JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF TRANSPORT AND COMMUNICATIONS
THE SOCIALIST REPUBLIC OF VIET NAM

FINAL REPORT
OF
THE FEASIBILITY STUDIES
ON
THE REHABILITATION AND IMPROVEMENT
OF
THE RAILWAY IN VIET NAM

Summary of Volume I

Master Plan at 2010 for Rehabilitation and Improvement of Hanoi - Hochi Minh Line

February, 1996

JAPAN RAILWAY TECHNICAL SERVICE
PACIFIC CONSULTANTS INTERNATIONAL
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PREFACE

In response to a request from the Government of the Socialist Republic of Viet Nam,the Government of Japan decided to conduct a Feasibility Study on the Rehabilitation and Improvement of the Railway in Viet Nam and entrusted the study to the Japan International Cooperation Agency (JICA) .

JICA sent to Viet Nam a study team headed by Mr.Sadaaki Kuroda,Japan Railway Technical Service (JARTS), 5times between February 1994 and February 1996.

The team held discussions with the officials concerned of the Government of Viet Nam, 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 Socialist Republic of the Viet Nam for their close cooperation extended to the team.

February 1996

Kimio Fujita
President
Japan International Cooperation Agency

CONTENTS

CHAPTER 1 INTRODUCTION

1.1 Background

The Government of the Socialist Republic of Viet Nam (hereinafter referred to as Viet Nam) made an official request to the Government of Japan to conduct the Feasibility Studies on the Rehabilitation and Improvement of the Railway in the Socialist Republic of Viet Nam (hereinafter referred to as the Study). In response to this request, the Government of Japan decided to conduct the said Study and commissioned the Japan International Cooperation Agency (hereinafter referred to as JICA). JICA then sent the Preparatory Study Team to Viet Nam in June, 1993 with a view to discussing the scope of work for the Study with the Government of Viet Nam.

On July 12th, 1993, the Government of Viet Nam and the Preparatory Study Team agreed and signed the Scope of Work and JICA then organized the Study Team and also established the Study Advisory Committee for the implementation of the Study.

JICA Study Team commenced the study from February 1994, carried out the field survey, collected the relevant data/information and prepared the Progress Report. The Progress Report was submitted to Vietnamese Government in May, 1994 for mutual discussion. Based on the discussion on Progress Report, JICA Study Team prepared the Report on "Selection of Optimum Alternatives of Master Plan at 2010 for Hanoi -- Hochi Minh Railway", which included the evaluation of alternatives of Master Plan, selection of optimum alternatives of Master Plan and outline of phased improvement plan.

The Report was submitted to Vietnamese Government in October 1994 for mutual discussion. Through discussion, Alternative I was selected as the optimum alternative for Master Plan and the outline of phased improvement plan was agreed in principle between Vietnamese Government and JICA Study Team.

Based on the above agreement, JICA Study Team prepared Interim Report I which includes the analysis of the current situation and problems of Vietnamese Railways, demand forecast of railway traffic, selection of optimum alternative of Master Plan at 2010, details of optimum alternative of Master Plan (namely Alternative I), phased Improvement Plan for Master Plan, and selection of feasibility study projects. Interim Report I was submitted to Vietnamese Government for mutual discussion in May 1995. Interim Report I was accepted by Vietnamese Government in principle. Various comments were presented by Vietnamese Government on Interim Report I. JICA Study Team revised Interim Report I through

responding suitably to those comments and submitted the Volume I to the Vietnamese Government as Draft Final Report of Master Plan at 2010 for Hanoi-Hochi Minh Railway in January 1996. Based on the discussion and suitably responding to the comments on Draft Final Report, Final Report has been prepared.

When Interim Report 1, which includes the contents of the Master Plan (MP), was explained to and discussed with the Government of Vietnam in May 1995, there was a request to correct the frame on socio-economy. In accordance with the request, the socio-economic frame and demand forecast used in the preparation of the MP was corrected. However, regarding the socio-economic frame, demand forecast, cost and cost/benefit analysis used in relation to the comparison of Master Plan Alternatives I, II and III, it was decided not to correct the values originally used in IR 1, because it is considered that the relative superiority of the alternatives would not change in the event of revisions being made to these factors. Corrections were only carried out on the socio-economic frame, demand forecast, cost and cost/benefit used in relation to the selected optimum Master Plan.

1.2 Objectives and Area of the Study

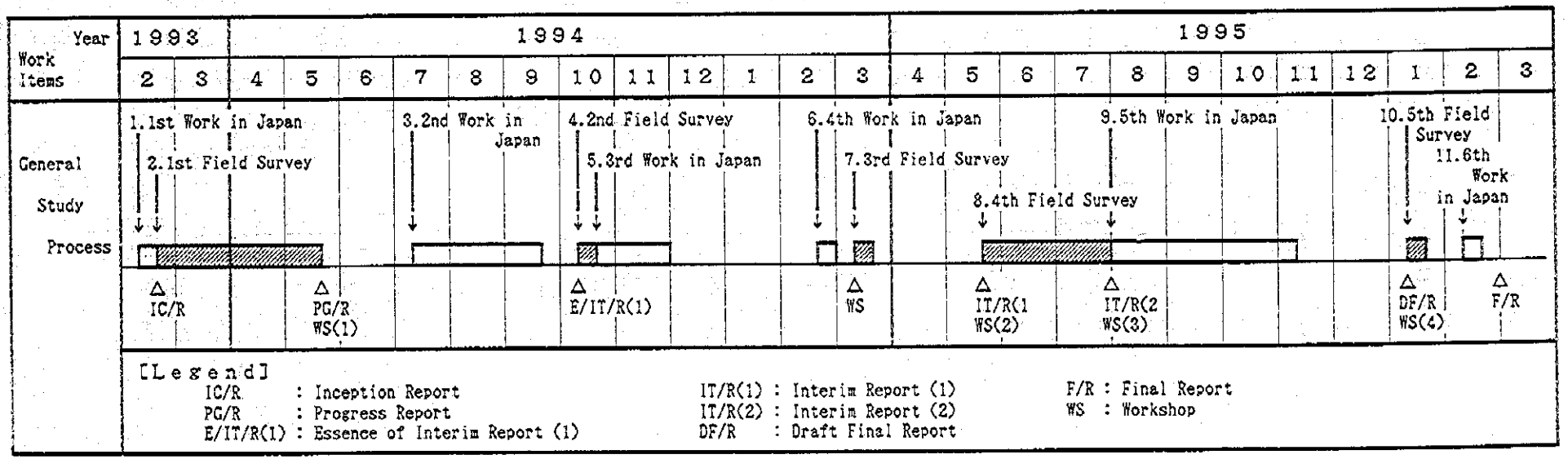
The Objectives of the Study are, in accordance with the Scope of Work agreed on July 12th, 1993 between the Government of Viet Nam and JICA, to prepare a master plan for the rehabilitation and improvement of the north-south trunk railway line with the target year of 2010, to conduct feasibility studies on the high priority projects of the north-south trunk railway line based on the above Master Plan and also to conduct feasibility studies on high priority projects selected from the Lao Cai – Cai Lan/Hai Phong Line and Hanoi – Lang Son line based on the JICA's Master Plan Study on the Transport Development in the Northern Part of Viet Nam (Lao Cai – Cai Lan line was selected). During the Study, efforts has been made to transfer the relevant technologies/ techniques to the Vietnamese side though the exchange of opinions and workshops, etc.

