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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

OFFICE OF THE NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD
STATE RAILWAY OF THAILAND
THE KINGDOM OF THAILAND

THE STUDY
ON
AN IMPROVEMENT PLAN
FOR RAILWAY TRANSPORT
IN AND AROUND THE BANGKOK METROPOLIS
IN CONSIDERATION OF URBAN DEVELOPMENT
IN
THE KINGDOM OF THAILAND

FINAL REPORT

VOLUME II

PART III RAILWAY IMPROVEMENT INTEGRATED WITH URBAN DEVELOPMENT

OCTOBER 1995

JAPAN RAILWAY TECHNICAL SERVICE
YACHIYO ENGINEERING
ALMEC

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PREFACE

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct the Study on an Improvement Plan for Railway Transport in and around the Bangkok Metropolis in Consideration of Urban Development in the Kingdom of Thailand and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Thailand a study team headed by Dr. Misao Sugawara, a Board Member of Japan Railway Technical Service (JARTS), consisting of JARTS, Yachiyo Engineering Co., Ltd. and ALMEC Corporation, 6 times between August 1993 and August 1995.

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

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

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

October 1995

Kimio Fujita
President
Japan International Cooperation Agency

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INTEGRATED WITH URBAN DEVELOPMENT

FEASIBILITY STUDY ON RAILWAY IMPROVEMENT
OF THE EASTERN LINE
INTEGRATED WITH URBAN DEVELOPMENT

ABBREVIATION

JICA	Japan International Cooperation Agency
NESDB	Office of the National Economic and Social Development Board
SRT	State Railway of Thailand
NHA	National Housing Authority
IEAT	Industrial Estate Authority of Thailand
DUIT	Department of Highways
OEPP	Office of Environmental Policy and Planning
MEA	Metropolitan Electricity Authority
BMA	Bangkok Metropolitan Administration
BMR	Bangkok Metropolitan Region
ESB	Eastern Seaboard
UCR	Upper Central Region
SBIA	Second Bangkok International Airport
ORR	Outer Ring Road
IURD	Integrated Urban and Railway Development
MRT	Mass Rapid Transit System
CBD	Central Business District
BTS	Bangkok Transit System
HST	High Speed Train
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
OD	Origin/ Destination
AS	Automatic Train Stop (System)
PSO	Public Service Obligation
CTC	Centralized Train Control (System)
VVVF	Variable Voltage Variable Frequency
LED	Light Emitted Diode
SBIA NT	SBIA North Terminal

MASTER PLAN STUDY ON RAILWAY IMPROVEMENT INTEGRATED WITH URBAN DEVELOPMENT

1. Master Plan Study on Railway Improvement Integrated with Urban Development

1.1 Overview

1.1.1 Concept of Integrated Urban Development and Railway Improvement

(1) Objectives

Many Bangkok commuters are spending long hours in cars, buses and other vehicles to make their way to their places of work and school every day. Over 20% of commuters spend more than four hours. Moreover, during the daytime, many people have to spend extra time in cars and other transport vehicles so that they can keep appointments and working schedules. As a result, an enormous loss to the national economy and environmental disruption by air pollution, etc. have been brought about.

The objective of integrated development is to provide housing with a better transport environment for an increasing number of people, and, from the view point of railway management, to ensure a large volume of stable passenger demand in order to increase revenues as well as to recycle the benefits of land development to railway investment costs and operational expenses so as to contribute to improved management in the railway business.

Furthermore, by introducing the integrated development method, the transport system in Bangkok Metropolis is to be converted from the conventional road-dependent system to a railway-oriented system. In this case, the aim is to ease the severe traffic congestion in and around Bangkok by eliminating the bottleneck of the Thai economy as well as ensuring its citizens a more comfortable and cultural life and realizing a Bangkok Metropolis with less environmental pollution.

(2) Physical coordination of urban development and railway improvement

In order to shift from road transport to railway transport for commuting and business purposes in the greater Bangkok area, new railway transport services must be formulated. This system must be integrated with urban development projects. For example, access means, including buses, "park and ride", and "kiss and ride", must be well taken into account when urban development projects are to be introduced. Needless to say, frequency, travel

time, comfort and other factors relating to railway operation must fit the citizens and urban life(Fig. 1.1.1).

Also, facilities and events appealing to the people and passengers must be introduced into the surroundings of railway stations located outside the center of Bangkok. This will work to counterbalance the centralization and flow of people to Bangkok.

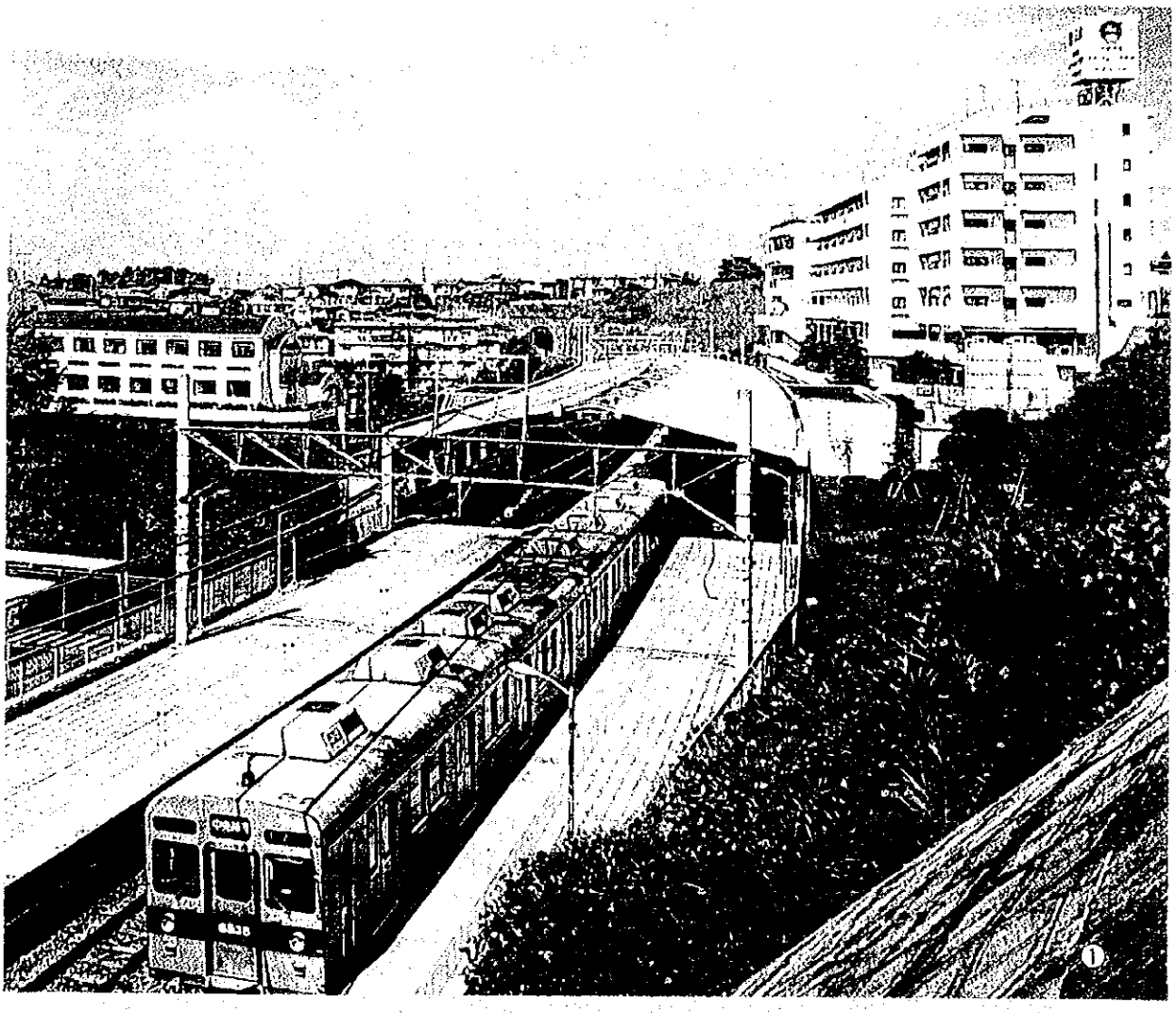


Fig. 1.1.1 Example of Urban Development Integrated with Railway Improvement

(3) Securing funds for investment and managerial increase

In the railway business, especially the railway business centering on commuter transport, is not easy to make stable profits (Table 1.1.1). This is because commuter transport is characterized as a one-directional and wave-like movement and because a very low transport fare is a must as a means of public transport.

Table 1.1.1 Example of Economic and Financial Evaluation on Mass Rapid Transit Systems

Item / City	System	Length (km)	Forecasted traffic demand (000 persons/day)	EIRR (%)	FIRR (%)
A	Subway	13.5	1,000	8.7	1.1
B	MRT (Elevated)	14.2	200	9.2	4.3
C	Railway (Surface)	30.0	90	16.4	5.7

Note: EIRR; Economic Internal Rate of Return
Note: FIRR; Financial Internal Rate of Return

Generally the funds for railway investment and operation are procured by the following systems.

- Direct collection system (Fares, charges)
- Indirect collection system(Cost sharing by beneficiaries, special purpose taxes)
- General tax system (General taxes)

Beside the above, fund procurement by issuing bonds can be considered. In the final stage, however, the funds for the bond redemption are obtained by the above three systems.

Many countries subsidize commuter railway business using public fund. The Government of Thailand is also proposing compensation for the losses caused by commuter railway business as a PSO (public service obligation).

On the other hand, railway investment enhances the utilization of the surrounding land, raising land prices. In some land development methods, an unreasonable practice that

railway investment is borne by public funds or funds from railway enterprises and most profits from the land development are received by landlords and developers, prevails.

For a nation which has fixed asset tax urban planning tax and other similar taxation systems, a small portion of such railway development profits is returned to the government in the form of increased taxes. However, these tax increases far from covering the deficit of the railway investment and managerial cost increases.

The main financial purpose of the integration of urban development and railway improvement is to return development profits in order to cover the deficits of railway investment and management.

This report discusses and analyzes appropriate development and investment methods, and implementation systems.

(4) Refunding by value capture through an integrated development

1) Value capture

Many theoretical studies have been carried out so far, which are based on the assumption that reduction of transport cost and time through the introduction of new transport means or improvements of existing transport means enhances the utilization of surrounding land.

The most classical theory was introduced in the 19th century for agricultural fields. This theory simply calculated value capture under the assumption that land prices decreased in a straight line from the business district, the center of the area projected.

However, it must be taken into account that the reduction of transport cost and time to and from a particular city will lead more people to live there. The boundary areas enjoying traffic conveniences will also be affected. When functions of a railway are upgraded, areas with a permissible maximum commuting time will expand (Fig. 1.1.2).

In an area located at a distance (x) from the city center, the land price rises because of increased usefulness as residential land if commuting time and commuting cost are decreased. This is called "Value Capture" (External land profit due to railway improvement and urban development).

Detailed calculation of the value capture brought by railway improvement projects is carried out in the feasibility study for some specified railway sections.

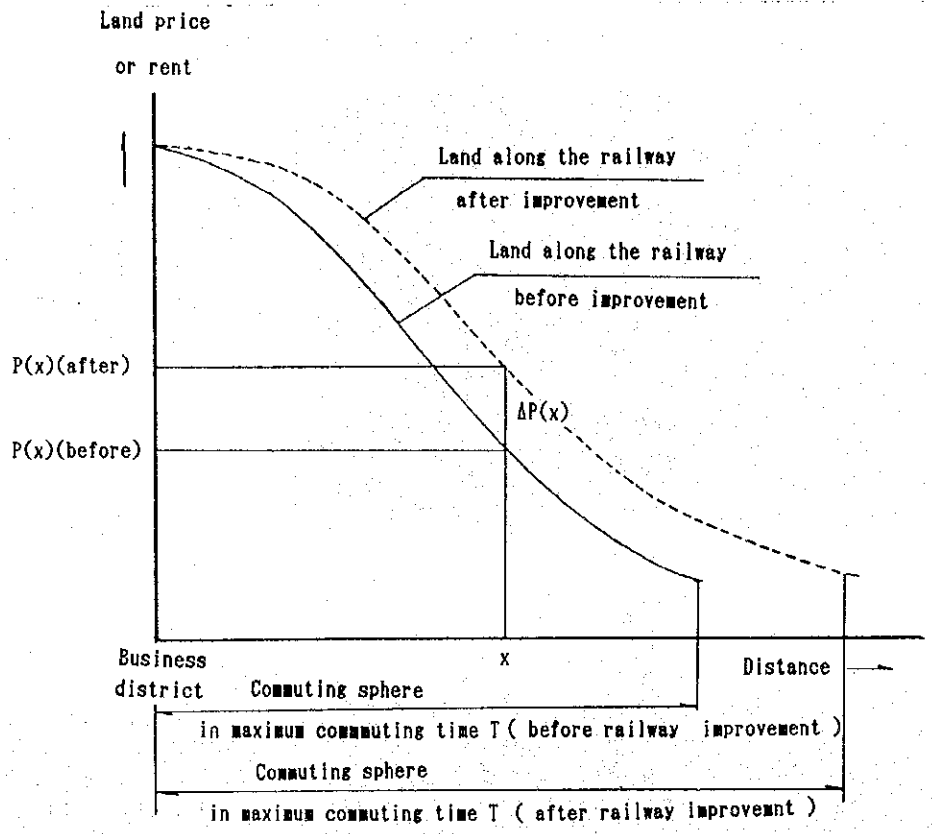


Fig. 1.1.2 Concept of Relation Between Travel Time and Land Price

2) Integration of urban development and railway improvement

If the purchasing of land for public transport and for urban development is easily made by the enterprise for the project, there would be no problem obtaining value capture.

In other words, if the railway operator has the opportunity to purchase any land at the original price and introduce a new transport means, by disposing of or leasing the railway-surrounding land with an increased utilization, or by constructing houses and other urban facilities, the development profits can be directly obtained by the railway operator himself.

However, generally, the above land purchasing and railway construction are not supported by owners of railway-designated land. Therefore, in order to carry out land acquisition and

railway construction, a system which guarantees development profits are shared with the railway operator, surrounding communities and landlords must be made.

Creation of land for railway construction and public facilities by means of "land readjustment system" meets the above objective (Fig. 1.1.3).

[Before]
* Public facilities: roads, parks, sewerage, drainage, river works etc. are inadequately provided.

[After]
* Public facilities: roads, railways, parks, sewerage, drainage, river works etc. are developed in an integrated manner.
* Building sites: lots are regularly shaped and have frontages on roads or railway: water supply, drainage and sewerage are adequately provided.

Land readjustment is a comprehensive urban area development project which provides urban infrastructure such as roads, parks and sewerage in an integrated manner together with serviced building sites.

Fig. 1.1.3 Effect of Land Readjustment

3) Examples of integrated railway improvement and urban development

(a) Tama Den'en Toshi

A good example of integrated railway construction and urban development on the outskirts of Tokyo is shown in Fig. 1.1.4. Tama Den'en Toshi is located 18 to 36 km southwest of Tokyo. The development area covers some 5,000 ha and today's population is half a million. Since the development project started, 40 years have passed.

At the beginning of the project, over 50 section readjustment unions were formed in surrounding areas to create new land for urban development and railway construction.

Tokyu Corporation, the railway operator, worked for the land readjustment unions as secretary-general of the unions. The company utilized reserved land and exchanged land for railway construction, station-surrounding area development and housing at the same time.

As a result, the railway construction cost was partially financed by the development profits. At the same time, the surrounding area development contributed to many passengers and eventually to good management of the railway company.

