.2	125.2	131.4	138.0	144.9	152.1	159.7
Special Projects	344.5	361.7	379.8	398.8	418.7	439.6	461.6	484.7	508.9	534.4
Total	14,416.8	15,137.6	15,894.5	16,689.2	17,523.7	18,399.9	19,319.9	20,285.9	21,300.2	22,365.2

Source: Table 5.5, Chapter 6.

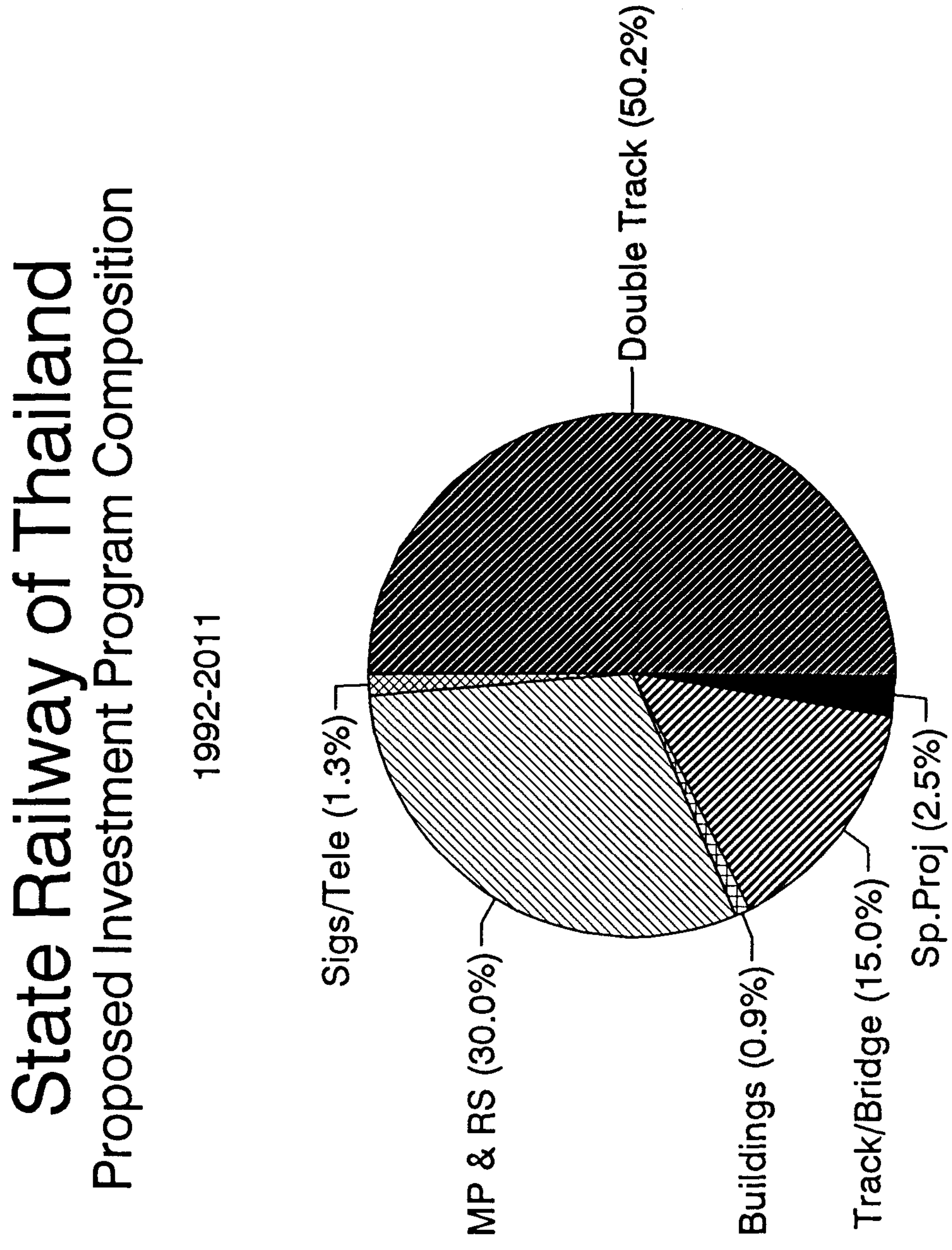
State Railway of Thailand
Proposed Investment Program Composition
1992-2011
Double Track (50.2%)
Sp.Proj (2.5%)
Track/Bridge (15.0%)
Buildings (0.9%)
MP & RS (30.0%)
Sigs/Tele (1.3%)