The subject area of the Master Plan to be prepared covers the railway section of 1,726km between Hanoi and Ho Chi Minh. In the case of the feasibility studies, the study area is the area of a priority project identified by the above Master Plan and also a priority project selected from the Lao Cai – Cai Lan/Hai Phong Line and Hanoi – Lang Son Line identified by the Master Plan Study on the Transport Development in the Northern Part in Viet Nam.

1.3 Schedule for the Study

Schedule for the Feasibility Studies on the Rehabilitation and Improvement of the Railway Vietnam is shown in Fig. 1.1.

Fig.1.1 Schedule for the Feasibility Study on the Rehailitation and Improvement of the Railway in Viet Nam

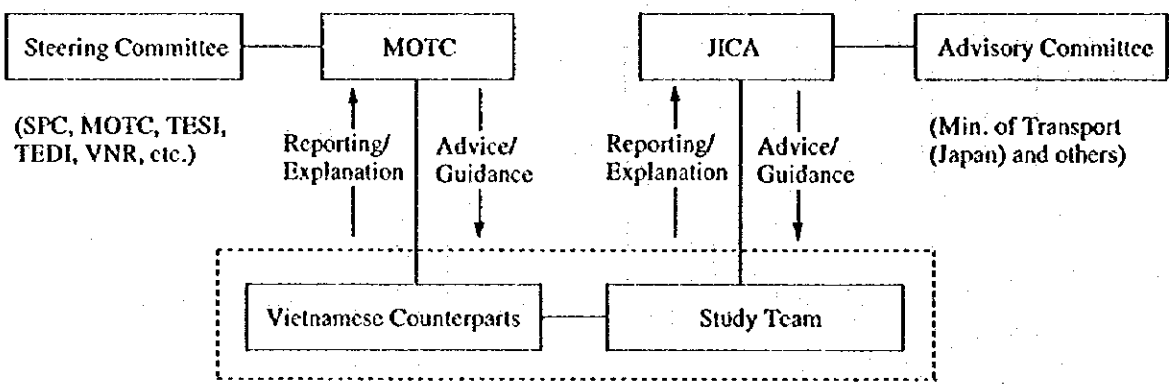


Legend : ——— Preparatory Period ▨ Field Survey Period □ Work in Japan Period △——△ Explanation of Report ····· Other Work

1.4 Organization for the Study

For the implementation of the Study, a Study Team consisting of Japanese railway experts was organized by JICA. Similarly, a team of counterparts consisting of senior staff members of the TEDI and VNR (responsible for Hanoi-Hochi Minh Railway Line) and VRDI (responsible for Lao Cai Cai Len Railway Line) was organized by the Vietnamese side. The JICA Study Team has conducted the Study in close cooperation with the counterpart team.

JICA also established an Advisory Committee consisting of senior officials of the Ministry of Transport in Japan to guide the Study Team and to ensure the smooth implementation of the Study. On the Vietnamese side, a Steering Committee was established consisting of representatives of such organizations as the SPC, MOTC, TESI, TEDI and VNR, etc. to provide guidance, advice and recommendations for the smooth completion of the Study by the Study Team. The members of the Advisory Committee and the Study Team and the JICA coordinator for the Study are listed below.



(1) Advisory Committee

Name	Work Assignment	Current Position
Kazuo Notake	Chairman	Director, Technology Development Office, Technology Planning Division, Railway Bureau, Ministry of Transport
Toshio Ikari	Railway Facilities Planning	Chief, First Technology Section, Railway Division, Kinki Transportation Bureau, Ministry of Transport
Masayuki Fuji	Railway Planning	Chief, Oshiage Office, Construction Headquarters, Tokyo Rapid Transit Authority

(2) JICA

Name	Work Assignment	Current Position
Kazufumi Shiii	Study Supervision (1994. 2 - 1995. 9)	First Social Development Study Division, Social Development Study Department, JICA
Shoichi Tsugane	Study Supervision (1995. 10 - 1996. 2)	