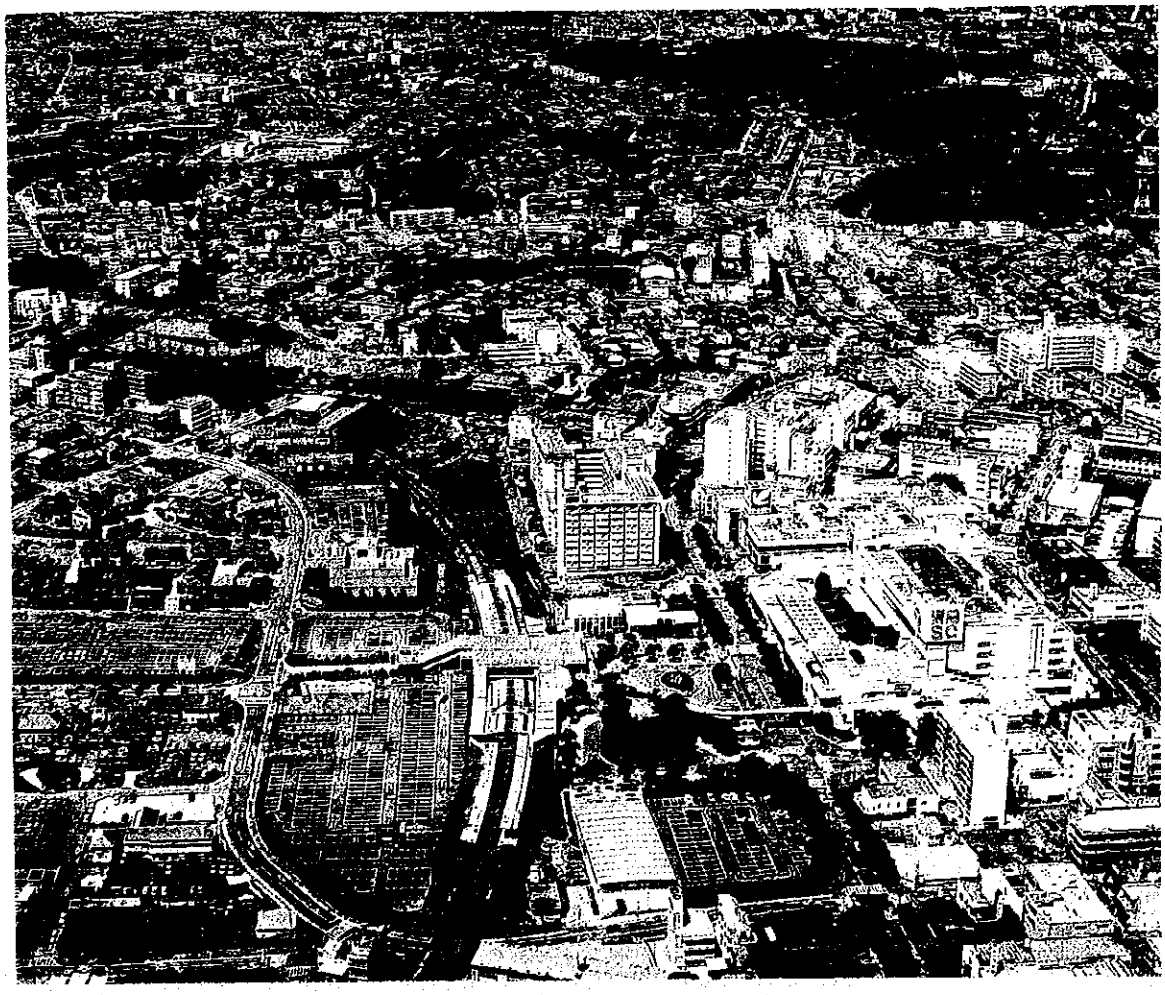


Fig. 1.1.4 Tama Den'en Toshi Development Integrated with Construction of Railway

(b) Senboku New Town

A successful example of integrated new railway line construction and urban development in a suburb of Osaka, Japan is described below. Senboku New Town Project was executed by Osaka Prefecture, for housing development at three areas in hilly districts extending to the south about 20 to 25 km from the city center, and by the third sector, in which Osaka Prefecture has invested, for construction and operation of a 12.1 km railway connecting with the existing railway line passing nearby. (Third sector: a joint venture of local government and private business) (Fig. 1.1.5)

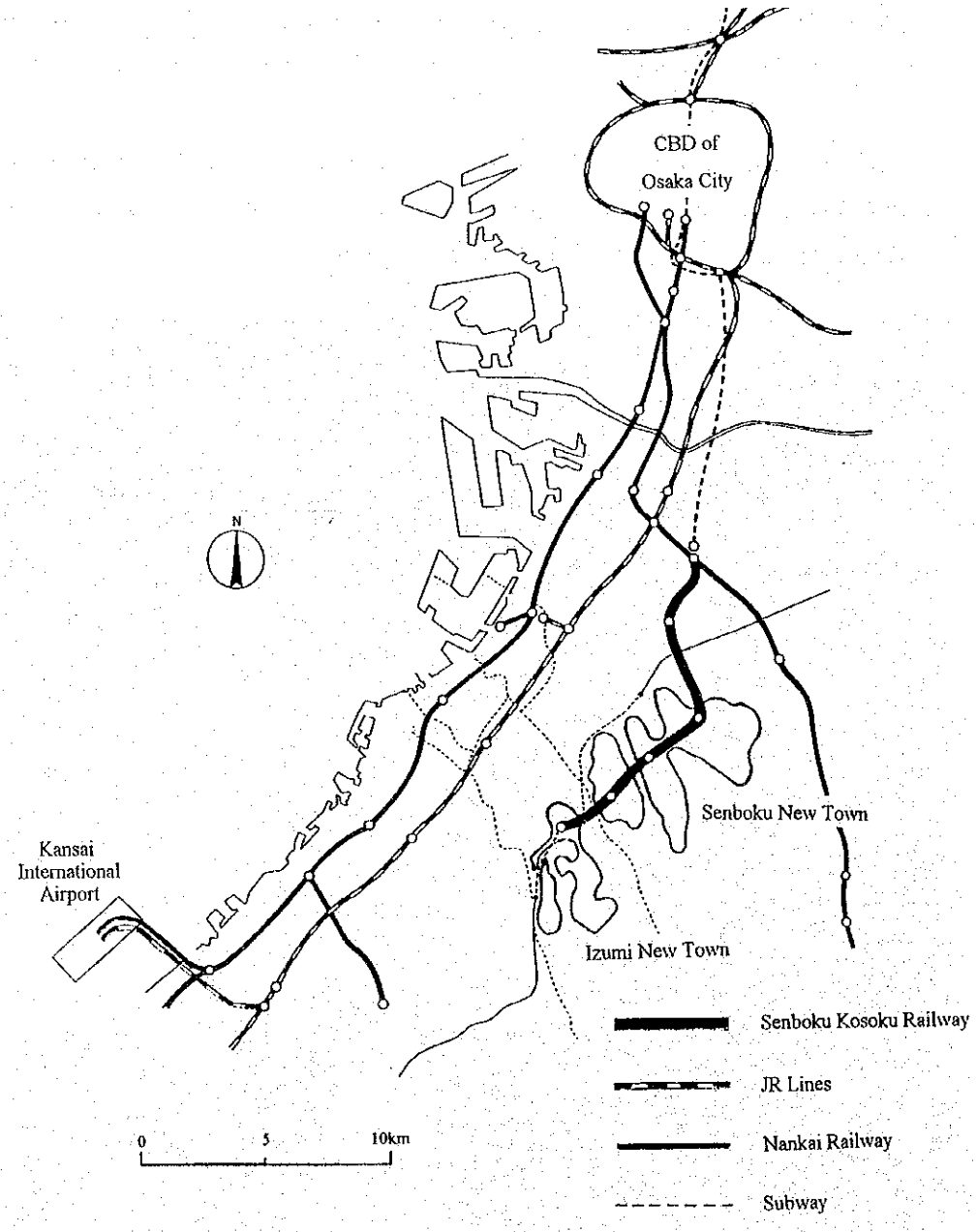


Fig. 1.1.5 Senboku New Town and New Railway Line

The railway new line, Senboku Kosoku Railway, connects the three new stations at the new town with the existing station, Nakamozu of the Koya Line of Nankai Electric Railway, forming its double-tracked, 12.1 km branch line. Senboku New Town expands 1,520 ha of newly developed areas. The project started in 1965 and now, 30 years later, the population has reached 160,000.

The development of this new town was executed by a department of Osaka Prefecture and the construction and operation of the railway was executed by an enterprise in which Osaka Prefecture has invested. Therefore, very cooperative planning and timely construction work were realized, and the railway is working successfully to serve commuters of the new town. (Fig. 1.1.6)

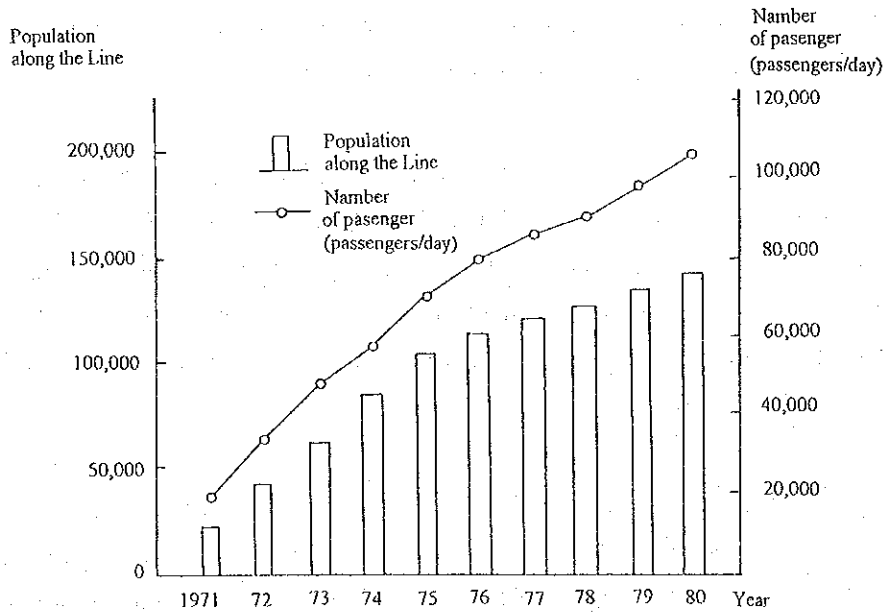


Fig. 1.1.6 Change of Population of Senboku New Town and Number of Passengers of Senboku Kosoku Railway

As for the construction cost, at the initial stage, Osaka Prefecture granted an interest free loan, so that the railway has managed well.

The line extended (2.2 km) to Izumi-Chuo, at the center of Izumi New Town Project, executed by the Housing and Urban Development Corporation with the subsidy system of the "new town system". The project started in 1984 and the railway has opened in April, 1995.

(c) New Town with new station

There are many cases where a community requests a railway enterprise to establish a new station on the existing railway line and new housing development is carried out around the station.

In these cases the burden borne by the beneficiary is only within the extent of the construction cost of the station and a part of the compensation for loss caused by expenses of managing the station in the case of a few customers, and most of the development gain falls to the community and the owners of lands around the station.

A case realized recently by the East Japan Railway Company (JR-East) that the development gain can return broadly for reinforcement of the railway facilities as well as the increase of management expenses is described below.

The Housing and Urban Development Corporation, which is carrying out a land readjustment project of 174 ha at Ushiku City (60 km from the center of Tokyo in the northeast direction) recently changed its regulations taking into consideration cooperation on an urban development project with a railway enterprise in 1994 so as to make it possible to transfer lands to the railway enterprise who would establish the new station on the exiting related line.

JR-East will buy 2.3 ha of land near the planned new station within the project area at the current price, construct condominiums and sell them when the new station is opened in 1997. Thus, the Housing and Urban Development Corporation can provide housing with a convenient commuting means and, on the other hand, JR-East can attain a part of the development gain directly in addition to the direct cost of the new station construction borne by the corporation and besides, customers of the railway will be ensured (Fig. 1.1.7). JR-East actively participates in land readjustment projects on other lines also and is carrying out land acquisition.

The Housing and Urban Development Corporation intends to promote establishment of new stations on other lines of other companies as well in order to expand new town development projects.

Another example of integrated development was realized in Sapporo City with a population of 1.7 million. In the western part of the city at a distance of 15 km from the

center, a private company has executed housing development including establishment of a new station (Hoshimi Sta.). The area of development is 21.1 ha, the area of land for sale is 10.3 ha and planned population is 1.550.

In this project, the railway enterprise, JR Hokkaido, has joined in the project as well as was payed construction cost of the station facilities and management expenses at the initial stage. A company in which JR Hokkaido invests has purchased about a half of the developed land with no buildings and has been carrying out housing development and selling the lots (Fig. 1.1.8).

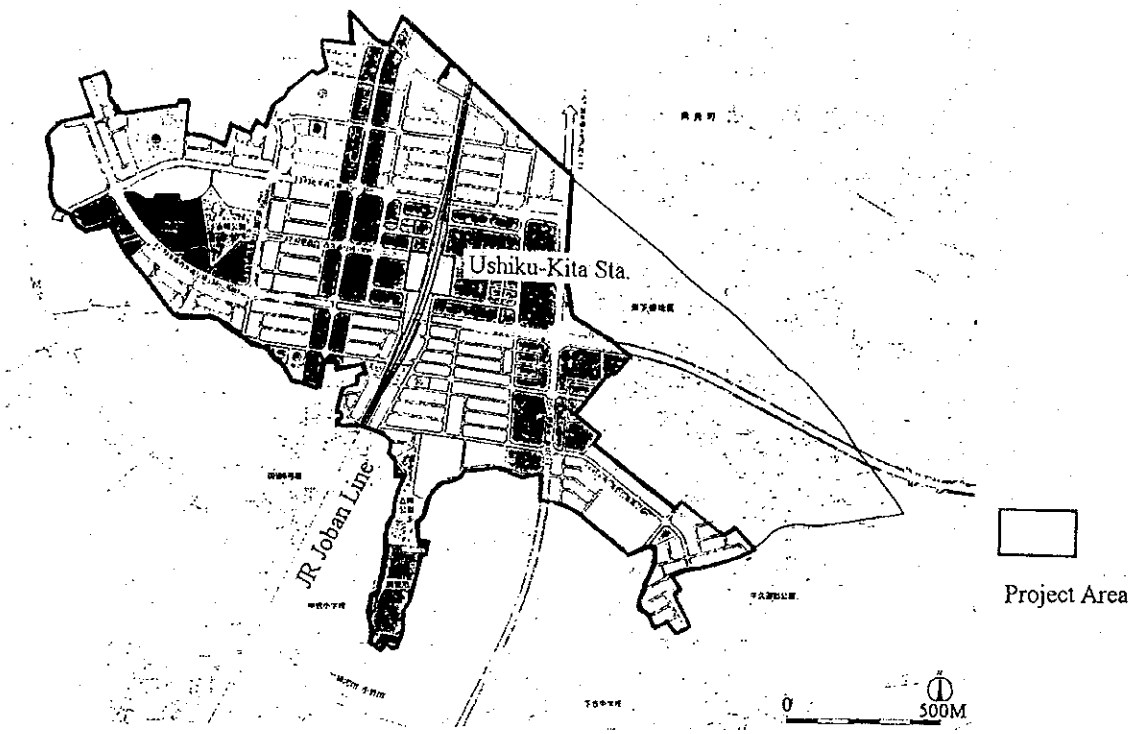


Fig. 1.1.7 Example of New Town with New Station (1) Ushiku-Kita

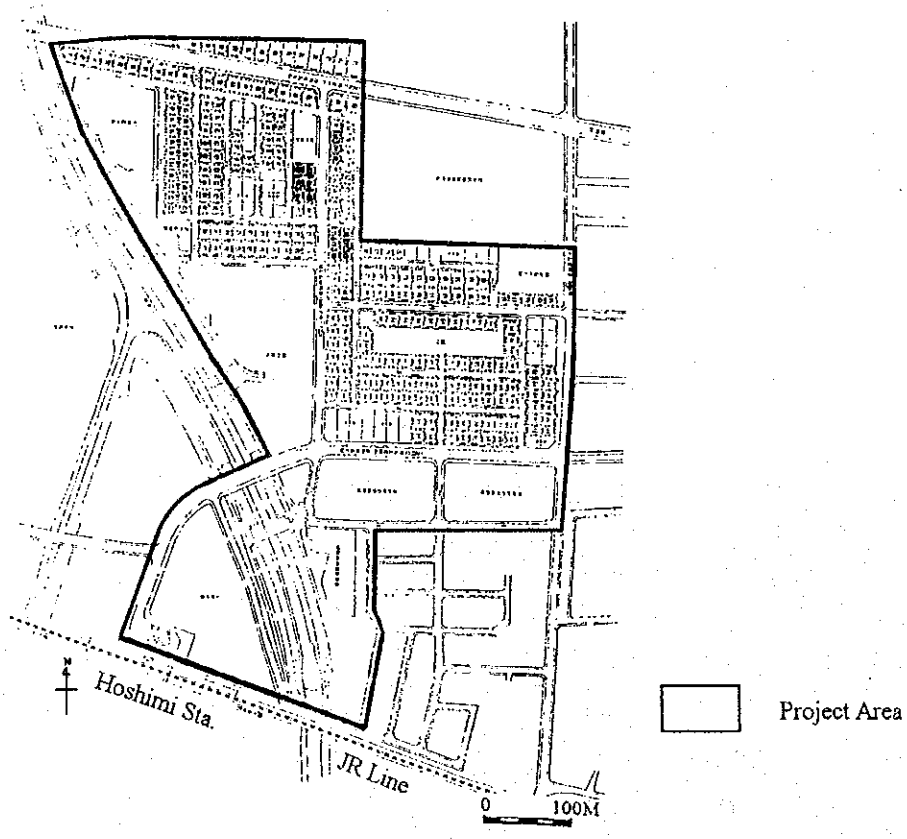


Fig. 1.1.8 Example of New Town with New Station (2) Hoshimi

1.1.2 Proposal of the Master Plan for Integrated Urban Development and Railway Improvement

(1) Policy of urban development integrated with railway transport

The population increase in the area of Extended BMR up to the year 2010 is estimated to be about 5 million, of which about 1.7 million people will be induced to live in the new cities to be developed in combination with the railway network.

As built-up areas in the suburbs of Bangkok have been developed mainly along roads, most residents commuting to the center of Bangkok have to depend on automobile and bus transport. There is no guided transport system but the SRT in the city center of Bangkok, causing serious road traffic congestion. The situation has become worse with the increase in automobile traffic from the suburbs. This is causing a waste of time for Bangkok citizens as well as damage to the city environment.

Since three rapid transit systems, including the Hopewell Project, are in progress to alleviate traffic congestion in the city center, this Study aims to improve transport systems by integrated implementation of railway improvement and urban development in the suburbs in combination with reinforcement of access transport systems, so that the railways can become a major means of transport by providing high-speed, reliable, comfortable and safe service.

(2) Location of urban development

1) Areas in and around Bangkok

The areas along the Eastern Line of the SRT have a high potential for development in the future, because there are many large-scale concrete projects such as the Eastern Sea Board (ESB), Second Bangkok International Airport (SBIA), Inland Container Depot and NHA City Development Project.

The areas along the Northern Line of the SRT already have an international airport and are densely populated toward Ayutthaya and Sara Buri. The railway line up to Ban Phachi is double-tracked, and the region along the route has a high potential of developing favorable residential areas if at-grade crossings in the Bangkok city center can be eliminated.

As for the areas along the Southern Line of the SRT, access to the city center is insufficient because the railway connecting with the city center is partitioned by the Chao Phraya River and is forced to make a large detour. Therefore, although fairly urbanized areas can be seen along the roads, urbanization along the railway route is delayed. However, if the east-west connection by railway is realized by the Hopewell Project, the potential of the regions will greatly increase.