Figure 4-1

4. INVESTMENT PLAN

Given the past deferred maintenance and low investment, the investment plan is a critical component necessary to improve SRT performance and prepare the railway for an increased role in the future. Chapter 6 has already developed the detailed future investment requirements for the SRT, in order to achieve the new level of business desired. These requirements can be summarized in the Investment Plan shown below as Table 4.1. This plan is intended to be in order of magnitude of total only, and obviously much further study needs to be undertaken on the individual investment programs. We are confident, however, that this plan will provide SRT and Government planners with the appropriate magnitude of investments required.

Figure 4-1 provides an overview of the major items which make up this investment plan. As can be seen, almost half of the requirement relates to the double tracking project. Certain other potential investments for new lines of business, such as high speed train service, are not included. These need to be studied in more depth, and it is anticipated that they could be developed using private capital.

The plan shows a level of average investment for the next 20 years much greater than the average for the past 5 years. To avoid the need to develop a very large project management staff, it is recommended that to the extent possible future projects be contracted on a "turn-key" basis.

5. FINANCIAL PROJECTION

An important question in the reform process is whether the SRT will become a financially viable operation once the PSO and various reforms are in place. While the situation will need continual monitoring, a rough projection indicates that the SRT is in a position to become financially viable. Table 5.1 gives a rough projection of the SRT's financial position to 2011. The various assumptions are indicated in the table. The volume of passengers follow that in the fixed share case of Chapter 6, and the volume of freight has been assumed to grow at 6% per annum. A crucial assumption in this table is that unit cost can be reduced by 1.5% per annum in real terms. If this and other assumptions in the table holds, then it can be seen that, with the PSO in place, the SRT's is expected to become fairly profitable in the future, with the profit rate increasing to about 6.7% of turnover in 2011, or 7.8% of turnover excluding PSO service costs. This is, of course, dependent on the PSO. Without the PSO, the SRT is expected to continue to make large losses.

A final note on the financial projection is that the reduction in unit cost is contingent on the SRT making appropriate investment. The investment plan indicated in Chapter 6 and in the last section are rough guidelines. It should be stressed that for large scale investment, the SRT should carefully carry out a feasibility study, focusing in particular on the rate of return. If over-investment is carried out, then this will eventually show up in the depreciation costs which would make it very difficult for the SRT to achieve unit cost reductions in its operations.

6. CONCLUSIONS

This study has indicated the necessity and desirability of reforms so that the SRT can play a more active and commercially oriented role to serve the nation's future transportation need. From all the previous analyses, there appears to be a great potential for rail transport in Thailand. An expanded role for rail would serve the rapidly growing demand for transportation of both passenger and freight in line with the country's development, and also help reduce the worsening trends of negative externalities associated with other modes of transport. To be able to exploit this potential fully, however, the "status quo" approach needs to be changed. Explicit understandings and contractual plans need to be developed between the government and the SRT. Actions will be required on both sides. If such agreements can be implemented and actions seriously carried out to conform to the agreements, along the lines suggested above, then one can optimistically look forward to the day when the SRT will be regarded as an efficient and successful organization by a wide spectrum of the population, and rail transport regarded as a high quality transportation system which is indispensable for the nation.