(3) Study Team

Name	Work Assignment
Sadaaki Kuroda	Team Leader/General Management
Korehide Miyaguchi	Deputy Team Leader/Basic Planning (1995. 4 - 1996. 2)
Nobuo Osawa	Deputy Team Leader/Basic Planning (1994. 2 - 1995. 3)
Akira Tamura	Subsidiary Basic Planning (1995. 4 - 1996. 2)
Isamu Yoshitake	Transportation Planning
Toshiaki Saiko	Stations/Track/Disaster Prevention Planning
Tsuneo Hashimoto	Structure Planning (1995. 4 - 1996. 2)
Ikujiro Kikuta	Structure Planning (1994. 2 - 1995. 3)
Shigeru Doi	Structure Planning (1994. 2 - 1995. 3)
Koji Terado	Rolling Stock and Workshop Planning (I)
Misao Hasegawa	Rolling Stock and Workshop Planning (II)
Masahiko Yamamoto	Signaling and Communication Planning (1995. 4 - 1996. 2)
Tohru Igarashi	Signaling and Communication Planning (1994. 2 - 1995. 3)
Kunihisa Sugiyama	Marketing Planning (1995. 4 - 1996. 2)
Katsuo Hayashi	Financial Analysis
Kiminari Tachiyama	Management Analysis (1995. 4 - 1996. 2)
Akihisa Kojima	Developing Economy/Economic Analysis
Hideo Arikawa	Demand Forecast (I)
Junji Shibata	Demand Forecast (II) (1995. 4 - 1996. 2)
Shunji Sato	Structural Design and Construction
Teruo Otsuki	Station Design and Construction
Kazunori Ishikawa	Signal and Communication Design and Construction
Tomotaka Ichimura	Rolling Stock and Workshop Design (1995. 4 -1996. 2)
Hiroshi Takagi	Rolling Stock and Workshop Design (1994. 2 - 1995. 3)
Shogo Shibata	Natural Conditions
Akinori Sato	Environmental Impacts Assessment (1995. 4 -1996. 2)
Sanpei Nakanishi	Environmental Impacts Assessment (1994. 2 - 1995. 3)

(4) Vietnamese side Counterpart

Hanoi-Ho Chi Minh line

Name	Assignment	Office
Mr. Nguyen Van Luong	Leader	TEDI
Mr. Nguyen Tien Toi	Deputy leader	VNR
Mr. Ngo Ngoc Tran	Transport Economy	TEDI
Mr. Le Bao Vinh	Planning	TEDI
Mr. Nguyen Ngoc Long	Bridge, Tunnel	TEDI
Mr. Tang Van Thin	Bridge	TEDI
Mr. Vo Duy Hoa	Station	TEDI
Mr. Nguyen Minh Thang	Track	TEDI
Mr. Dang Vu Binh	Signalling, Communication	VNR
Ms. Do Thi Hoa	Signalling, Communication	TEDI
Mr. Doan Trong Dinh	Rolling Stock, Workshop	VNR
Mr. Nguyen Xuan Hung	Rolling Stock, Workshop	VNR
Mr. Dang Dinh Tieu	Economy	VNR
Mr. Pham The Khai	Cost Estimate	TEDI
Mr. Le Bao Vinh	Hydrology	TEDI
Mr. Nguyen Van Cuong	Technical Geology	TEDI
Mr. Do Ban	Hydrology	TEDI

Lao Cai-Cai Lan line

Name	Assignment	Office
Mr. Pham Manh Thuong	Leader	VRDI
Mr. Nguyen Thanh Tinh	Deputy leader	VRDI
Mr. Pham Van Lan	Bridge	VRDI
Mr. Nguyen Van Quynh	Bridge	VRDI
Mr. Tran Van Su	Track	VRDI
Ms. Ho Thi Dung	Track	VRDI
Ms. Bui Thi Minh Thu	Station	VRDI
Mr. Ha Trung Nghia	Station	VRDI
Ms. Nguyen Thi Xuan Phong	Communication	VRDI
Ms. Nguyen Thi Ngoc Chau	Signalling	VRDI
Mr. Doan Trong Dinh	Locomotive	VRDI
Mr. Pham Xuan Hung	Coach	VRDI
Mr. Nguyen Ba Nha	Geology	VRDI

CHAPTER 2 CURRENT NATURAL, ENVIRONMENTAL AND SOCIO-ECONOMIC CONDITIONS

2.1 Natural Conditions

Vietnam stretches in a S-shaped form in the north-south along the eastern coast of Indochina. The Changshan Mountains run along the western border with Laos while the eastern coast facing the South China Sea is as long as some 3,260 km. The total land area is approximately 331,000 km^2 and mountains and highlands accounts for three-quarters of the national land.

Topographic structure is diverse in Vietnam, with three constituent parts: mountains, plains and sea, resulting from cycles of tectonic activity and at the same time exposed to the effects of a humid tropical monsoon climate accounting for the differences among the three.

As far as geological structure is concerned, the territory of Vietnam, and of Southeast Asia stands at the point where ancient continents met resulting in extremely complicated structures. The active geosynclines of Indochina were reborn from an ancient Euro - Asia foundation of the pre-Cambrian age. The tectonic activities of the Indochinese geological block ended in the Mesozoic era and left their mark in the form of the Truong Son Range.

Vietnam has a humid tropical climate heavily influenced by the monsoon regime prevailing in Southeast Asia.

Vietnam's territory contains no less than 64 categories of soil coming within 14 groups which can in turn be classified into four main species - alluvial soils, eroded and poor soils, red and yellow soils, and humus on the high mountains.

There is no earthquake recorded in Vietnam, during last fifty years.

The records of inundation on railway tracks between Hanoi and Ho Chi Minh during the period 1931 -1990 can indicate the location and the track length of inundation, spots which had been covered with water, and the location of the collapsed banks.

2.2 Environmental Conditions

It is judged that there are not so serious environmental problems concerning with the existing North-South Railway. However, the following matters call attentions.

(1) Legislation, environmental impact assessment systems and environmental standards:

(2) Dwellings along railway in urban areas

(3) Sanitary conditions of railway car

(4) Water pollution around workshops at the depot

(5) Noise and vibration along the railway

As for the social environment is concerned, some issues are noticed.

(1) Dwellings along Railway in Urban Areas and Resettlement

There are some houses extraordinarily close to the railway track in Hanoi city and some other areas. There are no equipment installed to guarantee a safety of train operation and inhabitants' lives.

(2) Public Health

Sanitary conditions of coaches itself is poor. Passenger coaches do not facilitate any evacuation tank, and pollutants are dumped into the track without any treatment. Periodical cleaning and/or medicine sprinkling has not been carried out by VNR.