Along the Maeklong Line of the SRT, large development of city areas is seen up to Maha Chai, and urbanization along the roads is especially remarkable. Therefore, city formation integrated with railway reinforcement will progress, if railway service is improved in such respects as speed frequency, reliability and comfort. Especially, if the Hopewell Project is completed, this area will be much developed because of short distance to the Bangkok city center.

The above is an outline of the situation in each direction along the railway route centering around Bangkok. In general, there remains a great deal of land suitable for urban development along the existing railways in the suburbs of Bangkok. Therefore, urban development taken up by the Study has mainly been limited to the development of areas along the existing railways from the standpoint of investment efficiency and urban development by new line construction has been excluded. However, from a long term view, a case of integrated implementation of new railway line construction and urban development can occur.

On the other hand, the Second Bangkok International Airport is scheduled to be constructed 2 km away from the Eastern Line of the SRT. Needless to say, a guided transport system as access to the airport is essential. Therefore, the aim is to construct an access railway from the Eastern Line to the airport for the convenience of passengers.

In improving railway transport, bus routes will be reorganized. In the review, the bus routes running in parallel with the railways will be modified to directly connect with the railway terminals or railway stations as much as possible, in order to realize integration of railway and bus transport.

2) 200 km radius area

In the 200 km radius area, further away from the suburbs of Bangkok, there are influential regional core cities such as Nakhon Sawan and Nakhon Ratchasima. The Government of

Thailand is taking measures for urban decentralization, based on the Metropolitan Region Structure Plan. It is thus advisable to foster these cities as independent cities by keeping contact with the mother city Bangkok so as to ensure close exchange of information.

Accordingly, facilities convenient for connection with access transport systems (bus and other automobiles) will be installed at railway stations in these cities. At the same time, development of areas around stations will be promoted in order to make these areas charming community centers of the cities. It is also planned to take such measures as introducing high-performance diesel-railcar trains between these cities and Bangkok Central Station (Hua Lamphony) to ensure reliable operation at intervals of one to two hours.

3) Contents of the Master Plan

As mentioned above, the Master Plan proposes to execute integrated urban development and railway improvement. The integrated projects realize preferable housing areas, etc. for a population of 1.7 million ensuring convenient and comfortable transport means in the suburban areas of the Bangkok Metropolis. Besides, it promotes prosperity of regional core cities organically combined with each other and with Bangkok, the political and economic center of Thailand.

(a) Urban development

Along the four SRT lines in the "50 km" areas the projects will be spread. The outline of the proposed plan is shown in Fig. 1.1.9.

(b) Railway improvement

The four SRT lines will be improved to provide commuter service in the "50 km" area and intercity express service in the 200 km area as fast, reliable, safe, comfortable and environment-friendly transport means. The outline of proposed railway service is shown in Fig. 1.1.10 and Table 1.1.2.

(c) Allocated population and railway improvement cost

The allocated population and railway improvement costs classified by line (direction) are as shown in Table 1.1.3.

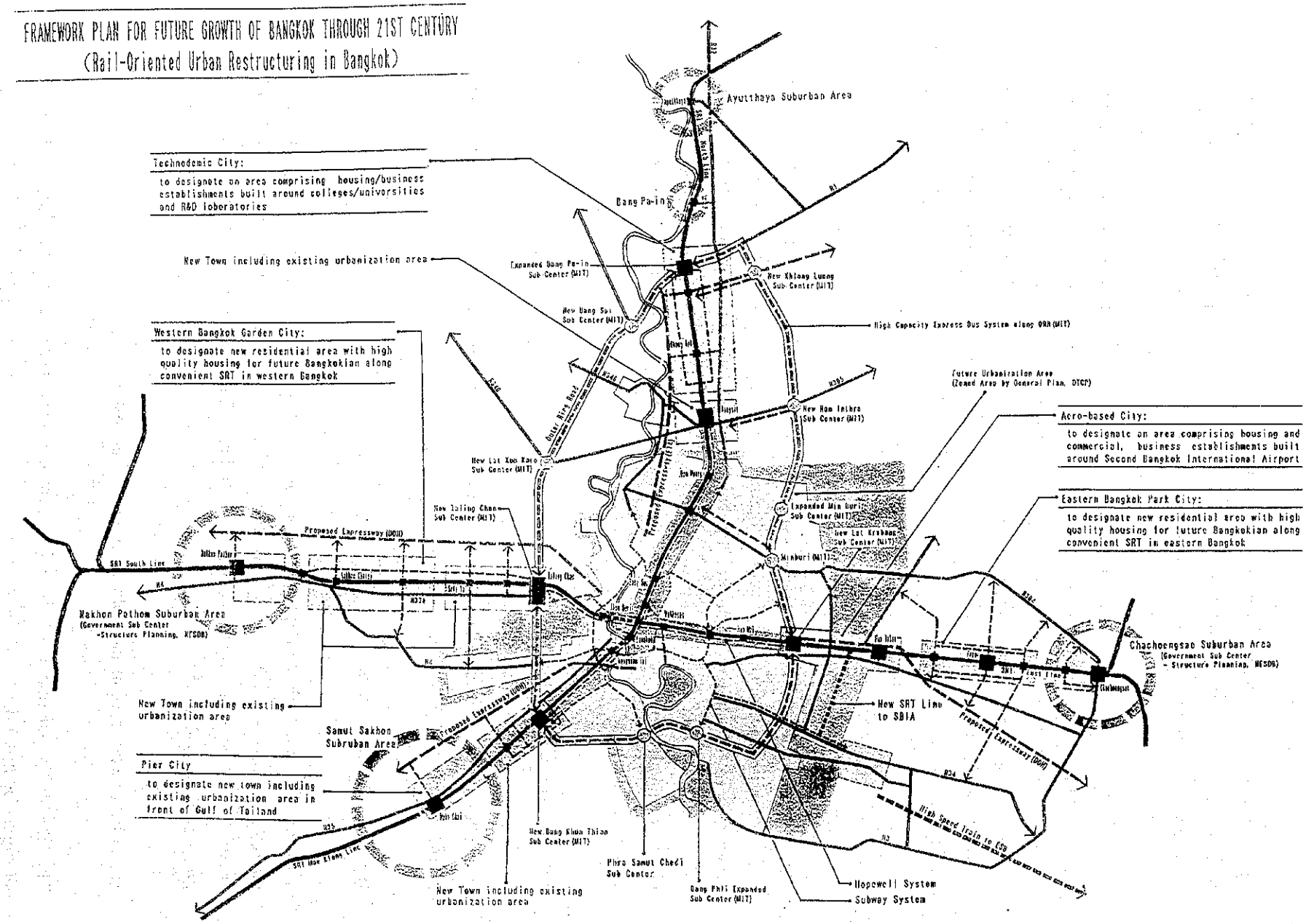


Fig. 1.1.9 Proposed Master Plan for Urban Development Integrated with Construction of Railway

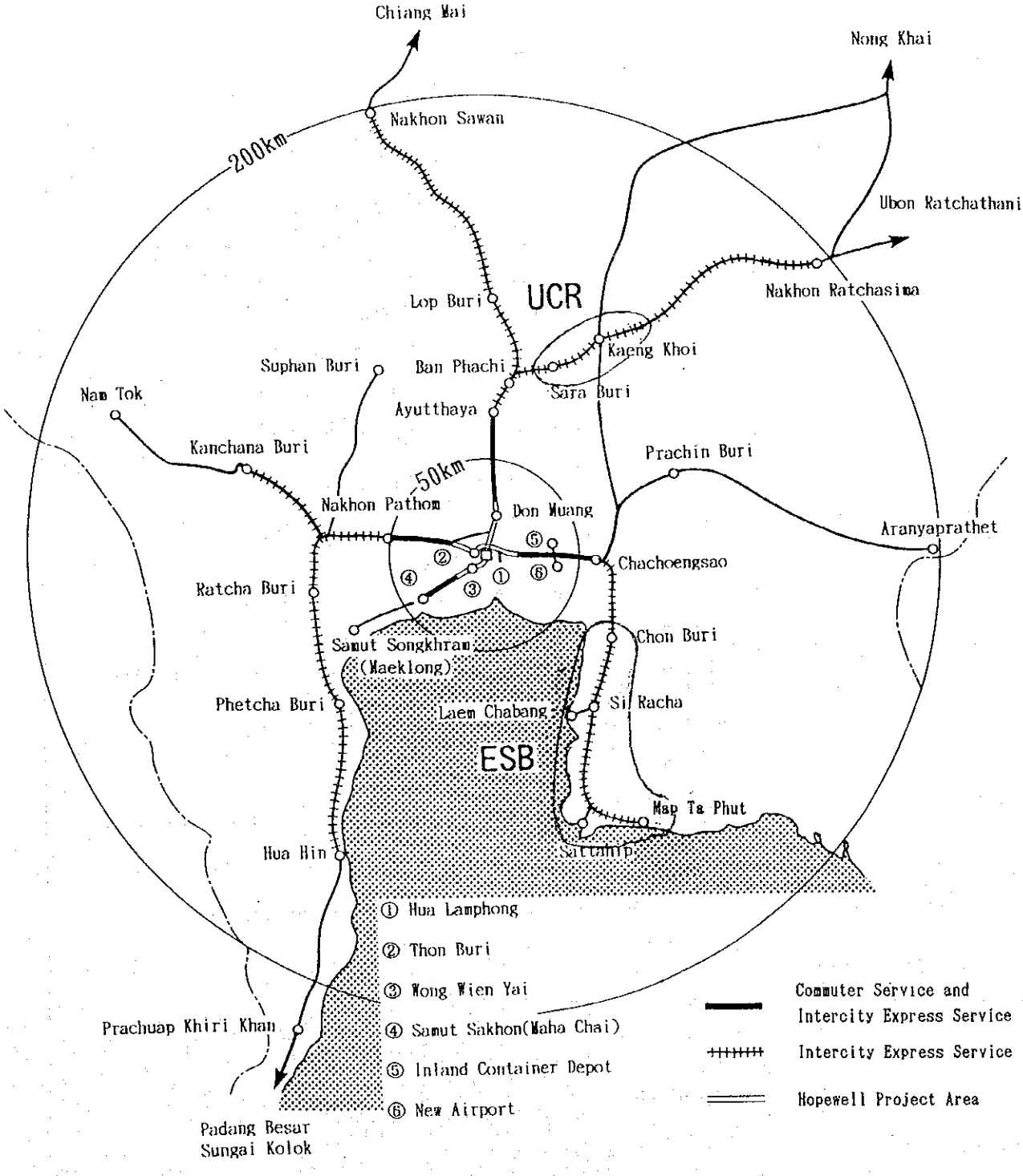


Fig. 2.1.10 Network of Railway in the Master Plan

Table. 1.1.2 Railway Improvement in the Master Plan

Item	Contents
Commuter Service	
Service/operation	- Headway Rush hours: 10 min.* (Max. 15-car train) Off peak: 20 min. With comfortable electric railcars - Operation pattern: Rapid-local-combining operation Average Spead: 65km/h (Rapid and local)
Project area	- Area "50km" Area (Except Hopewell Project area) - Length Eastern Line: 45.6km (59.0km) SBIA New Line: 7.0km Northern Line: 42.6km (71.1km) Southern Line: 42.0km (52.0km) Maeklong Line: 29.2km (34.9km) ( ): Length from the center of Bangkok including Hopewell Project area
States of improved facilities	- Double track (or more) (Eastern Line, Southern Line: Ongoing) (Northern Line: Already) - Electrified (Including Hopewell Project area) - Improved at-grade crossings - Stations for high density train operation of various types of trains and strengthened tracks - High-grade signalling and telecommunication systems - Others
Rolling stock	- High-perfomance, comfortable electric railcars (The number of railcars is to be increased depending on the demand.)
Items relating with integrated urban development	- Development around the stations - Improvement/reinforcement of access transport means
Intercity Express Service	
Service/operation	- Headway 1 hour (2 hours at the start of service, 1997-2000) With comfortabl diesel railcars - Operation Scedule speed: 100km/h (Eccept mountainous areas)
Project area	- Area 200km Area
States of improved facilities	- Increase of crossing Loops and refuge tracks (It is taken into consideration that at the same time improvements for commuter service and trunk line service are to be executed.)
Rolling stock	- High-perfomance, comfortable diesel railcars (The number of railcars is to be increased depending on the demand.)

* Remasks: This headway is short enough to be used as convenient transport means and not too short to cause operation time to lengthen.

Table. 1.1.3 Allocated Population and Railway Improvement Cost by Line

Line \ Item / Step		Allocated population (1000 persons)	Railway Improvement costs (million baht)		
			Commuter service	Intercity express service	Total
Eastern Line *	I		7,340	1,060	8,400
	II		3,970	700	4,670
	III		1,720	140	1,860
	Total	499	13,030	1,900	14,930
Northern Line	I		6,490	2,130	8,620
	II		5,820	980	6,800
	III		2,030	170	2,200
	Total	636	14,340	3,280	17,620
Southern Line	I		140	1,530	1,670
	II		4,080	720	4,800
	III		4,950	490	5,400
	Total	364	9,170	2,740	11,910
Maeklong Line	I		100	(None)	100
	II		6,510		6,510
	III		610		610
	Total	197	7,220	(None)	7,220
Grand Total	I		14,070	4,720	18,790
	II		20,380	2,400	22,780
	III		9,310	800	10,110
	Total	1,696	43,760	7,920	51,680

Remarks: Urban development area: 47,850 ha
Urban development construction costs: 354 billion baht

*: Including SBIA Branch Line

(d) Project period, project life and phases

The project period is 15 years from 1996 to 2010. The year of 2010 is the appointed target year, and the project life extends 30 years until 2025. The project period is phased into the following three phases which are considered to be suitable terms for such projects.

- Project period	1996 - 2010 (15 years)
Step I	1996 - 2000
Step II	2001 - 2005
Step III	2006 - 2010
- Target year	2010
- Project life	1996 - 2025 (30 years)

(c) Hopewell Project area

Within the Hopewell Project area a cross-shaped main line system grade-separated and double-tracked (Northern Line: triple-tracked) is to be formed by the year 2000 by the Hopewell Project. This Master Plan is composed on the condition that a railway system of double (triple) track (including the above) through from the core of Bangkok Metropolis to the suburban areas is to be completed. The electrification work even within the Hopewell Project area is to be executed in this Project. As SRT railway stations in the Hopewell Project area are only limited to a few main stations, SRT railway passenger trains are to be only rapid and express within the area.

(4) Evaluation of the Master Plan

1) Process and assumptions of project evaluation

(a) Process of project evaluation

The process of project evaluation is explained in Fig. 1.1.11. As shown in the figure, the Master Plan study starts by forming "the concept of integrated urban development and railway improvement". Subsequently, urban development planning, railway improvement planning and demand forecasting (including mutual feed-back) are carried out. Based on this benefit, revenue and project costs/expenses are calculated. Finally, economic/financial analysis is conducted.

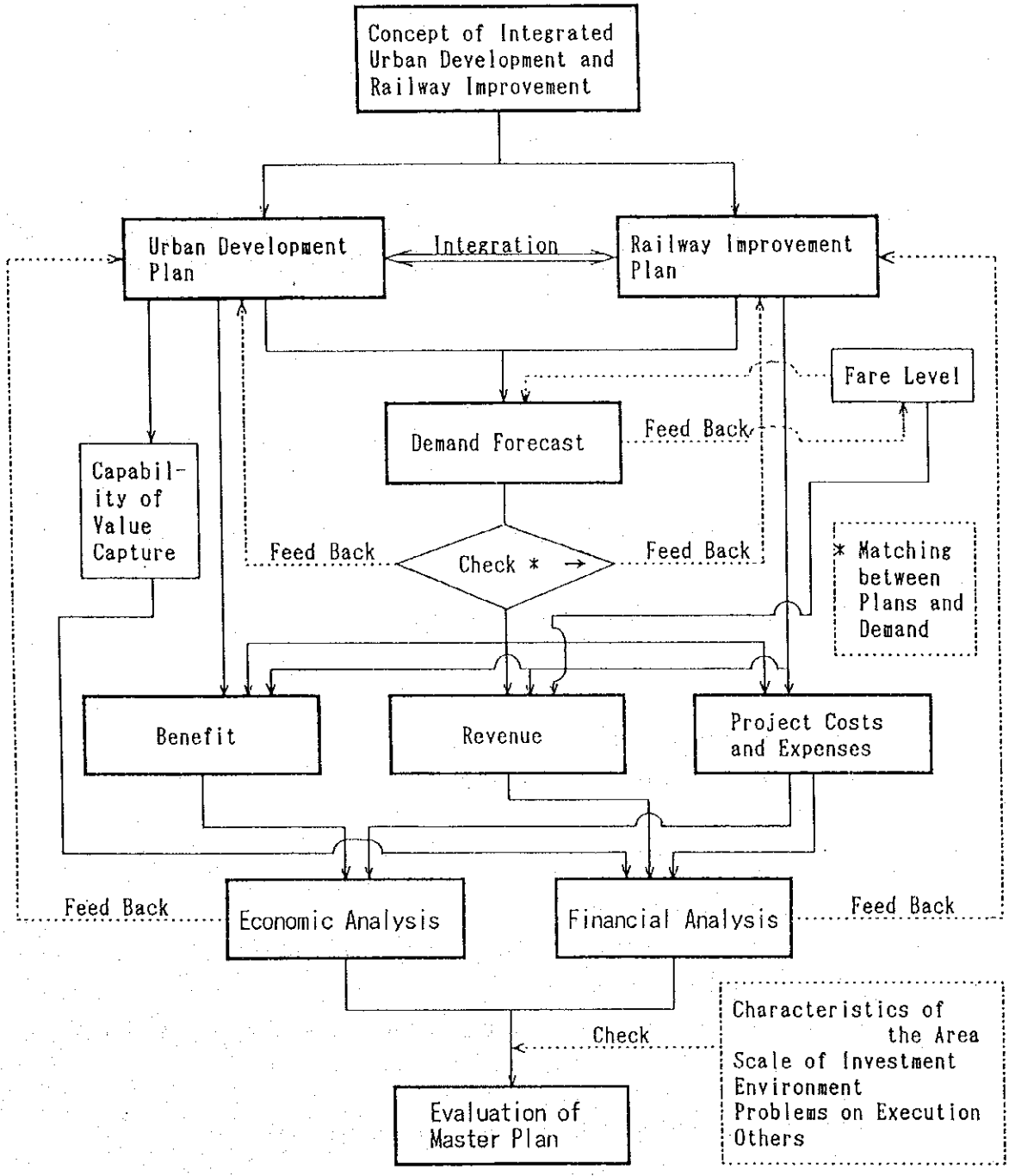


Fig. 1.1.11 Flow of Master Plan Evaluation

(b) Setting up the assumptions and cases for project evaluation

a) Level of service

Fast, reliable, convenient transport service is to be provided as shown in "Fig. 1.1.10 and Table 1.1.2".

b) Railway facilities and rolling stock

To provide the above mentioned service high grade railway facilities and high-performance, comfortable rolling stock are to be prepared as shown in "Fig. 1.1.10 and Table 1.1.2".

c) Demand

The demand is estimated for different cases under the combined assumptions that follow:

i) Assumptions concerning urban development and railway improvement

The following combined assumptions are set up.