Table 5.1
The Projection of the SRT Financial Situation 1992-2011 (Million Baht)

	Actual	Projected									
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Operating Revenue											
Passenger	3,177.7	3,537.3	3,950.5	4,412.3	4,928.2	5,504.8	6,139.4	6,847.4	7,637.3	8,518.7	9,502.0
PSO	230.1	245.9	275.2	308.3	345.6	387.7	433.7	485.4	543.5	608.9	682.5
Non-PSO	2,947.6	3,291.4	3,675.3	4,104.0	4,582.6	5,117.1	5,705.7	6,362.0	7,093.8	7,909.7	8,819.5
freight	1,324.8	1,470.5	1,632.3	1,811.8	2,011.1	2,232.4	2,477.9	2,750.5	3,053.1	3,388.9	3,761.7
others	972.8	1,031.2	1,093.0	1,158.6	1,228.1	1,301.8	1,379.9	1,462.7	1,550.5	1,643.5	1,742.1
PSO Payment	819.9	900.7	977.5	1,061.2	1,152.5	1,252.0	1,359.4	1,476.2	1,603.4	1,741.9	1,892.7
Total	6,295.2	6,939.7	7,653.3	8,443.9	9,320.0	10,291.1	11,356.7	12,536.8	13,844.2	15,292.9	16,898.5
Operating Expenses											
Total	6,191.4	6,819.5	7,511.4	8,273.6	9,113.3	10,038.4	11,052.1	12,168.4	13,397.5	14,750.9	16,241.3
Operating Profit	103.8	120.2	141.9	170.3	206.7	252.6	304.5	368.5	446.8	542.0	657.2
Without PSO (Loss)	(716.1)	(780.5)	(835.5)	(890.9)	(945.8)	(999.4)	(1,054.8)	(1,107.7)	(1,156.6)	(1,199.9)	(1,235.5)

Note:
PSO passengers assumed to increase as in Table 1.3, Chapter 6.
Non-PSO passengers increase per annum as follows.
1991-96=6.66%, 1996-2001=6.5%, 2001-06=5.7%, 2006-11=6.06%
Freight volume increase 6% per annum, 1991-2011.
Fares and freight rates constant in real terms (5% inflation) from 1992.
Unit Costs declines 1.5% in real terms, so increases 3.5% per annum.
Total passenger and freight unit aggregated using revenues in 1991 as weights.
Other revenues assumed to increas 6% per annum (nominal).

Table 5.1 (Continued)
The Projection of the SRT Financial Situation 1992-2011

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Operating Revenue										
Passenger	10,525.5	11,659.5	12,916.1	14,308.4	15,851.3	17,612.2	19,569.0	21,743.4	24,159.7	26,844.6
PSO	762.4	852.0	952.3	1,064.7	1,190.7	1,330.0	1,485.8	1,659.9	1,854.6	2,072.4
Non-PSO	9,763.1	10,807.6	11,963.8	13,243.7	14,660.5	16,282.2	18,083.2	20,083.5	22,305.0	24,772.3
freight	4,175.4	4,634.7	5,144.6	5,710.5	6,338.6	7,035.9	7,809.8	8,668.9	9,622.5	10,681.0
others	1,846.7	1,957.5	2,074.9	2,199.4	2,331.4	2,471.3	2,619.5	2,776.7	2,943.3	3,119.9
PSO Payment	2,055.7	2,194.3	2,289.1	2,385.7	2,483.7	2,697.5	2,929.2	3,180.3	3,452.1	3,746.4
Total	18,603.3	20,446.1	22,424.6	24,604.0	27,005.0	29,816.9	32,927.6	36,369.3	40,177.5	44,391.9
Operating Expenses										
Total	17,827.3	19,568.2	21,479.2	23,576.9	25,879.4	28,427.8	31,227.1	34,302.3	37,680.4	41,391.4
Operating Profit	776.0	877.9	945.4	1,027.1	1,125.6	1,389.2	1,700.5	2,067.0	2,497.1	3,000.5
Without PSO (Loss)	(1,279.7)	(1,316.5)	(1,343.6)	(1,358.6)	(1,358.2)	(1,308.4)	(1,228.7)	(1,113.2)	(955.0)	(745.9)

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