(3) Waste

Hanoi-Ho Chi Minh line almost passes the cultivated areas of low lands or residential areas and partly passes the artificial woods. However, it does not pass the designated reserved areas. The Railway passes closest near the Bac Ma Hai Van Reserved Area for endemic and rare species situated in Thua Thien - Hue Province. However, the distance is several kilometers from the existing railway. Therefore, the existing railway operation has no environmental impact on this item.

2.3 Socio-economic Conditions

(1) Population

Population Census was conducted in 1989, and provides the most reliable population data. Total population is 64.4 million, and its growth rate 2.1% per year between 1979-1989, recording rather high growth rate.

Table 2.3.1 Spatial Distribution of Population

Region	Land	Population	
		1979	1989
Whole country	100.0	100.0	100.0
Northern Uplands	16.4	15.3	15.9
Red River Delta	8.6	21.7	21.4
North Central	11.3	13.8	13.5
Central Coast	9.4	11.0	10.5
Central Highlands	13.9	2.9	3.9
Southeast	10.8	11.9	12.3
Mekong River Delta	29.6	23.4	22.4

Source; Vietnam Population Census 1989, The Population of Vietnam, Statistical Publishing House 1992.

Population of base year, 1994 is estimated by expanding the figures of 1989 at the rate of population growth rate between 1979-1989, and then adjusted proportionally according to the 72.0 million (official figure of the General Statistics Department).

(2) Gross Domestic Products

GDP figures of the whole state in the past are summarized in Table 2.3.2.

Whole Vietnamese economy has experienced a steady growth at higher rates compared with the surrounding Asian countries, ranging 6.1% in 1991 to 7.5% in 1993 (at the 1989 prices). In the nearest future, it is expected to reach at 8% in 1994 and 9.0% in 1995. It is really climbing at an accelerated rate. This phenomenon is boosted by the industrial sector, which marked the growth rates ranging from 10.4% to 15.3%. Significance of industry sector is apparent when

compared with the agricultural sector that experienced rather stagnating rate of growth from 2.9% to 4.2%, except extraordinary expansion in 1992. It is also noteworthy that the output of industrial sector overwhelmed that of agricultural sector in 1993.

Table 2.3.2 GDP Performance

	1991	1992	1993	1994 (planned)	1995 (planned)
GDP (bil. dong in 1989 prices)	28,651	30,988	33,310	36,000	39,250
GDP Growth Rate (%)	6.1%	8.1% (8.6%)*	7.5% (8.1%)*	8.0%	9.0%

Source; Vietnam in 1993 and Socio-Economic Prospects for 1994-1995. The GIOI Publisher, 1993.

(*) indicates the different figures released by General Statistical Office,

Table 2.3.3 Economic Performance by Region

Region	Annual Growth Rate (1990-1992)			Share (%)	
	Agri.	Industry	Total	1990	1992
North Mountain and Midland	3.1%	10.6%	6.1%	11.4%	10.7%
Red River Delta	6.1%	2.4%	4.4%	18.1%	16.3%
Central Coast and Northland	4.4%	9.1%	5.9%	7.2%	6.7%
Central Coast and Southland	5.0%	4.6%	4.8%	8.5%	7.7%
Central Highland	10.7%	9.7%	10.5%	2.5%	2.6%
North East of Southland	7.4%	22.6%	19.9%	25.3%	30.1%
Mekong River Delta	7.2%	9.5%	7.9%	25.9%	25.9%

Source; same as Table 2.3.2.

(3) Budgetary Condition

Table 2.3.4 shows the trend of the state budget since 1990. Budget balance and the components of revenue and expenditure are clarified in the table. Most apparent features are a rapid expansion both in revenue and expenditure since 1992. Proportionally budget deficit had sharply increased up to 1994. In addition, the share of deficit against GDP shows a high rate of expansion.

Table 2.3.4 State Budget

Item	1990	1991	1992	1993 (estimated)	1994 (planned)
Budget Revenue	8,109	10,613	18,970	29,895	38,660
Budget Expenditures	9,285	12,081	22,815	36,590	46,510
Balance	-1,176	-1,468	-3,845	-6,695	-7,850
Share of Budget Deficit against GDP (%)	3.1%	2.1%	3.8%	5.4%	5.2%
Revenue Items					
Taxes and Fees	6,249	10,083	18,400	26,740	35,200
Loans and Amortization	1,860	530	570	3,155	3,340
Expenditure Items					
Regular Expenditure	6,257	8,728	15,005	23,860	30,600
Development Investment	2,123	2,135	n.a.	9,540	10,300
- Industry	736	420	n.a.	5,692	2,226
- Transport & Communication	399	508	n.a.	979	2,428
- Others	988	1,207	n.a.	2,869	5,646
Payment of Debts and Loan	905	1,218	2,100	1,610	3,110

Note; Items of the state budget revenue have been revised into new formation since 1994. Figures in this table are compiled based on the data of the Ministry of Finance.

(n.a.) stands for "not available."

Among five transport sectors, a share of railway has been declining up to 9.9% in 1993, averaging at 11.4% in a period 1990-1993.

Table 2.3.5 Budget Distribution among Each Transport Sector

Sector	1990	1991	1992	1993
Railway	7.9%	15.7%	12.2%	9.9%
Road	83.3%	66.4%	74.8%	76.8%
Inland Waterway	1.5%	2.9%	0%	1.2%
Sea Port	3.4%	8.8%	3.8%	3.2%
Aviation	4.0%	6.2%	9.2%	8.9%

Source; (1) Vietnam; Economy and Finance of Vietnam, 1986-1992, and

(2) Economic and Development Resource Center, Asian Development Bank, 1993.

CHAPTER 3 DEVELOPMENT FRAMEWORK

3.1 DEVELOPMENT POLICY

(1) "Doi Moi" Policy and Recent Trends

The Vietnamese government commenced its "Doi Moi" policy in 1987, which means "Changes for Building a New Country". Its four main policy and other national development policies are summarized with their diagrammatic relationships in Figure 3.1-1. This "Doi Moi" policy is outlines all the other policies.