(Urban development)

i. With "Integrated urban development"
ii. Without "Integrated urban development"

(Railway and access)

a. Railway improvement only
b. Railway improvement and feeder service improvement in time (average access/egress time decrease: 30%)
c. "b." and feeder service improvement in cost (average access/egress cost decrease: 30%)

Six combinations of assumptions, i.a./i.b./i.c./ii.a./ii.b./ii.c., are set up.

ii) Assumptions concerning railway fares

For the commuter service, the following three fare levels are set.:

i. Basic condition : 0.215 baht/km (current 3rd class fare)
ii. Medium : 0.44 baht/km (current 2nd classfare)
iii. Upper limit : 1.0 baht/km

For the intercity express service, the following fare rate is set, taking into consideration competition with air-conditioned buses.

0.6 baht/km (2nd class including express, reserved seat and air-conditioning charge)

d) Benefits

In order to carry out the economic analysis a conception of benefits mentioned below is adopted.

i) Classification of benefit

In this study, benefits are classified as follows:

a. Time saving of railway users
b. Time saving of road transport users brought by decrease of traffic congestion
c. Savings in operation expenses of railways and automobiles
d. Others: Tourism development along the lines; promotion of housing, commercial, industry; reduction in traffic accidents and air pollution; reduction in natural resource consumption; creation of higher living standard; etc. and a rise in land value brought about by all of the above

Out of those benefits, as quantifiable items, amounts of "time saving benefit" and "operation expense saving benefit" are calculated.

ii) Time value

Time value of automobile users and railway passengers is estimated as shown in Table 1.1.4, based on the time-value factor and composition ratio by trip purpose, which are shown in Table 1.1.5.

Table 1.1.4 Estimated Time Value

Year	Estimated time value
2000	19.3 baht/hour
2010	25.9 baht/hour

Table 1.1.5 Time Value Factor and Composition Ratio by Trip Purpose

Trip purpose	Time value factor	Composition ratio
Business	100%	11.0%
To work	50%	18.6%
To home	50%	42.5%
To school	0	11.6%
Private	0	16.3%

e) Revenue

In order to carry out financial analysis, revenue is calculated applying three kinds of fare rates based on person-kilometers founded on estimated demand.

f) Investment costs and operation expenses

The investment costs of railway facilities and rolling stock and expenses for railway operation and management are calculated, corresponding to the proposed service level and estimated demand. Rolling stock investment costs and operation expenses are varied corresponding to demand that changes depending on a settled fare level.

2) Estimated demand

(a) Commuter service

As a major example the estimated demand for commuter service with the following conditions is shown in Fig. 1.1.12, which is the the most positive and the greatest case.

i) i. With integrated urban development

c. Railway improvement and feeder service improvement both in time and in cost (Average access/egress time/cost decrease 30%)

ii) i. Fare 0.215 baht/km

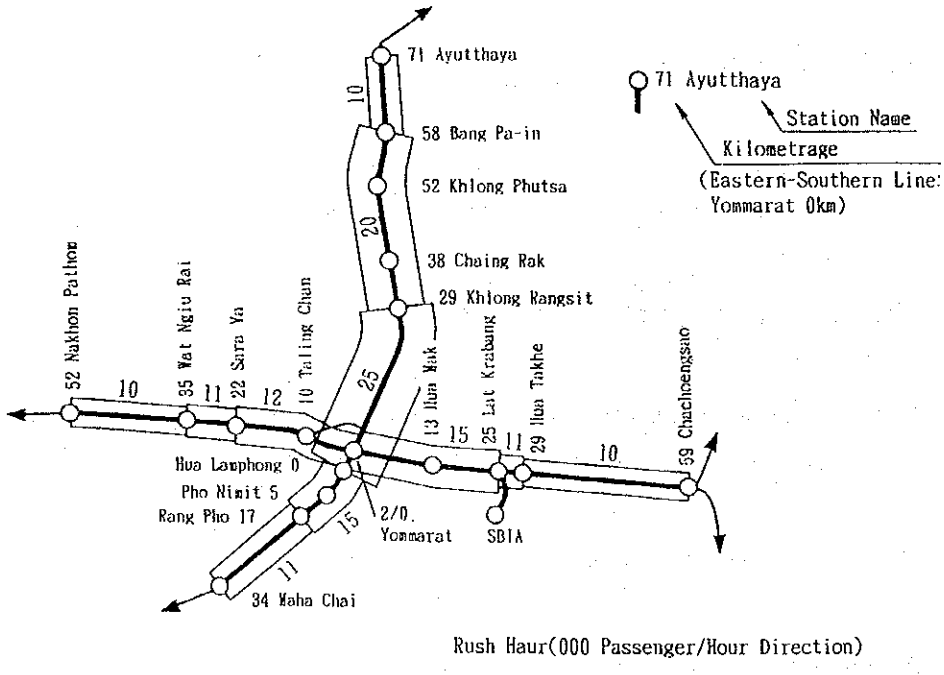
(b) Intercity expres service

Estimated demand of intercity express service is shown in Table 1.1.6.

Table 1.1.6 Estimated Traffic Volume of Intercity Express Service

(Passengers/day ¥ direction)

Year / Section	1997	2000	2010
Hua Lamphong - ESB	1,700	2,400	5,300
Hua Lamphong - Nakon Sawan	1,350	1,600	3,000
Hua Lamphong - Nakhon Ratchasima	1,400	1,100	3,200
Hua Lamphong - Hua Hin	1,550	1,900	3,600
Hua Lamphong - Kanchana Buri	1,350	1,600	3,000



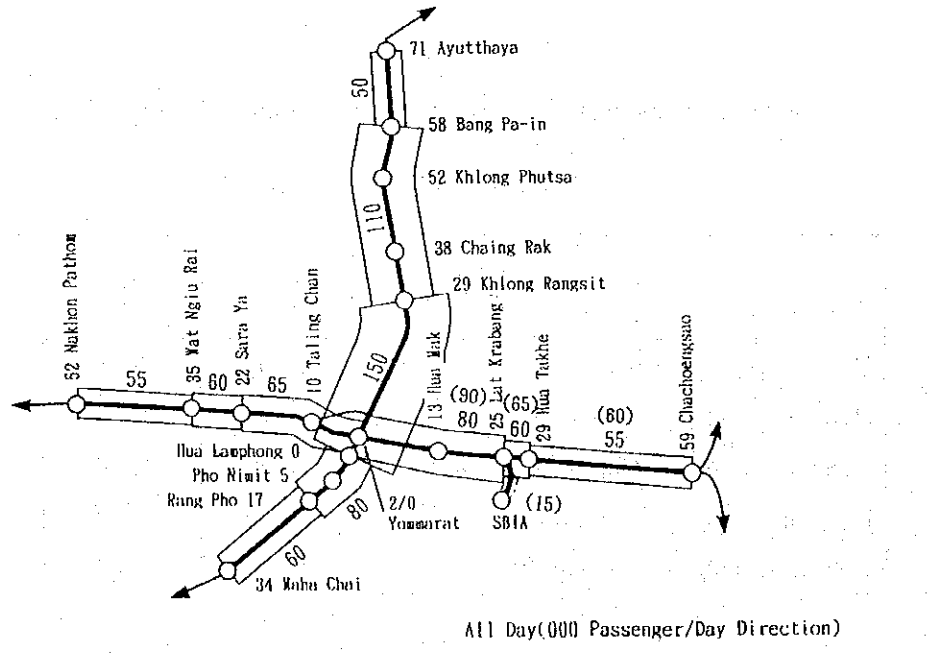


Fig. 1.1.12 Estimated Traffic Volume of Commuter Service

3) Evaluation

(a) Economic evaluation

The economic internal rate of return (EIRR) classified by combinations of improvement (in commuter service only / intercity express service as well and with/without integrated urban development) in assumptions mentioned previously is shown in Table 1.1.7 and Table 1.1.8.

As shown in the tables, in most cases investment efficiency from the view point of the national economy is high. The EIRR exceeds 12%, which is the standard for Thailand. In the case of railway improvement with integrated urban development, the investment efficiency is higher. It is suggested that improvement of feeder service, reducing access/egress time and cost, increases the demand of railway transport, which raises the investment efficiency.

Table 1.1.7 EIRR of Railway Improvement for Commuter Service

(%)

Case \ Line		Eastern Line	Northern Line	Southern Line	Macklong Line
With integrated urban development	Railway improvement only	-	13.0	0	13.2
	Railway improvement and feeder service improvement in time (30% decreace)	17.8	23.1	16.7	19.2
	In addition to the above feeder service improvement in cost (30% decrease)	20.8	30.9	21.2	25.9
Without the integrated urban development	Railway improvement only	-	-	-	-
	Railway improvement and feeder service improvement in time (30% decrease)	9.9	14.4	-	14.9
	In addition to the above feeder service improvement in cost (30% decrease)	10.8	20.4	-	24.1

Remarks: "-" Not available or not calculated

Table 1.1.8 EIRR of Railway Improvement for Commuter Service and Intercity Express Service

(%)

Case \ Line		Eastern Line	Northern Line	Southern Line
With integrated urban development	Railway improvement only	-	11.3	-
	Railway improvement and feeder service improvement in time (30% Decreace)	18.0	16.7	16.9
	In addition to the above feeder service improvement in cost (30% decrease)	22.6	23.4	22.1
Without integrated urban development	Railway improvement only	-	-	-
	Railway improvement and feeder service improvement in time (30% decrease)	11.5	11.3	-
	In addition to the above feeder service improvement in cost (30% decrease)	14.8	16.7	-

Remarks: "-" Not Available or Not Calculated

Maeklong Line do not provide the intercity express service.

(b) Financial evaluation

a) Revenue

In the financial evaluation, the revenue to be evaluated was limited to those of passengers' fares calculated by multiplying the fare rate with the passenger-kilometers.

As fare rates, the followings were applied:

i) Commuter Service

- Basic Condition (Third class: 0.215 baht/km)
- Medium (Second class: 0.44 baht/km)
- Upper limit (1baht/km)

ii) Intercity Express Service

- 0.6 baht/km (Second class including express, reserved seat and air-conditioning charge)

b) Development profit

As a result of urban development, large amounts of profit will be gained from sale/rental of the developed land. In the feasibility study to be carried out after the Master Plan study, it will be necessary to calculate the specific development profit based on the actual land price distribution and to propose the necessary procedures, institutions and organizations so that the development profit may be returned to the railway improvement projects.

According to the results of NESDB's study, the following equation, representing the relationship between the land price and the distance from the Bangkok city center, is adopted.

$$Vx = e^{-0.06x + 16.6}$$

Where x : Distance (km)

Vx : The land price at distance x from the city center (million baht/rai)

If the land price for 47,850 ha in the area to be developed is estimated on the basis of the findings of the above study, the land price would rise from 11.7 million baht/ha to 38.1 million baht/ha on the average, supposing that the reduction of travel time by the railway improvement has the same effect as the shortening of the distance (x) to the center of the city.

As a result, the development profit may roughly be estimated as follows:

- Total rise of the land price:
  (38.1 - 11.7) million baht/ha x 47,850 ha = 1,264,000 million baht
- The amount to be returned to the public project: 458,000 million baht
- Development work expenses: 354,000 million baht
- Net development profit: 454,000 million baht

Since the above estimated net development profit is the maximum amount returnable, an important point would be what proportion of such profit may be returned to the railway reinforcement.

With the total amount of 51,680 million baht invested in the railway improvement, in the calculation of the internal rate of return, cases where 1/2 or 3/4 of the amount to be invested in facilities would be by external free fund are set up, because it can be expected that a certain portion of the development profit might be thus returned.

c) Financial internal rate of return (FIRR)

When the long-term balances of the projects of the individual lines (taking the above conditions into account) are estimated, it is found that the investment could not be recovered in a case where the current second-class fare rate is applied without any subsidies granted and, therefore, a deficit would be accumulated.

Therefore, referring to the examples in Japan and other countries, the assumption that 1/2 of the investment in facilities (3/4 for the Maeklong Line and the SBIA New Line) is by an external free fund is set up and trial calculations of internal rate of return are made, applying the second-class fares (in the case of the Airport Branch Line the maximum fare). The results are indicated in Tables 1.1.9 and 1.1.10.

Although the above financial internal rate of return is calculated on the basis of several assumptions, they may be effectively utilized in reviewing the relative effectiveness of the project on each line.

Concerning Table 1.1.9, in case 1/2 is by external free fund, the Eastern and Northern Lines may be regarded as feasible, provided that the second-class fares are applied.

Concerning the Maeklong and SBIA New Lines, since large amounts must be invested, it is essential that the ratio of external free fund be enlarged to 3/4 of the amount required.

Table 1.1.9 FIRR of Railway Improvement for Commuter Service

(%)

Line / Adopted fare level / Case	Eastern Line	Northern Line	Southern Line	Maeklong Line	SBIA New Line
	Medium (0.44B/km)	Medium (0.44B/km)	Medium (0.44B/km)	Medium (0.44B/km)	Upper Limit (1.0B/km)
"1/2" of investment cost of railway facilities by external free fund	9	12	5	5	6
"3/4" of investment cost of railway facilities by external free fund	-	-	-	9	11

Remarks: "-" Not calculated

Table 1.1.10 FIRR of Railway Improvement for Commuter Service and Intercity Express Service

(%)

Line / Adopted fare level / Case	Eastern Line	Northern Line	Southern Line
	Medium (0.44B/km) Ic. Express (0.6B/km)	Medium (0.44B/km) Ic. Express (0.6B/km)	Medium (0.44B/km) Ic. Express (0.6B/km)
"1/2" of investment cost of railway facilities for commuter service by external free fund	11	12	7

Remarks: Maeklong Line and SBIA New Line do not provide the intercity express service.

In addition, in the case of the SBIA New Line, it is necessary to apply the maximum fare so as to make the project feasible.

As commuter transport is undulatory in general, a large amount of investment in facilities is required. However, because of its public nature, the fare rate may not be raised so much. Therefore, in order to make it feasible, external free funds are indispensable for investment in facilities.

As to a source of revenue for investment, in case the project is integrated with urban development and a considerable amount is returned from the land-development profit, the project would also be sufficiently feasible.

d) Financial burden of the government of Thailand

The specific amount to be borne by the government of Thailand for the execution of this project will be estimated as a result of the Feasibility Study. However, in the stage of the Master Plan the followings are considered.

The total amount of the government budget of Thailand was 450 billion baht in 1992, out of which 130 billion baht was expended as investment including 31 billion baht invested in the field of transport and communication. As to the past SRT investment, 8.8 billion baht was invested in total (during the five years from 1989 to 1993), and the average amount per year was 1.8 billion baht.

The amount of investment proposed here by the Master Plan is 354 billion baht for the fifteen years from 1996 to 2010 and the average per year is 23 billion baht. As for the improvement of commuter transport by the SRT, the amount proposed is 52 billion baht for fifteen years and the average per year is 3.4 billion baht. The amounts to be invested according to the Master Plan account for considerably large ratios of the entire amounts of both the national and SRT budgets.

However, in urban development, by introducing a method like land readjustment, development gains can be internalized to a fairly large extent. In the case where the development gains are smoothly recycled, the investment may not be a substantial burdens on the government and the SRT even if the subsidy for the railway improvement is included. The problem is how to finance the amounts to be invested.

It is necessary, therefore, to adjust timing of urban development and railway improvement in appropriate stage choices and to obtain development gains so as to be applied to the next investment for urban development and railway improvement.

(4) General evaluation

The proposed Master Plan where urban development and railway improvement are integrated is to improve the existing four lines of the SRT during the period from 1996 to 2010 as well as to provide 1,700,000 persons with residences with a good living environment. As a result, the following effects will be obtained:

i) Since the commuters may reach their places of work (situated in the Bangkok city center) by safe, fast and reliable trains, the loss of time would be reduced compared with the cases where they drive to their places of work and thus a stable rhythm of life may be ensured.

ii) The trip from Bangkok to the regional core cities may be supported by the intercity express trains leaving the Bangkok city center once an hour (once every two hours in

the beginning). Moreover, since the access traffic from the railway stations will also be reinforced, it will be easier for people to use railway services. Therefore, their opportunities for business trips and exchange of information will increase, which will also help to develop the regional core cities.

iii) Accompanied by the enlarged tendency to use railway services more frequently of the people living in the existing residential areas, the number of cars arriving at the Bangkok city center may decrease. In addition, coupled with the completion of the MRT projects, this may also alleviate the traffic congestion and air pollution.

iv) With the possible saving of the traffic time and operational expenses of transport facilities, the EIRR exceeds the 12% which is the standard adopted by projects in Thailand and, consequently, the Master Plan is considered feasible.

v) In addition to the measured results as mentioned above, the following advantages may be obtained by executing the Master Plan.

- Reduced air pollution would save Bangkok's urban environment from destruction.

- The modal shift from car driving with wasteful use of oily fuel to railway operation enabling more efficient use of natural resources may be realized. Besides, the burdens on the global environment such as those caused by the discharge of carbon dioxide will be alleviated.

- By converting from street traffic to railway traffic, traffic accidents in which many people are killed and injured may decrease.

vi) According to the results of financial analysis, concerning the Eastern and Northern Lines, the projects may be feasible in case 1/2 of the investment in facilities is by external free funds and second-class fares are applied. On the other hand, concerning the Maeklong Line and SBIA New Line, extenal free funds of 3/4 of the necessary investment are required to make the projects feasible, and as to the SBIA New Line, the application of the maximum fares may also be required. In view of the presumed rise in the price of land subject to development, the maximum returnable amount of the development gains is estimated to become approximately eight times as large as the total amount to be invested in the railway improvement. Therefore, by adjusting the

execution system, it may be possible to allot the amount to be subsidized out of the development gains.

As a precondition to this Master Plan, the Hopewell Project (which covers the area within 10-30 km from the center) should be executed as scheduled. It is expected that when the twenty or more at-grade crossings situated within Hopewell Project area whould all be converted to grade separated crossings and each line whould be double (triple) tracked, the time required to reach the city center by railway would be reduced and the restriction on the number of trains operated would be removed.

Consequently, should the Hopewell Project fail to progress as scheduled, the railway improvement would be realized only in the section other than the section covered by the Hopewell Project and the prospective effects mentioned above would be reduced to a large extent.

(5) Execution of the Master Plan

1) Urban development program

The program of integrated urban and railway development is prepared taking the following factors into account:

- The east-west axis and north-south axis of the Bangkok Metropolis
- The passengers to be attracted and developed
- Priority of the execution scheduled per direction and line
- The adjustment in the pace and period of execution between urban development and railway improvement

The execution phases of the urban development and railway improvement based on the above factors are indicated in Figs. 1.1.13, 1.1.14 and 1.1.15.

The most important matter to be noted is that residences should be built as soon as possible in the newly developed urban area so that the population there may increase. For this purpose, railway services should be started there as reliable transport facilities. Especially in the initial stage of the urban development, the effect of the new investment in railways such as electrification may not be reflected instantly. During such a period, it is important to improve the railway service by introducing diesel railcars, etc.

Figure 5.1.2 Development Phase

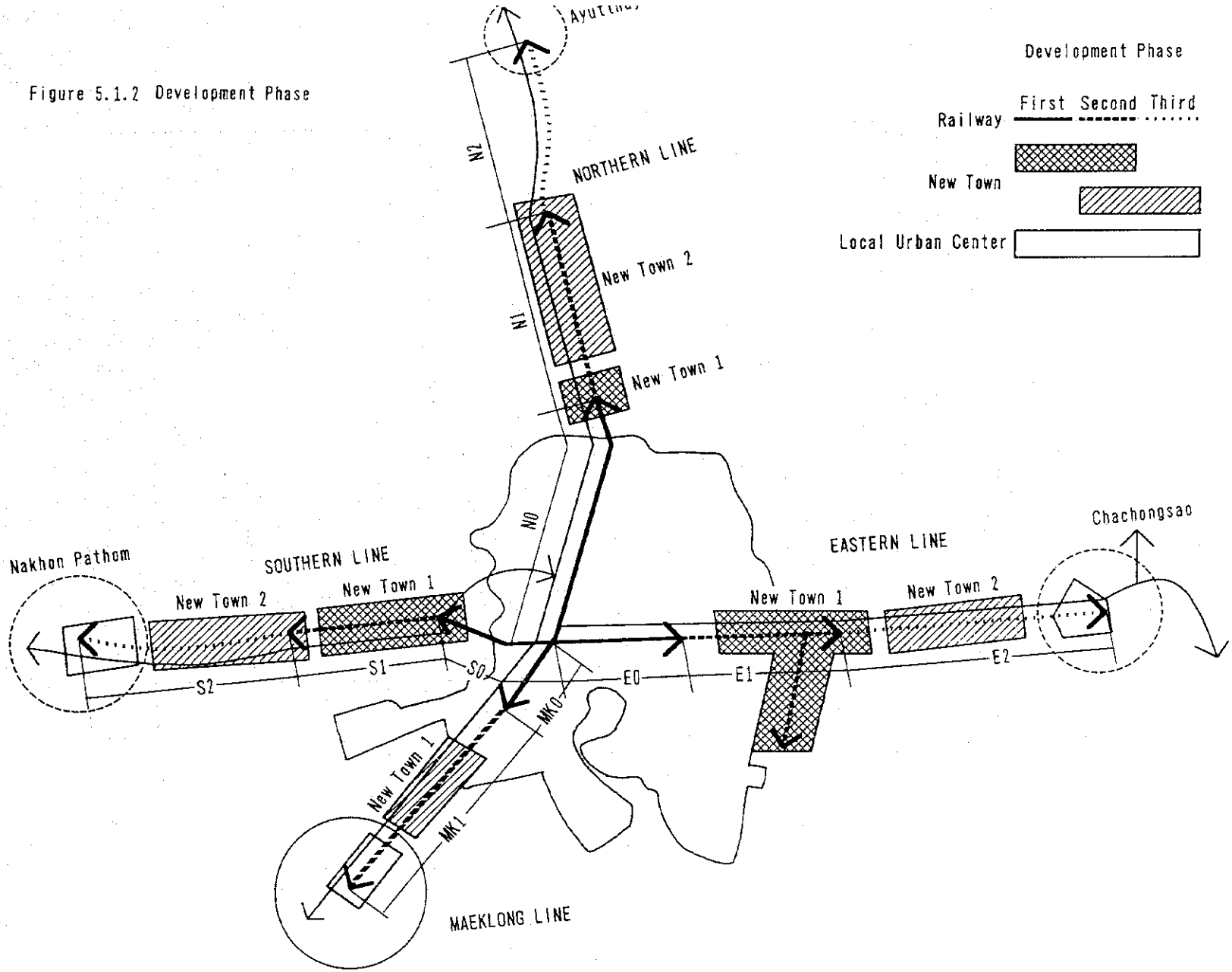


Fig. 1.1.13 Development Phase

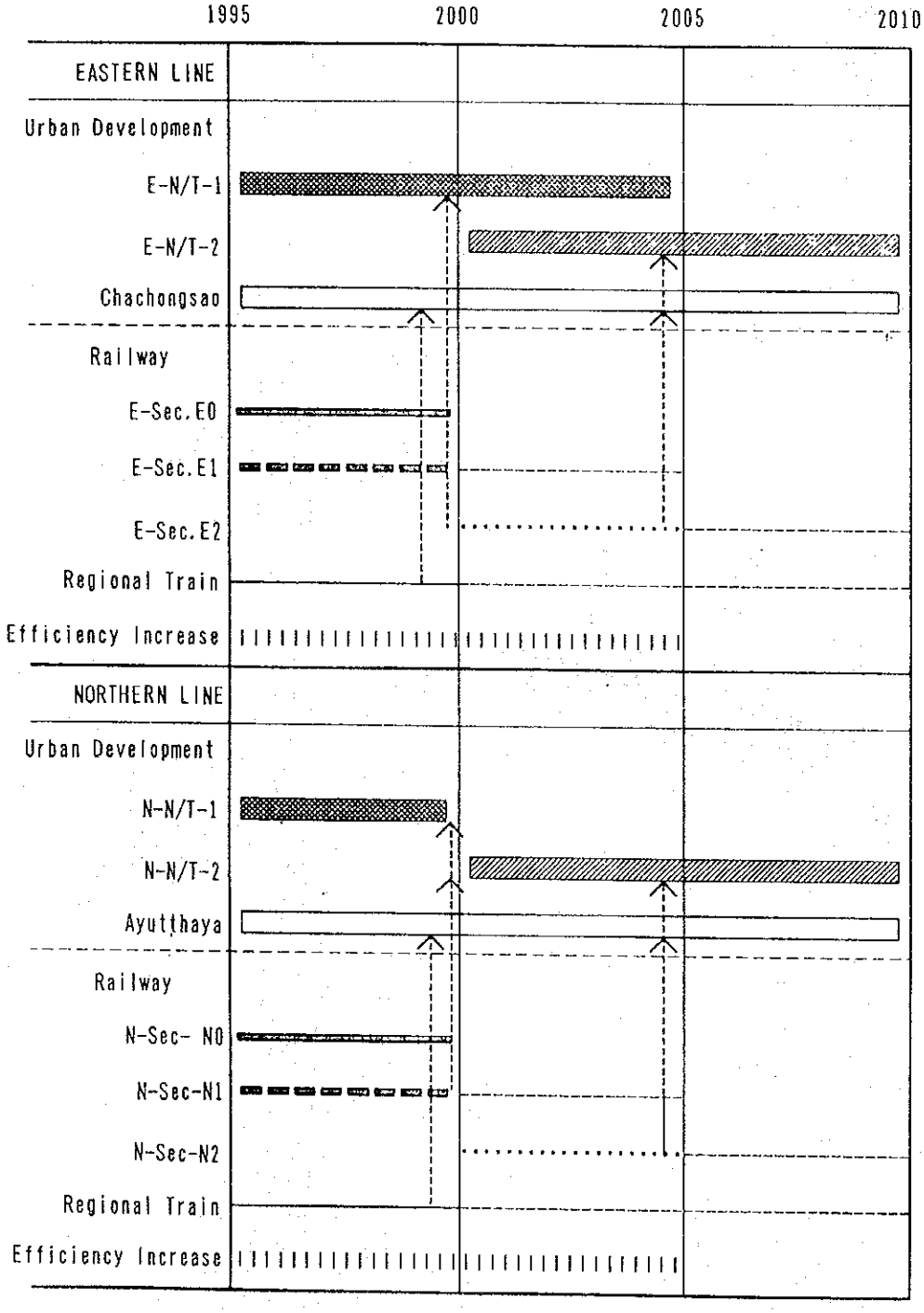


Fig. 1.1.14 Development Program for Eastern and Northern Lines

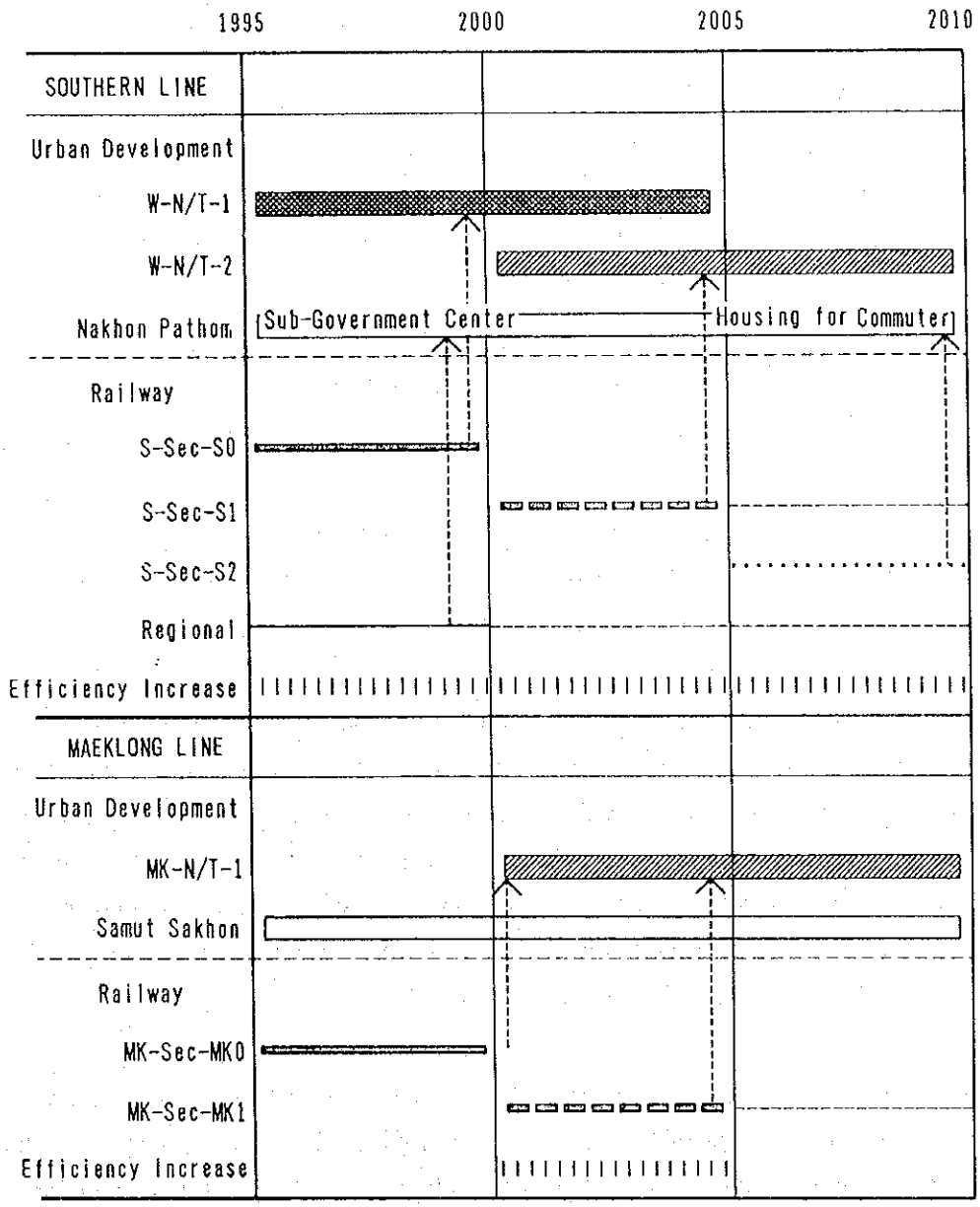


Fig. 1.1.15 Development Program for Southern and Maeklong Lines

2) System and method for execution

The integration of urban development and railway improvement is aimed at the following points:

- To contrive a physical adjustment between plans for urban development and railway improvement
- To ensure financing resources to cover the shortage in the fund for investment and increase in operational costs

The desired system to support the execution of the project where two kinds of social developments are integrated would be as follows:

- A new system based on new regulations on the integrated development
- Close cooperation among the existing organizations such as the SRT, the NHA, etc.
- A new sector including private organizations based on new regulations

When similar projects were executed in Japan in the past where urban development and railway improvement were integrated, various systems to support their execution were examined. Among them, projects which were executed with in a great success were: Tama Den'en Toshi by a single private company, Senboku New Town by a local government (Osaka Prefecture) and a third sector in which Osaka Prefecture has invested, etc. Many examples which were supported by multiple existing organizations working in close cooperation with one another also can be enumerated.

In a recent case, a new organization (of the third sector) started to undertake a project where construction of the New Joban Line was integrated with urban development. All the local governments along the line participated in the project, and the government granted a tax reduction and interest-free loan. In order to ensure the acquisition of the land for the intended railway, they used the method of land readjustment by specifying zones oriented to the railway facilities beforehand.

Specific systems to support the execution of the projects in Thailand will be proposed in the stage of the feasibility study. It can be pointed out here that the method of land readjustment is a quite effective means although various modifications will have to be made on the basis of the local situations.

3) Financial resources for investment

According to the result of the financial analysis of the Master Plan, a large development profit is expected in the case where urban development is integrated with railway improvement. However, with regard to the investment and management of the railway alone, unless external free funds are alocated to cover 1/2 (3/4 for some lines), feasibility would not be anticipated.

Thus, the way to return development gains to the railway investment constitutes an important point of the project.

In order that the project can be financially realized, the capital flow should be as indicated in Fig. 1.1.16.

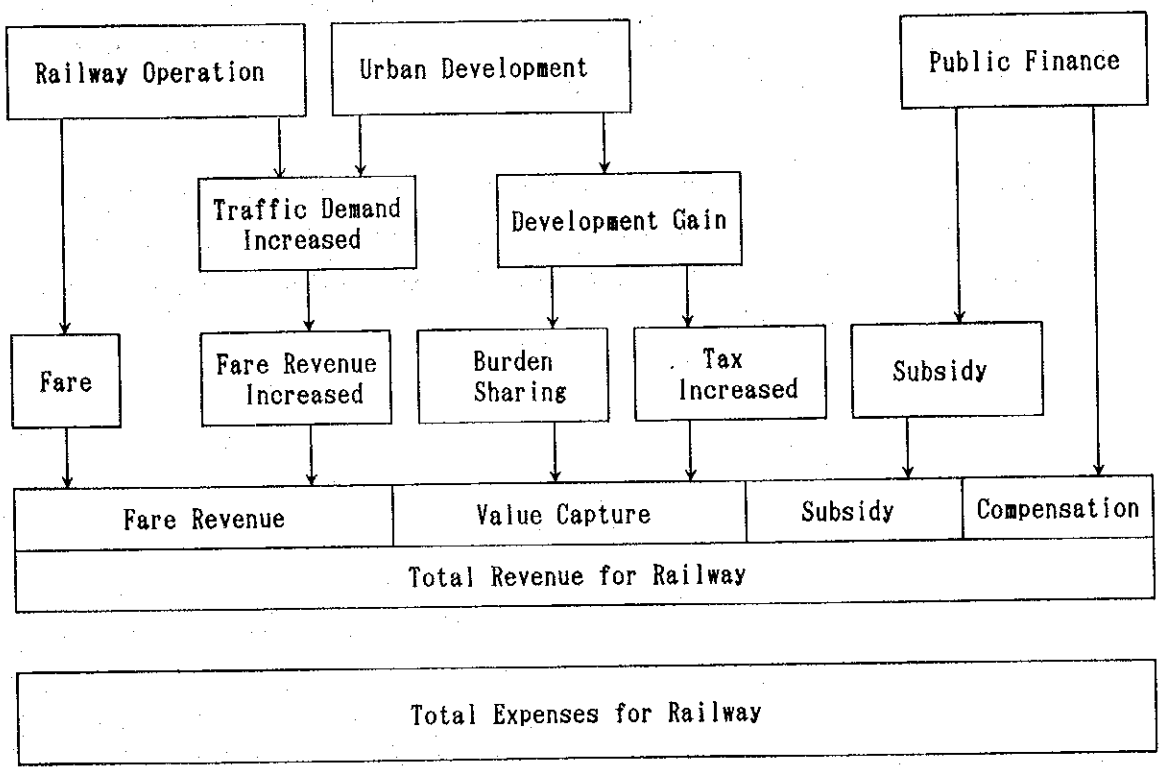


Fig. 1.1.16 Financing Resources for Railway Operation

That is to say, it is proposed that the financing resources of the investment in the SRT should consist of the revenue from fares, subsidies and the amount returned from the development gains. In addition, with regard to the PSO, which the SRT has been discussing with the government on public transport, it is proposed that the compensation should be received from the Government of Thailand.