(2) Development Policy and Strategy

The basic framework of the development policy and the strategy of the Vietnamese government is clarified in "Stability and Development Strategy for the Economy and Society by the Year 2000." The Vietnamese government intents to learn some lessens from the development experiences of other developing counties, and formulates its own "catch-up" development plan.

(3) "Guidance" for Transportation Sector Development

This guidance for the transportation sector development is a break-down of the previous national development policy and strategy towards the year 2000, and provides more concrete principles specific to the transport sector.

3.2 FUTURE SOCIO-ECONOMIC FRAMEWORK

(1) Population

There are three kinds of population projection available as shown in Table 3.2.1, and in this study the population scenario 3 are employed as a socio-economic framework. This is because the growth rate of population is set most moderately compared with that of 2.1% in the period 1979-1989.

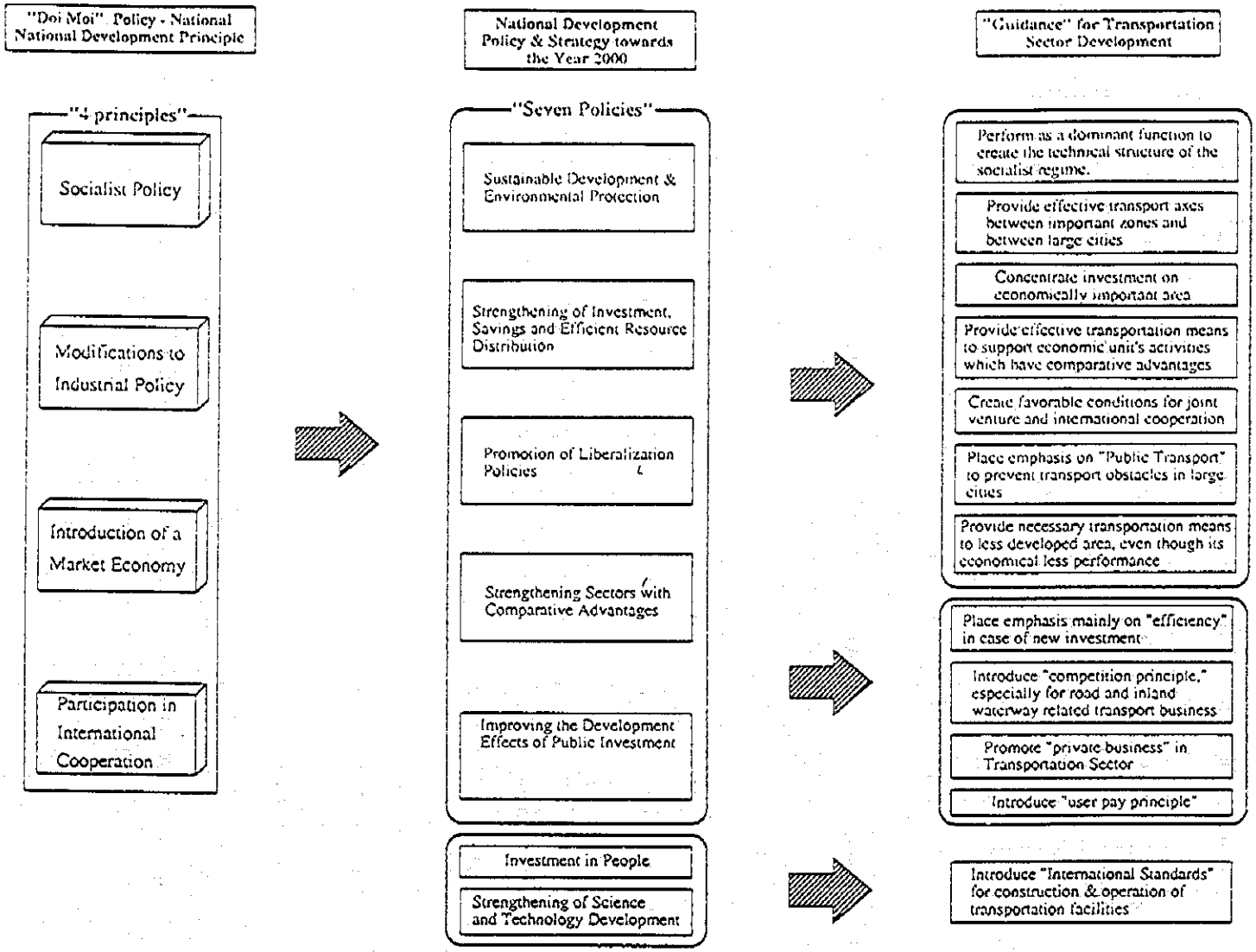


Figure 3.1.1 Relationship of Relevant Policies

Table 3.2.1 Population Forecast

	Population (unit; million persons)				Growth Rate (% per annum)	
	1993	1995	2000	2010	1995 - 2000	2001 - 2010
Projection 1	72.0	75.0	82.0	95.0	1.80%	1.48%
Projection 2	70.2	73.2	80.2	91.6	1.84%	1.34%
Projection 3 (The Study Team)	69.8 (1992)	73.0	80.3	93.5	1.92%	1.53%

Note; Scenario 1 is compiled by the General Statistics Department. These figures are tabulated together with GDP scenarios.

Scenario 2 is quoted from "Vietnam Population Census - 1989, The Population of Vietnam," Statistical Publishing House, 1992. Figures are forecast at 1994, 1999, 2004, and 2009. Those were adjusted into the each target year by interpolated.

"Projection 3; 69.8 million in 1992" is quoted from "Vietnam; Economy and finance of Vietnam, 1986-1992." This figure is equivalent to 71.3 million in 1993.

(2) Gross Domestic Products

This study employed the SPC's highest growth scenario as requested by the SPC. Since there are some vulnerability on assumptions such as saving ratio, financial infrastructure and investment ratio, it should be carefully observed how the economy will grow in the future.