The fare revenue includes the amount of revenue caused by the increase in the number of passengers attracted to the developed urban area.

Concerning the development gain, various means should be examined such as increased tax revenue to be allotted to the SRT and the development gain to be directly allotted to the SRT.

A direct method to have the development gains returned is that the SRT obtains such profit directly through acquisition and sale or rental of land. In practice, however, various restrictions may be placed on this method.

As mentioned above, an effective means for the railway enterprises, local communities and land owners to gain profit is to adopt the method of land readjustment. This method will be discussed later in the actual stage of the Feasibility Study by making proper modification to meet with local situations.

1.1.3 Recommendation of Lines to Be Examined in the Feasibility Study

(1) Selection of high-priority projects

The areas along the SRT lines in the four directions radiating from Hua Lamphong have respective possibilities of urban development integrated with railway improvement.

In order to compare priority concerning the four lines, examination in accordance with the following evaluation items is proposed.

- The scale of urban development
- Total amount of investment in railways
- Internal rate of return
- Local characteristics
- Relationship with the relevant projects
- Environmental problems
- Problems concerning execution

Since the Government of Thailand lays stress on the development of ESB, the improvement of railway transport is urgently required especially on the Eastern Line. Also, the large-scale national projects have been realized along the line as follows:

- Second Bangkok International Airport (SBIA)
- Residential Area Development by NHA
- Inland Container Depot

Furthermore, the High Speed Rail Project between the Bangkok city center and ESB has been proposed. The Second Bangkok International Airport is now under construction so that it is necessary to draw up development plans for the neighboring areas at an early date.

Table 1.1.11 shows the evaluation as compiled per items for each line.

By comparing the results per item indicated in Table 1.1.11, the projects along each line are feasible from the viewpoint of economic evaluation. However, from the viewpoint of financial evaluation, it is indicated that the Eastern Line and the Northern Line will be feasible and each of them is considered as a powerful proposed project.

Table. 1.1.11 Evaluation of Priority in Investment by Line

Item \ Line		Eastern Line		Northern Line		Southern Line		Maeklong Line	
Planned population in urban development (000 persons)		500	○	640	◎	360	○	200	△
Total amount of investment for railway (billion baht)		14.9	○	17.6	△	11.9	○	7.2	◎
EIRR (%)	Improvement only for commuter service	20.8	○	30.9	◎	21.2	○	25.9	○
	For both commuter and ic. express service	22.6	○	23.4	○	22.1	○	-	-
FIRR (%)	Improvement only for commuter service	9	○	12	◎	5	△	5	△
	For both commuter and ic. express service	11	◎	12	◎	7	○	-	-
Characteristics of the area		Close relation with ESB Project SBIA	◎	UCR Development Don Muang Airport	○	Delay in developing	○	Advantage in distance to the CBD	○
Relevant big projects	Hopewell Project	15km length	□	30km length	□	Crossing Chao Phraya River Passing by the Royal Palace Land acquisition in downtown	△	Crossing Chao Phraya River Land acquisition in downtown	△
	Housing development by NHA	Ongoing	◎	-	-	-	-	-	-
	SBIA	Ongoing	◎	-	-	-	-	-	-
	HSR Project	Under examination	◎	-	-	-	-	-	-
Environment		-	□	-	□	-	□	-	□
Problems on execution		-	□	-	□	-	□	-	□

Remarks: Marks show degree of urgency/effect of railway improvement and urban development.

◎: Urgency/effect; Large

○: Urgency/effect; Medium

△: Effect; Small

□: No special mention

Taking into consideration that the related projects such as the residential area development along the Eastern Line by NHA and the Second Bangkok International Airport are in progress and the Government of Thailand attaches greater importance to the development of ESB, it is proposed that the project of integrated urban and railway development along the Eastern Line should be taken up as top priority, and the feasibility study should be implemented.

The line to connect the Second Bangkok International Airport under construction with the Eastern Line may not be feasible itself. However, since a unified operation may be effective in the case of railway, it is proposed that the feasibility study of the Eastern Line should include the SBIA New Line in reviewing introduction of external free funds to cover the investment in facilities as well as examining fare level. (Infrastructures such as tunnels, viaducts within the airport area are to be provided in the Airport Project. This just suits to the conditions.)

(2) Concept of the lines to be examined by the feasibility study

1) Sections to be studied

It was decided at the discussion on the Scope of Work held in December, 1992 between the representatives of the governments of Japan and Thailand that 100 km of railway section, excluding the Hopewell Project area, would be studied on feasibility after the Master Plan is established.

In deciding the section of 100 km to be selected for the feasibility study along the Eastern Line (other than the sections in Hopewell Project area), the first priority may be given to the section where land suitable for residential development is included and a large-scale transport is involved. In addition, the section includes the regional core cities, Chon Buri and Chachoengsao, and the branch line to the Second Bangkok International Airport. The section thus selected is be as follows:

Hua Mak - Chon Buri of the Eastern Line, SRT : 93 km
Second Bangkok International Airport Branch Line : 7 km

2) Transport improvement investment plans

Electrification between Hua Lamphong and Chachoengsao
Automatic block signalling sysem with ATS-P
Track strengthening
Electric railcars for commuter service
Diesel railcars for intercity express service
Track-doubling between Hua Mak and Chachoengsao (Ongoing, out of the study)
Others

3) Train operation plan

To be examined for the following points depending on the results of the feasibility study:

Commuter service:
- Rush hour: 10-minute headway (each rapid and local)
- Off-peak hours: 20-minute headway (each rapid and local)

Intercity express service:
- One train per hour: (One train in every two hours in the beginning)

Schedule speed:
- Commuter service: 65 km/h (Average of rapid trains and local trains)
- Intercity express service: 100 km/h (Maximum speed, 120 km/h)

4) Urban development

Population newly attracted to the areas along the railway line:
0.5 million persons

To consider the number of passengers who use the airport, and those who have been added by the development around the airport

To calculate the effect of development in the areas along the railway line

1.2 Characteristics and Roles of Railways

1.2.1 Background

(1) Socio-economic conditions

The area where this Study is conducted is within a radius of 200km from the center of Bangkok, including the BMR (Bangkok Metropolitan Region), the extended BMR and the surrounding regions.

The gross domestic product (GDP) of Thailand, which reached 2 trillion baht in 1990, represents remarkable growth especially more than 10% per annum for the period from 1987 to 1990. In the meantime, the ratio of agriculture/forestry to industry has changed dramatically from 3:1 in 1960 to 1:2 in 1990. This is attributed to the rapid industrialization of the country. Although the BMR area accounts for only 1.5% to the total area, its gross regional product (GRP) is about 50% of the GDP of the country, which indicates a typical case of centralization.

GDP per person is US$1,430 (in 1990), which is ranked just in the middle among the member nations of the World Bank (the International Bank for Reconstruction and Development). So far the National Economic and Social Development Plan of Thailand, beginning with its initial plan for the period from 1961 to 1966 and ranging to the 7th, has been satisfactorily promoted. Subsequent to the rapid annual growth of more than 10% per annum achieved in the 6th plan, the 7th plan (covering the period from 1992 to 1996) is currently under way. In this plan, attention focuses on the strain caused by the aggressive growth of the country. The features of the current plan are moderate growth, decentralization of development and improvement of the environment.

This study specifies the year 2010 as its target year, aiming at its incorporation with the 8th plan prepared for the period from 1997 to 2002.

As stated above, the socio-economic conditions, which form a background for the planning of this project, contain two factors: the satisfactory and rapid economic growth, and the remarkable gap among different regions and business sectors. In making plans, therefore, it is necessary to pay careful attention to the possible changes in factors to be made by the target year of 2010 as well as to the assignment of the roles of the railways.

(2) General aspect of transport

With regards to the railways of Thailand, the main lines were built at an early stage, and the rails extend radially from the center of Bangkok. Although the amount of transport handled is steadily on the increase, its increasing speed is relatively low compared with the rapid economic growth of the country, and its share has fallen. However, little strengthening of facilities has been attempted to cope with the increased demand.

Except in Bangkok and its peripheral districts where centralization is extreme, there are enough roads to ensure satisfactory functions, and full-scale plans for reinforcement have been prepared.

Although the share of air transport is still small at present, it has the possibility for substantial promotion due to the increase in per capita income.

The shares in passenger transport in 1989 of road, railway and air transport in terms of passenger-kilometers were 92%, 7% and 1% respectively. Road transport has the top share also in freight transport. The shares of railways and inland water transport in terms of ton-kilometers are both presumed to be 5%. Incidentally, most of the railway freight is petroleum products and cement. There are plans to convert the transport means for some portion of petroleum products to a pipeline system.

Since Thailand is situated on the continent, its freight transport is not allowed to rely on marine transport. On the other hand, since the country has a big port on the sea in Laem Chabang, international freight transport between the port and surrounding inland countries may tremendously increase in the future, when the situations of international politics and economics will change. The role of the railway with its advantage of large-scale transport is expected to be of much importance in the future. Establishing an alternative transport route for freight from/to a port on the Andaman Sea is an expected future project.

(3) Urban transport in the Bangkok Metropolitan Area

Accompanied by the radical economic growth centering on industrialization, over centralization has arisen in Bangkok, which is the center of political and economic activity and plays a core role in the promotion of industrialization as well as a gateway for imports/exports, thus resulting in excess urbanization in the city.

Shares of Bangkok Metropolitan Region (BMR), including Bangkok Metropolitan Administration (BMA), in the entire country in terms of population, area, gross regional product (GRP) are indicated in Table 1.2.1; 15% of the total population is concentrated in the BMR whose area is only 1.5% of the total area, causing its GRP to account for 48% to the GDP of the country. It has been observed that the BMR was spreading over the surrounding districts, because of saturation in BMA.

Table 1.2.1: Population/Area/GRP to the Entire Country

Item / Area	Population unit:million			Area	GRP 1989
	1983	1991	1911/1983	km^2	billion baht
BMA	5.0 (10)	5.6 (9)	1.12	1,560 (0.3)	
BMR	6.1(12)	8.7 (15)	1.43	7,760 (1.5)	855 (48)
Entire Country	49.5 (100)	57.0 (100)	1.15	513 thousand (100)	1,776 (100)

Note: Figures in parentheses represent percentages.

In order to support the economic activities of the country, movement of passengers and freight is necessary. Road traffic has increased sharply inevitably accompanied by the economic growth, as well as induced by the worldwide development of the automobile industry and the growing affluence of both citizens and corporations.

Blessed with vast level ground, land is easily acquired, except in the limited highly urbanized area, which leads to ease in constructing roads even if it is rather slow compared with the speed of economic growth. Roads, therefore, have been steadily improved. However, the existing urban area (within a radius of about 20 km from the core) is suffering from exceptionally serious traffic congestion due to the excess centralization of key urban functions and the difficulty in constructing roads there.

Heavy car traffic in cities is a worldwide problem. The traffic congestion in Bangkok has always been one of the severest in the world. Although fundamental countermeasures should have been taken in parallel with the rocketing economic growth, few measures have been taken. The road improvement in the urban district so far enforced is no more than the construction of grade separation at some crossings and elevated expressways in some limited sections (about 50km in 1993). The mass rapid transit systems, including the effective use of the existing railways, were taken up in the 1970s. However, the systems remain unrealized. The historical factor that most of the access streets to main roads in Bangkok are blind alleys called "soi" also has influenced the traffic congestion.

As a result, in the city of Bangkok "it takes a tremendous time to move" and "no schedule can be decided" because of the uncertainty in the time required for movement. People are forced to stagger the start of their working hours ranging from dawn at 6:00 to 10:00 a.m. These conditions are hindrances to further economic development as well as economic and cultural activities. In addition, the polluted environment owing to the exhaust gas and car noise are seriously affecting the health and repose of citizens.

In Thailand the consumption of energy for transport is huge. Such energy use in the transport sector worsens the environment. Improvement of transport infrastructure and land use regulations cannot catch up with the speed of economic growth and urbanization. It is essential to improve systems of transport and land use there so as not to increase environmental damage.

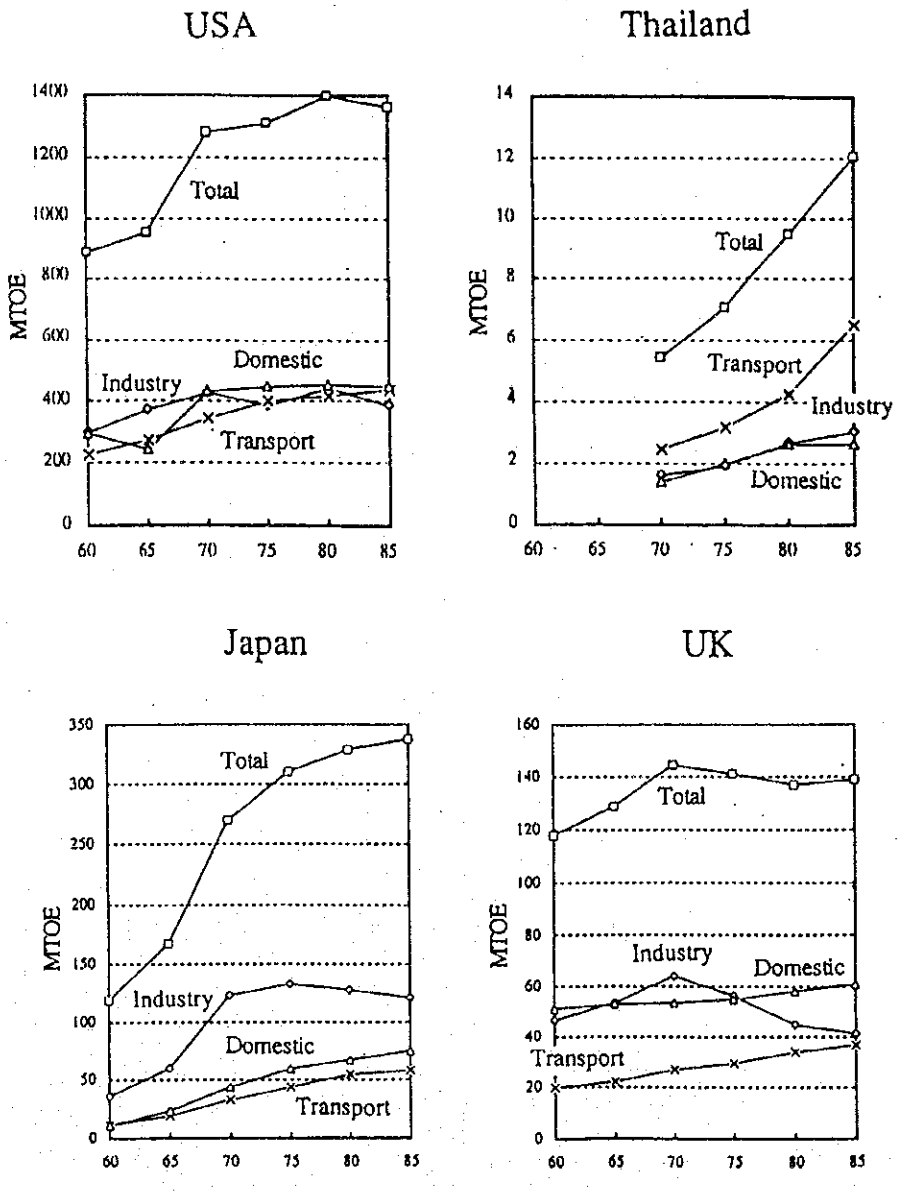
Same information concerned are shown in Fig. 1.2.1, Fig. 1.2.2, Fig. 1.2.3 (Source: Prof. Y. Hayashi, 1993) and Fig. 1.2.4. (Source: MOT). Fig. 1.2.3 suggests that the pace of road construction can no longer catch up with the rapidly increasing car ownership and only creation of a railway network can cope with the situation.

Accompanied by the remarkable economic growth mainly caused by industrialization centering in Bangkok, residential developments, commercial and service complexes as well as factories have been located along the well developed main roads which are planned to have ten lanes, thanks to the abundant and available, spreading through them from the existing over-crowded urban districts, creating what is called "ribbon development". The traffic originating in the above areas approaches the urban district where very little road construction has been undertaken. Therefore, traffic congestion in the urban district is increasing.

In the Bangkok area where transport entirely depends on roads at present, buses play an important part as public transport, and various services on fares and facilities are offered. Bus lanes have been provided including those going against the one-way traffic. However, under the exceedingly heavy congestion and traffic delay, the arrival/departure times are never as scheduled and promptness in reaching destinations cannot be guaranteed at present.