Table 3.2.2 Growth Scenarios

	Per Capita GDP (US$)	Growth Rate		
	1993	1994-95	1996-2000	2001-2010
SPC Scenario 1 (Low Growth)	263	8.6%	9.8%	10.0%
SPC Scenario 2 (High Growth)	263	9.0%	10.7%	11.5%
Northern VN M/P Scenario	240	7.0%	7.0%	10.0%
This Study's Scenario	263	9.0%	10.7%	11.5%

(3) Estimated Scale of State Budget for Transport Sector

This analysis concluded that the total amount of 1,876 million US dollar can be funded at the maximum by the state government from its own expense. This fund will be invested to the railway sector over the whole nation.

Vietnam government has given a priority allocation of budget to transportation. However this policy may be further accelerated or decelerated in the future, which depends on the growth performance. Table 3.2.3 indicates targets.

Table 3.2.3 Estimated Fund for Railway Investment

(unit; million US$)

Items	1994-2000	2001- 2005	2006-2010	1994-2010
3 % of GDP	186	483	1,008	1.632
	(26.6)	(96.6)	(201.6)	(96.0)
3% of GDP and Priority Allocation of 15% of Increment in Construction Investment	365	463	1.047	1,876
	(52.1)	(92.6)	(209.4)	(110.4)

Note; ( ) indicates annual figures.

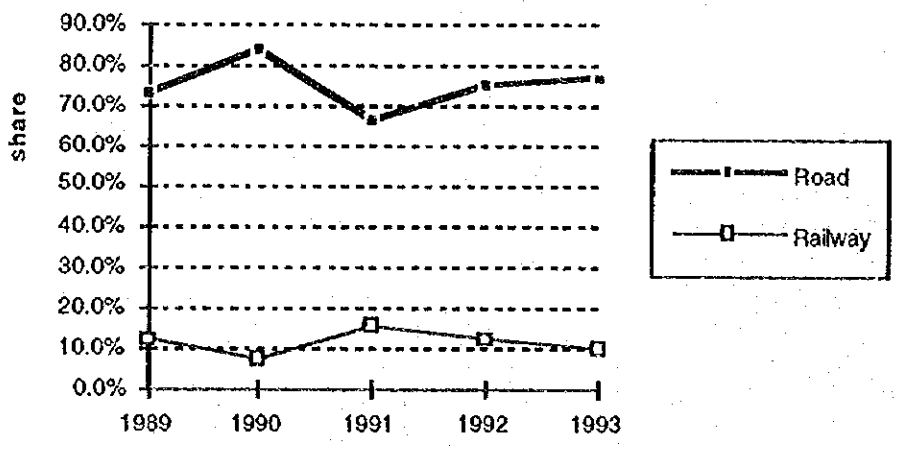


Figure 3.2.1 Share of Railway and Road Investment Budget

In compared with the investment amounts of each implementation stage, a shortage in investment cost during initial period can be paid back by the surplus of budget of railway sector in the period 2005-2010. This is also diagrammatically shown in Figure 3.2.2.

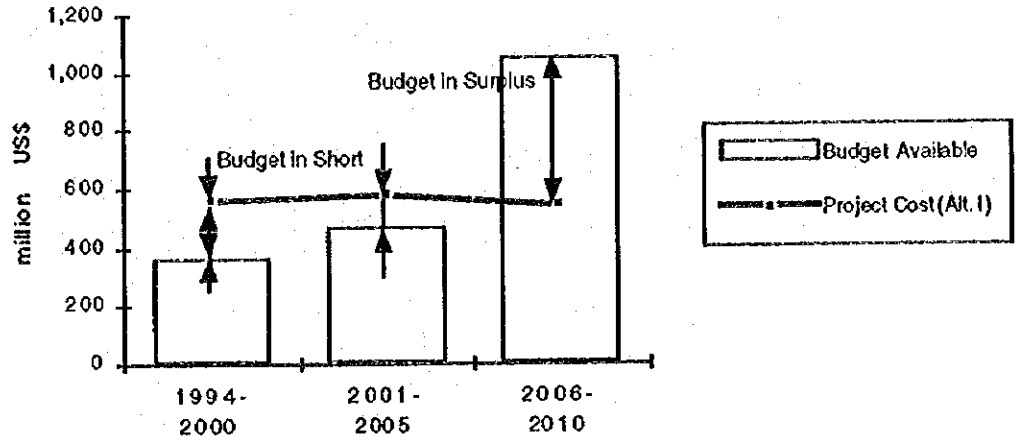


Figure 3.2.2 Actual Investment Cost and Budget Available

3.3 Spatial Development Plan

Three kinds of development plan were reviewed: industrial development plan, infrastructure development plan that covers road, port, air port, and tourism development plans. Road development plan is explained, which can be a competitor of the railway.

National Road 1 (Lang Son - Hanoi - Da Nang - HCMC - Can Tho) runs parallel to the North-South Railway line. And its improvement plan has covered almost 1,422 kilometers, more than 80% of the section between Hanoi and Ho Chi Minh City by 1997.

Table 3.3.1 Improvement Plan of National Road 1

	Section	Kilometer	No. of Lanes	Completion Date	Fund
Section of D/D completed					
1.	Hanoi - Vinh	184 - 463	2	End of 1997	IBRD loan
2.	HCMC - Can Tho	1915 - 2055	2	End of 1997	IBRD loan
3.	Nha Trang - HCMC	1451 - 1900	2	End of 1997	ADB loan
Section of F/S offered					
4.	Dong Ha - Nha Trang	757 - 1451	2	n.a.	ADB loan
5.	Lang Son - Hanoi	0 - 184	2	n.a.	ADB loan

Note;
- Two (2) lanes with 7.5 meter in width.
- Bicycle lanes attached on both sides.
- n.a. indicates "information not available."

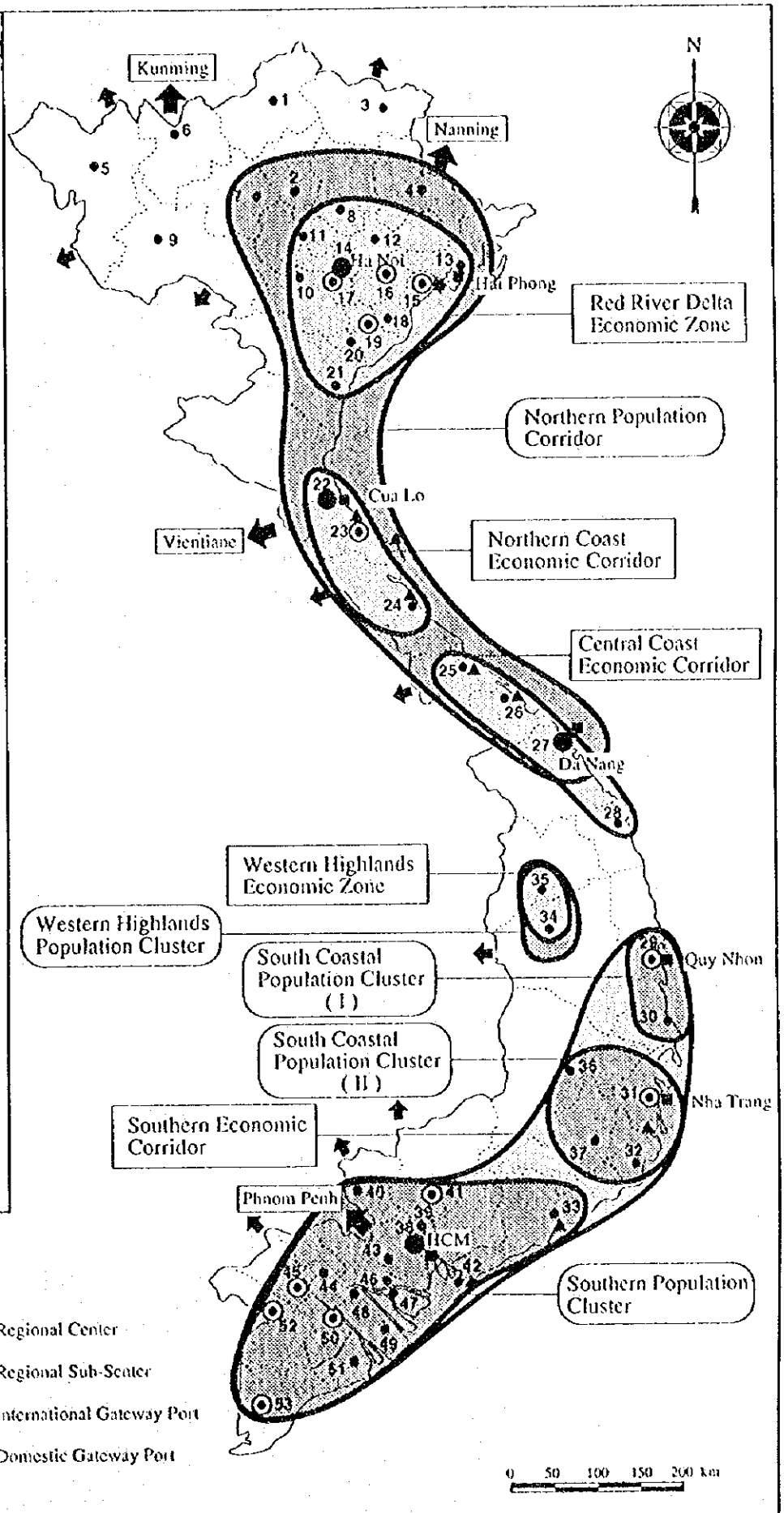
3.4 Regional Setting

It is essential to recognize spatial structure of linkage between the places for an advanced transportation planning.

Cluster is formed by cities being interconnected each other. Future interconnections are guided by expected intra- and inter-transactions of people and commodities. The magnitude of transactions, being considered that it is proportional to scale of socio-economy of the cities and in inverse proportion to distances between them, it could be estimated by using an analogy of a gravity model.

Results are shown in Figure 3.4.1.

Region / Province	GDP (Mil. US $)	Population (Thousand)
TOTAL	72.717	95.000
I Northern Mountain	6.580	16.496
1 Ha Giang	154	674
2 Tuyen Quang	215	824
3 Cao Bang	202	820
4 Lang Son	285	889
5 Lai Chau	209	652
6 Lao Cai	207	689
7 Yen Bai	393	866
8 Bac Thai	723	1.571
9 Son La	338	1.015
10 Hoa Binh	361	956
11 Vinh Phu	1.097	2.962
12 Ha Bac	958	3.216
13 Quang Ninh	1.438	1.352
II Red River Delta	16.756	18.907
14 Ha Noi	5.450	3.128
15 Hai Phong	3.595	2.346
16 Hai Hung	2.150	3.574
17 Ha Tay	1.748	3.016
18 Thai Binh	1.031	2.311
19 Nam Ha	2.195	3.436
20 Ninh Binh	587	1.006
III North Coastal	5.866	12.887
21 Thanh Hoa	1.808	4.501
22 Nghe An	1.300	3.436
23 Ha Tinh	1.040	1.715
24 Quang Binh	410	1.028
25 Quang Tri	438	762
26 Thua Thien-Hue	870	1.445
IV South Coastal	10.670	10.571
27 Quang Nam-Da Nang	3.909	2.268
28 Quang Ngai	672	1.478
29 Binh Dinh	1.481	1.823
30 Phu Yen	763	936
31 Khanh Hoa	1.844	1.301
32 Ninh Thuan	936	1.593
33 Binh Thuan	1.065	1.172
V Western Highlands	3.657	4.866
34 Gia Lai	600	1.031
35 Kon Tum	502	371
36 Dac Lac	1.308	2.251
37 Lam Dong	1.247	1.213
VI Eastern Nam Bo	14.334	11.903
38 T.P Ho Chi Minh	8.528	5.728
39 Song Be	589	1.680
40 Tay Ninh	753	962
41 Dong Nai	4.213	2.411
42 Ba Ria-Vung Tau	251	1.122
VII Mekong River Delta	14.854	19.362
43 Long An	1.189	1.475
44 Dong Thap	1.105	1.844
45 An Giang	2.178	2.354
46 Tien Giang	1.303	2.017
47 Ben Tre	703	1.561
48 Vinh Long	804	1.274
49 Tra Vinh	479	1.119
50 Can Tho	2.540	2.324
51 Soc Trang	1.032	1.449
52 Kien Giang	1.506	1.721
53 Minh Hai	1.885	2.229