The railway has already been equipped radially in the eastern, northern, western and southwestern directions from Bangkok. However, only trunk line services have been provided. Commuter service has just started recently.

As mass rapid transit systems, three projects (Hopewell Project, BMA <Tana Yong> Project and MRTS <Sky Train> Project) have been planned. In addition to these, subway projects and the SRT improvement project (under this Study) have started under increasing understanding of the necessity for mass rapid transit systems as a means to solve the current serious traffic gridlock.



*)MTOE:million ton oil equivalent

Fig. 1.2.1 Changes in Energy Consumption by Sector

However, mass rapid transit system projects contain financial risks because they require a large amount of initial investment and take quite a long time before their completion. Therefore, it is essential that the government substantially finance the project with strong leadership rather than choosing an easier way like BOT.

In conclusion, the introduction of mass rapid transit systems is the most urgent project for providing indispensable urban transport modes without which Bangkok cannot achieve further prosperity.

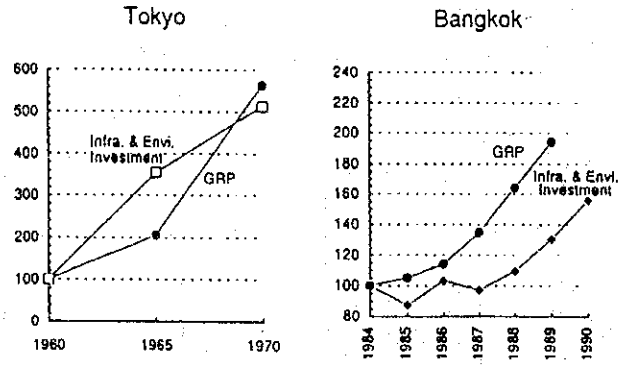


Fig. 1.2.2 Economic Growth and Infrastructure Investment (index)

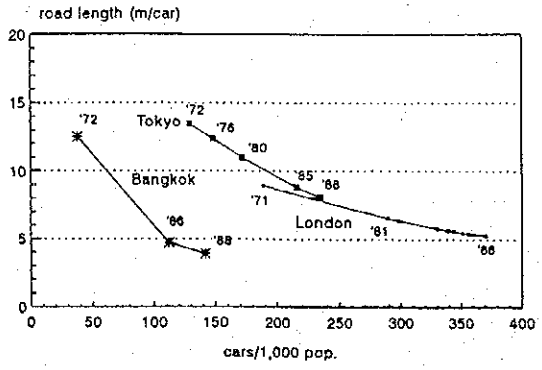


Fig. 1.2.3 Motorization and Road Supply Level

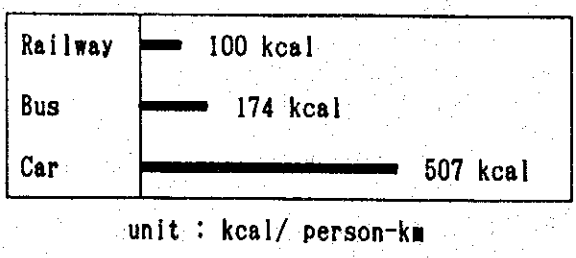


Fig. 1.2.4 Transport Energy Consumption Amount

1.2.2 Characteristics of Railways

Merits of railways can be listed as follows:

- Fast
- Reliable (Punctual)
- Safe
- Comfortable
- Inexpensive (for large volume transport)
- Suitable for large volume transport
- Environment-friendly
- Natural-resource-saving (for large volume transport)
- Space-saving (small space requirement / availability of underground because of no problem of exhaust fumes)

As to "Space-saving", a railway is the only transport means which can accomplish mass transport saving valuable, hard-to-get space in great city areas.

On the other hand some demerits are listed as follows:

- Not door-to-door
- Not at any time

However, the demerit of "not door-to-door" may be overcome by the merits of "fast, reliable, safe, comfortable, inexpensive" passenger transport and by means of container or piggyback freight transport, and the demerit of "not at any time" can be overcome by short headway with large volume transport which is the role of railway transport.

A railway is to accomplish large volume transport as trains owning and using exclusive facilities and spaces as railway lines. Therefore, unless it is backed by a sufficient great demand, it is rather an inefficient transport means.

Characteristics of railways are on the basis of following technical factors:

(i) A railway has a passage for its exclusive use and can transport passengers and goods reliably without being affected by others .

(ii) Since a train is guided by rails, a large volume of passengers and goods can be transported by a driver at the same time by connecting a lot of vehicles, contributing to labor-saving.

(iii) Since a train is guided by rails, only one-dimensional control is sufficient so that it is very safe.

(iv) Since a train does not require frequent acceleration and deceleration according to items (i) and (iii), power can be used efficiently. In addition, its running resistance is small because of its small rolling friction between the steel wheels and rails so that a railway is a natural-resource-saving transport means.

(v) If a railway is electrified, various energy sources such as hydraulic power, coal-fired power and atomic energy can be used instead of petroleum resources. At the same time, the energy efficiency is higher, more resources can be saved and in addition electric power can be recovered by regenerative braking.

(vi) If a railway is electrified, it is good for the environment because it does not emit exhaust gas. (Even in the case of thermal power generation, since the facilities can be installed in an unlimited space on the ground, it is quite easy to eliminate harmful substances from exhaust gas and this is usually done. In the case of operating by diesel power, air pollution by exhaust gas is less because of the higher efficiency in power as mentioned above (iv)).

(vii) A relatively large space can be easily secured in coaches so that comfortable service can be provided.

(viii) For commuter service in a large city with a right-of-way of only about 10m width, more than 50 thousand passengers can be transported per hour per one direction. In addition, as it discharges no exhaust fumes, a railway line can be constructed under ground easily. Thus a railway is a space-saving transport means, which is suitable in large cities where space is very precious and difficult to acquire.

1.2.3 Roles of Railways

Roles of railways are specialized to "large volume" and "high speed" transport based on the merits and demerits mentioned above. They have been reduced due to the development of automobiles and aircraft.

The roles of railways are classified in the following tables based on their degree of "large volume" and "high speed".

As to passenger transport, commuter service in great city areas, which is classified into superlarge volume relative high speed transport, is making the most of the merit of "space-saving" so as to utilize efficiently precious land and space in great city areas.

Besides, the merit that underground routes are easily adopted can bring further effective utilization of land and space. That is to say, a railway (including other mass rapid transit systems) is the only system which can practically transport extremely large numbers of passengers in huge city areas such as the Bangkok Metropolis reliably and fast with its many merits.

Table 1.2.2 Classification of Roles of Railways (Passenger Transport)

Speed / Volume	Superhigh speed (Over 200km/h)	High speed	Relative high-speed (With reliability)
Superlarge volume	-	-	Commuter service in large cities
Large volume	Intercity superexpress (Shinkansen)	Intercity express (Improvement of the existing lines)	Commuter service in large cities (Suburban area)
Medium volume	(Economically it can not manage.)	Intercity express (Utilizing the existing lines)	Commuter service in regional cities utilizing the existing lines)

Table 1.2.3 Classification of Roles of Railways (Freight Transport)

Speed / Volume	Higher speed (Over 90 km/h)	High speed (75-90 km/h)	Medium speed shuttle
Superlarge volume	-	-	Medium distance bulk, marine containers, petroleum products, cement transport service
Large volume	Long distance national /international trunk line service (Container etc.)	Long distance national /international trunk line service (Container, etc.)	-

As to freight transport, it is important that there is a great enough demand to make up trains operating among bases, which make full use of the merits of railways. Large volume is rather more important than high speed. As Thailand is a continental country, except in the southern region, long distance trunk line freight service including international service is the important role of the railways without competition with marine transport.

Out of the many roles mentioned above, the roles of railways in Thailand are practically as follows:

- Passenger transport

  Commuter service in great city areas (actually in the Bangkok Metropolis)

  Intercity express service

    Regional service
    National/international trunk line service

- Freight transport

  Medium distance shuttle transport (Regional service)

  Long distance transport (National/International trunk line service)

For reference

- Commuter service in regional cities: at present there is no city of large enough scale to adopt it, however, in the future it will be carried out in some cities enlarged by the policy of decentralization.

- A new trunk line for super high-speed with an exclusive track (Shinkansen): at present, from the view point of the scale of the regional cities to be connected with Bangkok by it, sufficient demand to manage it (more than 50 passengers/day × both direction) cannot be expected.

1.3 Present Conditions and Problems of the Railways of Thailand

1.3.1 General Conditions of the Railways

(1) Network

Since the first construction started in 1892, the railways in Thailand have been extended steadily from Bangkok, establishing a network toward the north, northeast, south, west, east, and Eastern Seaboard (ESB).

At present, the route extension is about 3,900 km, which roughly covers the whole nation. In the southern part the railway leads to Malaysia, and in the eastern part it used to lead to Cambodia and at present the train service is cut off on the border because of the present Cambodian situation. In the near future when a track on the bridge over the Mae Khon River is completed, the railway will lead to Vientiane in Laos. Extending the railway over the border in the future will make the railway play an important role as an international trunk line with the Bangkok and ESB port as its gateway (Fig. 1.3.1.).

The whole line has a gauge of 1 m, and only the section between Bangkok and Ban Phachi Junction, where the Northern and Northeastern lines join, has a double track. The whole line is not electrified. What is worthy of mention is that all the lines have secured the right-of-way of 40 m or more (14-20 m for only the Macklong Line) since their construction. It can be said that this has a high potential for the future reinforcement and improvement of facilities. This is also applied to the new lines which are now under construction.

The lines in the Bangkok Metropolitan Area are radiating toward the north, east, west and southwest from the center and are located so that they can play important roles in the future. (Cf. Fig. 1.1.10)

The lines extending toward the north, east and west are trunk lines. The Maeklong Line running toward the southwest is cut off from the other lines by three big rivers, but it will possibly be a short-cut route toward the south in the future. These four lines will form important main lines passing through the core of the city crosswise with the planned second phase of the Hopewell Project.

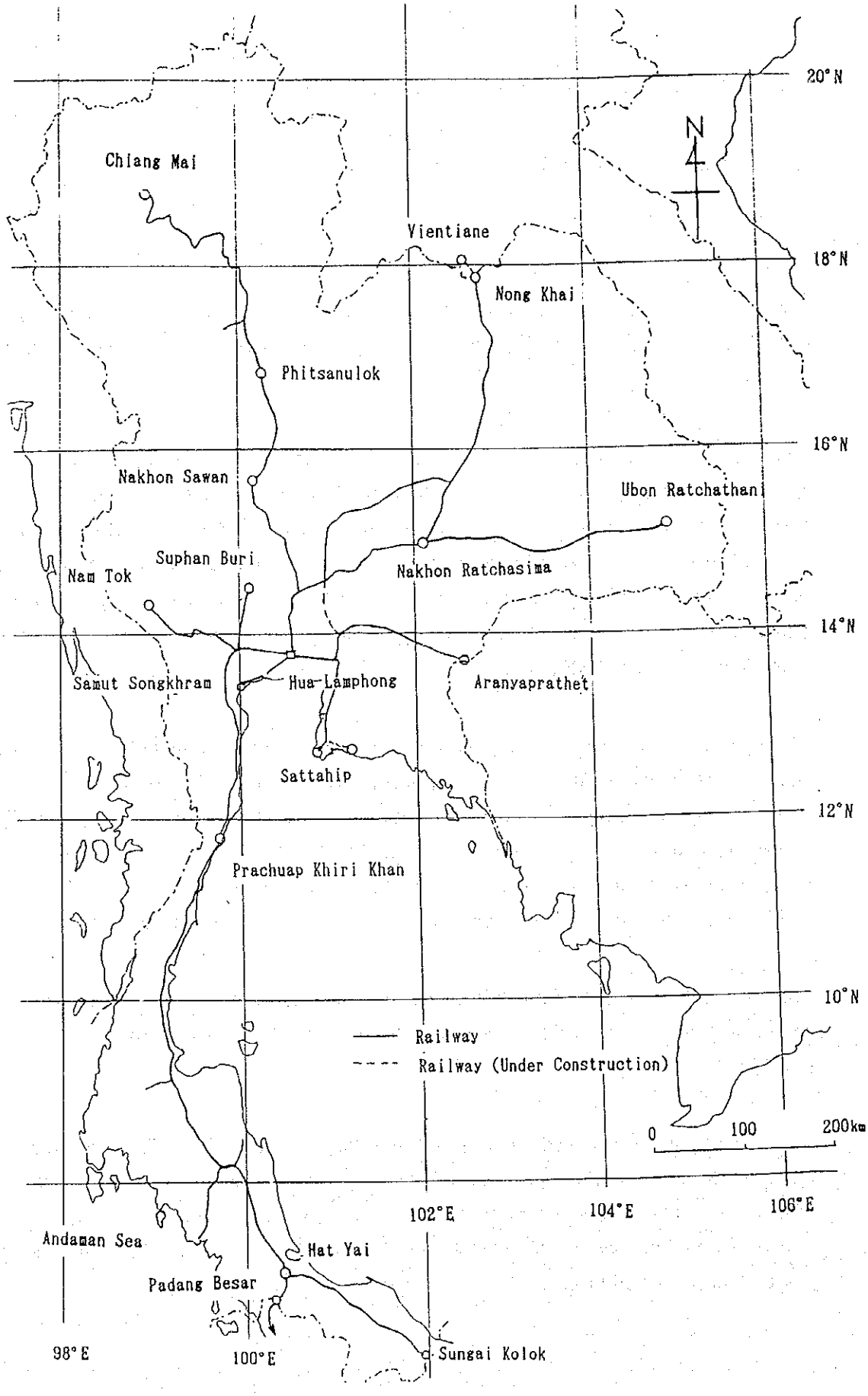


Fig. 1.3.1 Railway Network in Thailand

Thanks to the geographical features the alignment of track is very good except in mountainous areas (which are only a part of the whole network of the railways and Map Kabao - Khang Dong <25km> in the Study Area), and it presents the possibility of high speed train operation in the future.

The level of maintainance is rather high, and maximum operating speed at present is 120 km/h for express by diesel railcars and 90 km/h for passenger trains hauled by diesel locomotives. In actual operation, there is some delay but it is not so much as to lessen usefulness of the railway. Generally the railways of Thailand can be rated to be managed on high level enough.

A weakness of the railways in Thailand is that the priority on passing at-grade crossings with roads is not established, which causes much decrease of operation speed and confusion in the train schedule in the Bangkok Metropolis, and decrease of the maximum operation speed and frequent slowing down in local areas. Hereafter, the increase of car ownership in local areas will influence in all the country and make the railways unable to fulfil their role.

Another weakness is low efficiency vacuum brakes of freight cars which makes operation speed less than 40 km/h decreasing the whole capacity of the railway and affecting the at-grade crossing problem.

To get rid of these weaknesses, it is essential and urgent for the railways to keep playing their role fully in the future.

(2) The situation of railways in the socio-economic view of Thailand

The roles to be played by the railways (which match the characteristics possessed by the railways) are as follows:

- Commuter service
- Regional service (intercity express and large volume freight)
- National/international trunk line service (passenger and freight)

These roles still remain unchanged.

On the other hand, the SRT is not making an active investment but is only renewing its rolling stock and facilities. It is providing a low fare service at a low cost while its service is at a low level, and this constitutes a part of welfare policy. That is, as far as passenger transport is concerned, the SRT is reducing costs by running infrequent trains consisting of many coaches. A train mainly consists of third-class coaches, which cannot be said to be comfortable or even courteous. Comfortable night sleeping coarches and diesel expresses are also running on only a part of the services.

Commuter service is also provided by using passenger coaches (some diesel railcars) on hand, but it has not yet played an active role in relieving the serious traffic congestion in Bangkok which is one of the biggest problems in Thailand.

The freight fares are slightly higher than the passenger fares (the revenue per train-kilometer was 1.25 times more in 1990) so that the freight traffic does not have much implication on welfare policies.

The service of the SRT at present is provided at a low fare and this is only possible because of not making a reinforcing investment, in other words, the SRT is just playing a part of the role it could play.

Will the SRT continue to take this line in the future? Or will it continue to play an important role in the coming era by making an active investment? The SRT is now at a critical turning point. Which line the SRT adopts depends on the government's will on how to build up the traffic infrastructure.

The following are the reasons why it is now at a critical turning point.

(i) The rapid economic growth in Thailand still continues. As studied in the Master Plan (May 1993), the movement of people and goods keeps increasing with the economic growth. In these circumstances, the SRT no longer cannot deal with the increasing demand only with the existing facilities and vehicles.

(ii) The weaknesses of automobile traffic, that is, exhaust gas, noise, frequent accidents, and large fuel consumption, have already reached a level which cannot be ignored, and to cope with this situation it has come to be discussed whether to select a modal shift or not.

(iii) To relieve the serious traffic congestion in Bangkok, a railway/mass rapid transit system is essential, and the desire to complete it has grown among the people.

The Thai railways are now in the above-mentioned situation.

In order to increase transport capacity remarkably, it is indispensable to make an investment such as improvement and reinforcement of facilities and increase of rolling stock. On the other hand, since there is a big difference between the fare level (national market price) and the cost level for the investment (the international market price in major parts), it is impossible to cover the capital costs only with the proceeds from the passenger and freight fares so that the government need to make an investment as public utilities in some ways. (Even if the passenger fare is raised from the low level at which the railway seems to be almost a part of welfare policy, it is considered that this gap cannot be eliminated.) Consequently, the government's policy is an important factor. At least, urban transport in a great city area such as the Bangkok Metropolis cannot be dealt with without railways and mass rapid transit systems including the existing railways.

Therefore, it is essential that the government and the SRT grapple with it immediately in view of the existing state of urban transport in the Bangkok Metropolis.

As for a high grade railway whose operation speed is 150km/h on a meter gauge track and approx. 300km/h on standard gauge track, the SRT has high potential to realize this easily thanks to its broad right-of-way of good alignment. It is just dependent on demand and ability to invest.

(3) Situations of railways in urban transport

1) General

Urban transport in great city areas such as the Bangkok Metropolis must handle a large volume of people especially in commuter rush hours in the morning and evening. Although not so many as in the morning and evening, quite a lot of people use a means of public transport for their business purposes at other times of day. In this case railways/mass rapid transit systems usually play their role and in almost all the great city areas in the world, railways/mass rapid transit systems are functioning.

Since a car occupies a large space compared to its carrying capacity, it is not suitable for large volume transport. With the development of the automobile industry and more affluent individuals and enterprises, a class who can afford cars is increasing. This makes the traffic congestion more serious, and this deprives a means of public transport, such as buses, of their passage (even if some regulations are enacted such as a bus lane), paralyzing movement of people which is essential for urban activities. In addition, Bangkok had become prosperous with the canals as its main traffic passages and they have been filled in and made into roads with the development of automobiles. Therefore, this city is not sufficiently provided with roads which support automobile traffic because it has only a rough network of trunk roads and blind alleys. (If a feeder street is a blind alley having only one exit to the trunk road and if one-way traffic is practiced on the trunk road, sometimes one cannot reach a trunk road of the direction one wants to go, and consequently, dead runs <One goes in the opposite direction once and passes through a side connection road, then goes in the desired direction and passes near the starting point again.> will occur and traffic will increase which is very inefficient.)

Although Bangkok is one of the biggest cities in the world, neither a mass transit system is provided nor is the road network sufficient. Thus, the city is in the forefront of the traffic congestion. There has been an outcry for the necessity of completion of traffic infrastructure in both aspects of mass rapid transit systems and roads since the 1970's when the situation was quite serious, but no effective measures have been taken up to now. During this period, only some grade-separated crossings and elevated highways (approx. 50 km) have been constructed.

The SRT has four lines running toward the suburbs from three terminals including Hua Lamphong, but it has hardly played any role in the urban traffic.

Recently the SRT has provided a commuter service in the morning and evening by using the rolling stock on hand, but this is not full-scale because improvement of stations, access, etc. corresponding to the commuter service is not involved. Although the SRT possesses assets of the railway network, it is not fully utilized. At present, in the Northern Line, a commuter service with 9 trains and 140 coaches is provided between 6:30 and 8.20, transporting about 20,000 people and the importance of its role has been recognized little by little inside and outside the SRT in the recent serious traffic congestion. However, the SRT also has the difficult problem of at-grade crossings.

The urban transport by railways has just started and finally come to be recognized, but it is a little too late. It is another question whether or not completion of a mass rapid transit system can eliminate traffic congestion in large city. For a car which requires a large space to transport a small number of persons, a road will not have a lot of allowance, even if movement of people is transferred to a mass rapid transit system. However, it makes a big difference whether mass rapid transit systems are available or not because with these systems people can move in a short time without fail in a city and have a means by which they can use their valuable time effectively.

When people actually experience the recent serious traffic congestion in Bangkok, they come to recognize the necessity of mass rapid transit systems for urban traffic. Some plans have been made so far but have never been realized.

As for mass rapid transit plans, the first phase of the Hopewell Project has started pile driving. It started in a portion of the Northern Line of the SRT. Signs of carrying out the MRTA Skytrain Project and BMA Tanayon Project (elevated LRT) have begun to appear. In addition, a new subway construction project was brought forward. However, unfortunately, these mass transit networks have been planned separately and lacking in integration. (Two corporations have indicated their intentions to participate in the subway projects.)

At present, what is already under construction is only a part of pile driving of the Hopewell Project. It is necessary and possible to adjust the project as well as make an efficient investment and construct a easy to use system (especially convenient for transfer). But it seems to be considered that any one who can complete a project earlier may start to construct.

At a stage when a mass rapid transit system was first studied, it was considered that the subway could not be constructed in Bangkok with bad geological features and repeated floods, but this is not accurate. Now a subway construction plan has been finally made. Selection based on the construction cost, operatability, urban environment, etc. is a very important matter. Plans which were made based on the idea that a subway is impossible should be reconsidered. (Cf. Fig. 1.3.2)

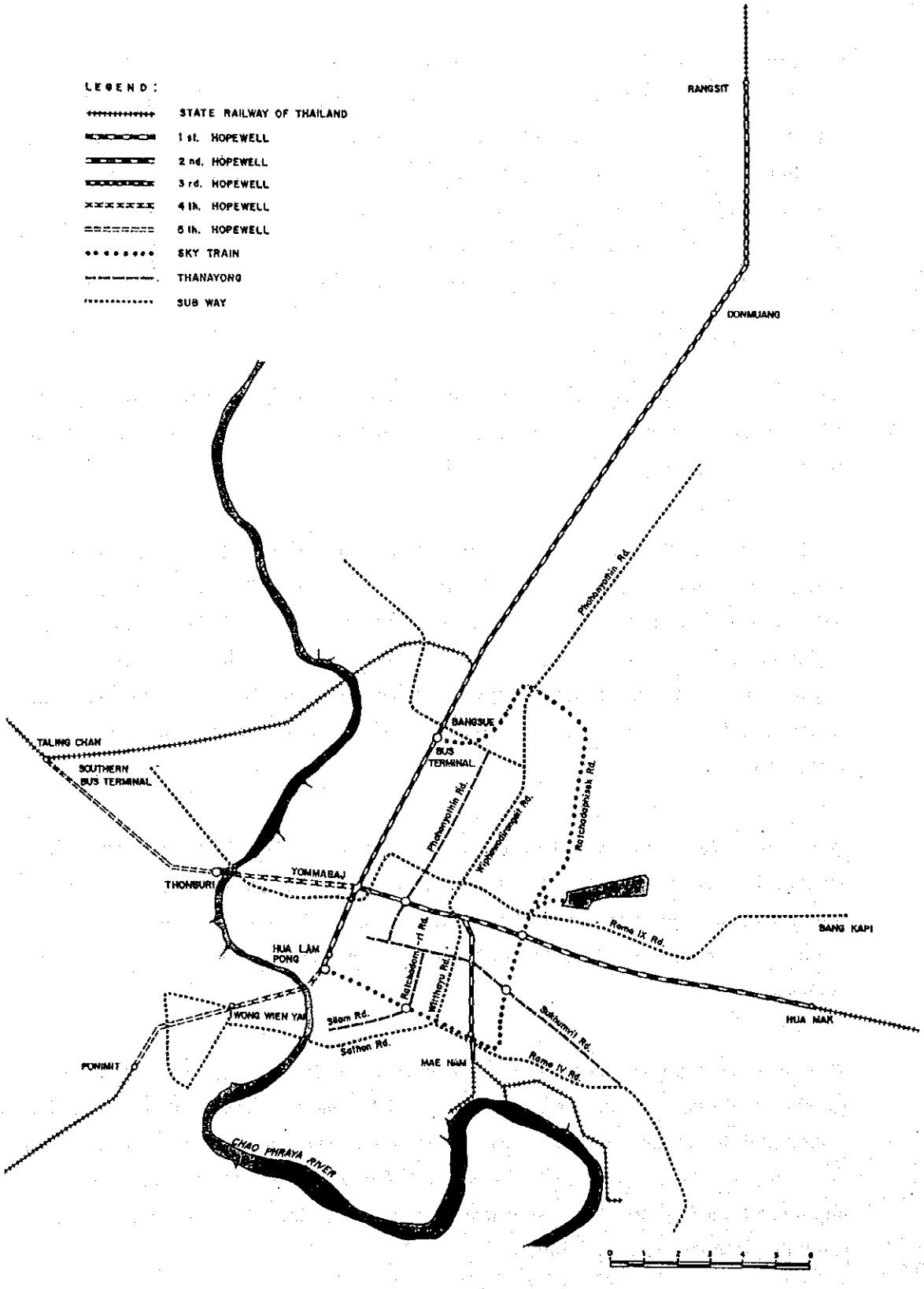


Fig. 1.3.2 Projected Railways / MRT

2) Role of the SRT

Now that the necessity of introducing mass transit systems including railways into urban transport has come to be recognized, what role should the SRT play? The SRT possesses not only railway tracks but also rights-of-way radiated toward the north, east, west and southwest in Bangkok Metropolis, has a high potential for managing a railway and is providing an actual commuter service though not a full-scale one.

At present, it is only the SRT that has railway tracks for commuter service connecting the suburbs with the center of the city and also has a human potential for operating trains. The SRT should be involved in the commuter service as much as possible. Although it has several problems including "the at-grade crossing problem", it should play a leading role by solving these problems, and improving and reinforcing facilities step by step.

The Hopewell Project is formulated up to 10 - 30 km (30 km only on the Northern Line) from the center of the city. After completion, the roles of both should be divided organically. That is, since the lines are parallel, the SRT should promote its projects, securing harmony between the rapid service connecting with the suburbs and the trunk line service, and Hopewell Community Trains should transport passengers as a means of transport in the center of the city. Although transfers between SRT's local trains and Hopewell's commuter trains are required at the terminal station of the Hopewell Project, thick commuter transport lines will be established which organically perform rapid-local-combining operations from the center of the city to the suburbs (Cf. Fig. 1.3.3.).

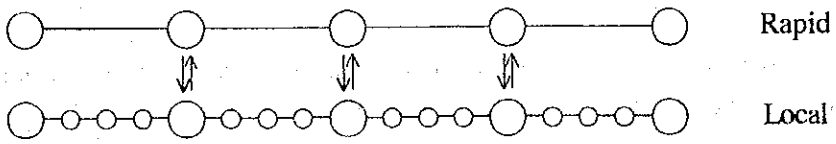


Fig. 1.3.3 General Idea of Rapid-local-combining Operation

If rapid trains mainly transport passengers based on rapid-local-combining transport, trains will run at about a scheduled speed of 70 km/h or higher in almost all the sections. Therefore, an area within 50 to 70 km from the center of the city is a satisfactory location as a commuter area, and the SRT, possessing radiated railway tracks in every direction, is in a position to play an important role in railway transport integrated with urban development along the lines.

In addition, since the SRT has secured rights-of-way of 40 m or more (14 to 20 m on the Maeklong Line) along these lines, they can be easily four-tracked and have enough potential to perform at the same time the trunk line transport which is SRT's other mission and commuter transport which will increase in the future.

As mentioned above, the SRT can and must contribute to the commuter transport connecting the suburbs and the center of the city with every aspect of the lines, assets and human resources that the SRT possesses in order to relieve the traffic congestion which is now the most serious problem in the Bangkok metropolis.

1.3.2 Service and Transport

(1) Fare and rate system

1) Principle of SRT's fares

The standard rates for passenger fares and freight charges should be set up subject to the sanction of the Cabinet in accordance with the SRT Act in B.E. 2494. However, the SRT has the discretion to increase these standard rates by a maximum of 25% and decrease them by a maximum of 50% on condition that such an action is not inconsistent with the general economic and financial policies of the cabinet.

2) Rates for passenger fares

The standard rates for passenger fares and the actual fares at various distances are show in Tables 1.3.1 and 1.3.2.

The following supplementary charges are made (per person).

- 20 baht for rapid service, 30 baht for express service, 50 baht for special express service
- 50 baht for air-conditioning service in second and third class coachs, 100 baht for air-conditioning service in first and second class sleeping coachs
- 70 to 150 baht for sleeping coachs

Table 1.3.1 Rates for Passenger Fares

Distance (km)	Fares/km (Baht)		
	1st Class	2nd Class	3rd Class
1 - 100	0.84	0.44	0.215
101 - 200	0.77	0.38	0.18
201 - 300	0.71	0.34	0.16
Over 301	0.67	0.305	0.145

Table 1.3.2 Actual Fares

Distance (km)	Fares (Baht)		
	1st Class	2nd Class	3rd Class
100	84	44	22
200	161	82	40
300	232	116	56
400	299	147	70
500	366	177	85
600	433	208	99
700	500	238	114
800	567	269	128
900	634	299	143

Since September 1, 1985

3) Rates for freight charges

Rates for freight charges are divided into those for a complete wagon load and a small-lot load. The rates for a complete wagon load consists of three classes such as Class 3, Class 4 and special bulk oil. The contents of the former two classes are as shown below.

Class 3: electrical appliance, motor car, tin, coil, log, timber, tile

Class 4: fresh fish, rice, maize, rubber, jute, kenaf, cement, lignite, fluorspar, manganese, gypsum, fertilizer, fresh fruit, paddy, bran, marl, sand, gravel, vegetable, coconut, steel

The above-mentioned standard rates for freight charges are negotiable. Special rates can be allowed by confirming shipment.

The rates for small-lot load are divided into three classes such as Class A, Class B and the special one. The contents of the special class consist of daily newspapers and other printed matter.

The rates for freight charges are shown in Table 1.3.3.

Table 1.3.3 Rates for Freight Charges

Distance (km)	Rate per ton (Baht)		
	Class 3	Class 4	Petroleum (bulk)
50	28.80	25.00	21.80
100	57.50	50.00	43.50
150	82.80	72.00	65.30
200	108.00	94.00	87.00
300	154.00	134.00	126.00
500	241.00	210.00	201.00
700	322.50	281.50	273.00
1000	444.00	388.00	375.00

Since March 15, 1984

4) Situation of the rates

The rates, especially those for passenger fares, have been held down for a long time politically, which seems to have brought exhaustion of facilities and rolling stock.

(2) Transport

The present situation of transport is as follows:

(a) Number of trains

Table 1.3.4 indicates the train service provided to connect Bangkok with local districts classified by line and by kind. Approximately 100 trains (both directions) a day operate on each line.

(b) Number of passengers within a radius of 200 km from the center of Bangkok

Table 1.3.5 indicates numbers of passengers at major stations within the 200km radius area.

Table 1.3.4 Number of Trains

Line / Kind of Train	Northern	Southern	Eastern	North-eastern	Total	Note
Special Express	4	6	0	0	10	
Express	8	4	0	12	24	
Rapid	10	8	0	10	28	
Ordinary	14	12	10	8	44	
Rural Commuter	11	20	0	26	57	
Special Commuter	16	0	0	0	16	Weekday
Commuter	1	4	6	0	11	Weekday
Commuter	13	0	14	4	31	Holiday
Tourist	2	4	1	2	9	
Mixed	0	12	2	2	16	
Freight	22	18	12	26	78	Regulary
Freight	18	14	26	20	78	Temporary
Operation	0	0	8	0	8	
Total	119	102	79	110	410	

Note: Special trains operate between Hua Lamphong and Don Muang (Airport).
On the Macklong Line 34 commuter trains operate.

Source: Diagram Oct., 1993

Table 1.3.5 Numbers of Passengers at Stations a Year

Unit: 1,000 Passengers/year

Northern / Northeastern Line		Southern Line		Eastern Line	
Bangkok	31,389	Thon Buri	538	Makkasan	540
Samsen	1,369	Nakhon Pathom	326	Khlong Tan	542
Bang Sue	976	Ban Pong	162	Hua Mak	899
Bang Khen	1,236	Ratcha Buri	208	Ban Thap Chang	238
Lak Si	1,449	Phetcha Buri	155	Lat Krabang	434
Don Muang	2,589	Kanchana Buri	140	Hua Takhe	997
Chiang Rak	202			Khlong Luang Phaeng	192
Bang Pa-in	325			Preng	228
Ayutthaya	1,256			Khlong Bang Phra	207
Ban Phachi Jn.	722			Chachoengsao	901
Tha Rua	633			Prachin Buri	431
Ban Mo	365			Prachan Takham	206
Lop Buri	875			Kabin Buri	241
Ban Mi	355				
Chong Khae	355				
Ban Takhli	355				
Sara Buri	312				
Kaeng Khoi Jn.	268				

(c) Schedule speed and average operation speed

Table 1.3.6 indicates schedule speed and average operation speed classified by lines and by kind of trains.

Table 1.3.6 Schedule Speed and Average Speed

Kind of trains / Line	Schedule speed (km/h)					Average operation speed (km/h)				
	Exp. P	Rap. P	Fast P	Stp. P	Frei.	Exp. P	Rap. P	Fast P	Stp. P	Frei.
Northern Line	66.1	54.4	-	40.4	-	70.4	59.3	-	50.4	-
Northeastern Line	58.6	53.7	-	43.3	21.4	63.0	57.3	-	51.1	33.8
Eastern Line	-	-	38.9	43.8	35.6	-	-	39.7	52.1	37.2
North-East Line	70.6	-	63.4	50.5	-	75.7	-	65.6	57.3	-
Southern Line	47.7	46.6	-	36.0	31.6	50.1	49.4	-	44.3	31.7

Note: Exp. P : Express passenger train
Rap. P : Rapid passenger train
Fast P : Fast passenger train
Stp. P : Stopping passenger train
Frei. : Freight train

$$\text{Schedule speed} = \frac{\text{Train operation kilometers}}{\text{Train operation hours (Including station stop time)}}$$

$$\text{Average operation speed} = \frac{\text{Train operation kilometers}}{\text{Train operation hours (Excluding station stop time)}}$$

(3) Average delay time of arriving trains at Hua Lamphong

Table 1.3.7 shows average delay in arriving at Hua Lamphong in October, 1993. The average delay ranged from 14 to 40 minutes, which is considered to be influenced by train stoppage at at-grade crossings caused by traffic congestion in the center of Bangkok.

Table 1.3.7 Average Delay Times of Arrival Train at Hua Lamphong (October, 1993)

Kinds of trains	Average delay time (min.)
Special express	40.8
Express	14.7
Rapid	33.5
Ordinary	25.0
Commuter	14.3
Special commuter	35.7