LEGEND

- Regional Cluster of Primary Level (Pop)
- Regional Cluster of Primary Level (GDP)
- International Inland Interface
- Regional Center
- Regional Sub-Center
- International Gateway Port
- Domestic Gateway Port

Figure 3.3.1 Overlayed Primary Regional Clusters

CHAPTER 4 OVERALL TRANSPORT SITUATIONS

4.1 Overview of Base Year Conditions

Passengers have a choice of traveling by rail, by road, or by air transportation. The most popular traffic mode by the travelers and commuters are bus and automobiles. The share of railway is about 5% as shown in Figure 4.1.1. Share of air traffic is very small.

Cargo load is transported mostly by trucks. The percentage of truck freight is about 67% in the year 1994, which is relatively low compared to the percentage of passengers, because railway, inland waterway and coastal shipping are also available for cargo freights. The share of each mode are shown in Figure 4.1.2. Total volume of cargo trips is 60.5 million tons.

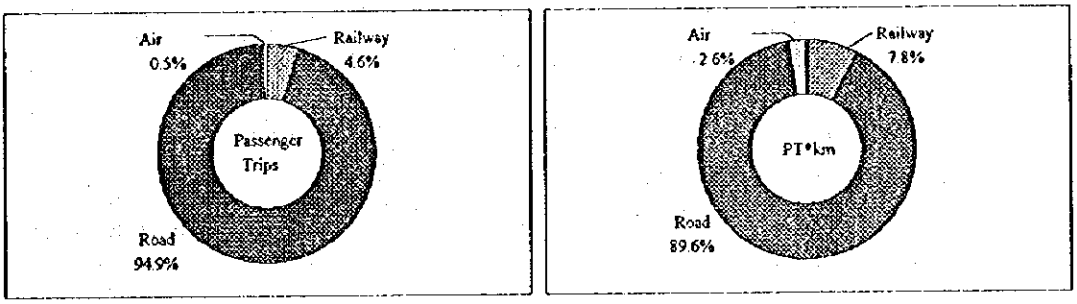
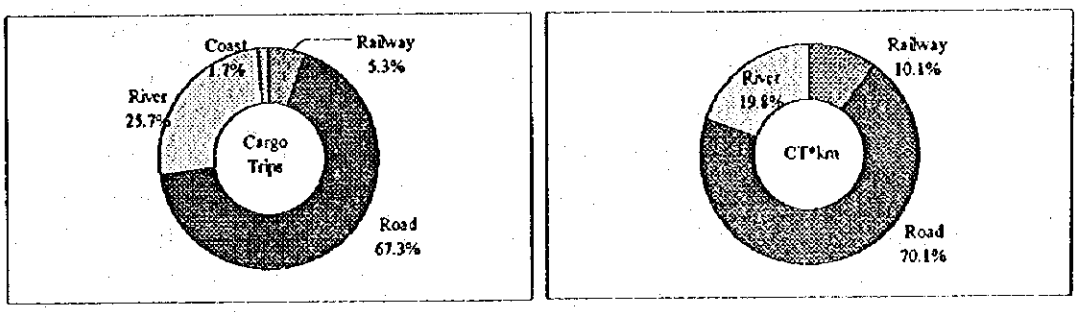


Figure 4.1.1 Passengers Analysis by Transportation (1994)



*) The volume of CT*km by coastal shipping is unknown.

Figure 4.1.2 Cargo Analysis by Transportation (1994)

4.2 Railway Demand

The number of passenger trips using railway stations is 8.8 million. The largest figure is generated in the Hanoi zone, reaching approximately 1.6 million trips in the year 1994. The second largest number is marked in the Ho Chi Minh City zone. Hanoi - Ho Chi Minh line transported 5 million trips, which is 57% of the railway passenger trips in Vietnam. The number of passenger along the Lao Cai line was 2.2 million, including connecting trips to/from other lines. The number at stations in the Quang Ninh zone and Ha Bac was 0.6 million trips.

Total volume of cargoes handled by railway was 3.2 million tons in the year 1994. The volume is almost the same as in the year 1993, but it has been growing up since the year 1990. The share of Hanoi - Ho Chi Minh line is 60% including cargoes that go to/from other lines.

But these numbers are based on the current preference of transportation model. If railways can prove that they are much more comfortable and convenient than using airplanes or buses, there is a possibility that the preference model itself will change. The quality of service is another key factor in increasing railway demand, in addition to time savings and cost saving.

On the other hand, the demand for air travel will increase to 11 million trips. However, the Vietnam Aviation Bureau only plans for expansion to 7 million trips, and that there will exist the excess demand of the aviation traffic. It is assumed in this study that the excess demand of aviation will convert to road traffic.

4.3 Road Transportation

Figure 4.3.1 shows the average daily traffic excluding motor cycle on the National Route 1. Rather heavy vehicular volumes are observed at the section between Hanoi - Thanh Hoa, around cities of Vinh, Da Nang, Qui Nhon and Ho Chi Minh. This traffic count data will be used for modifying the roadway passenger OD matrix developed in the Master Plan.

Total volume of traffic generation and attraction of Hanoi accounts for 74,000 in non-motorized-vehicle (NMV), 90,000 in motor cycle (MC), and 24,000 in motorized vehicle of more than four wheels (MV). More than 80 % of traffic is made by NMV and MC, while only 13 % of traffic is made by MV.

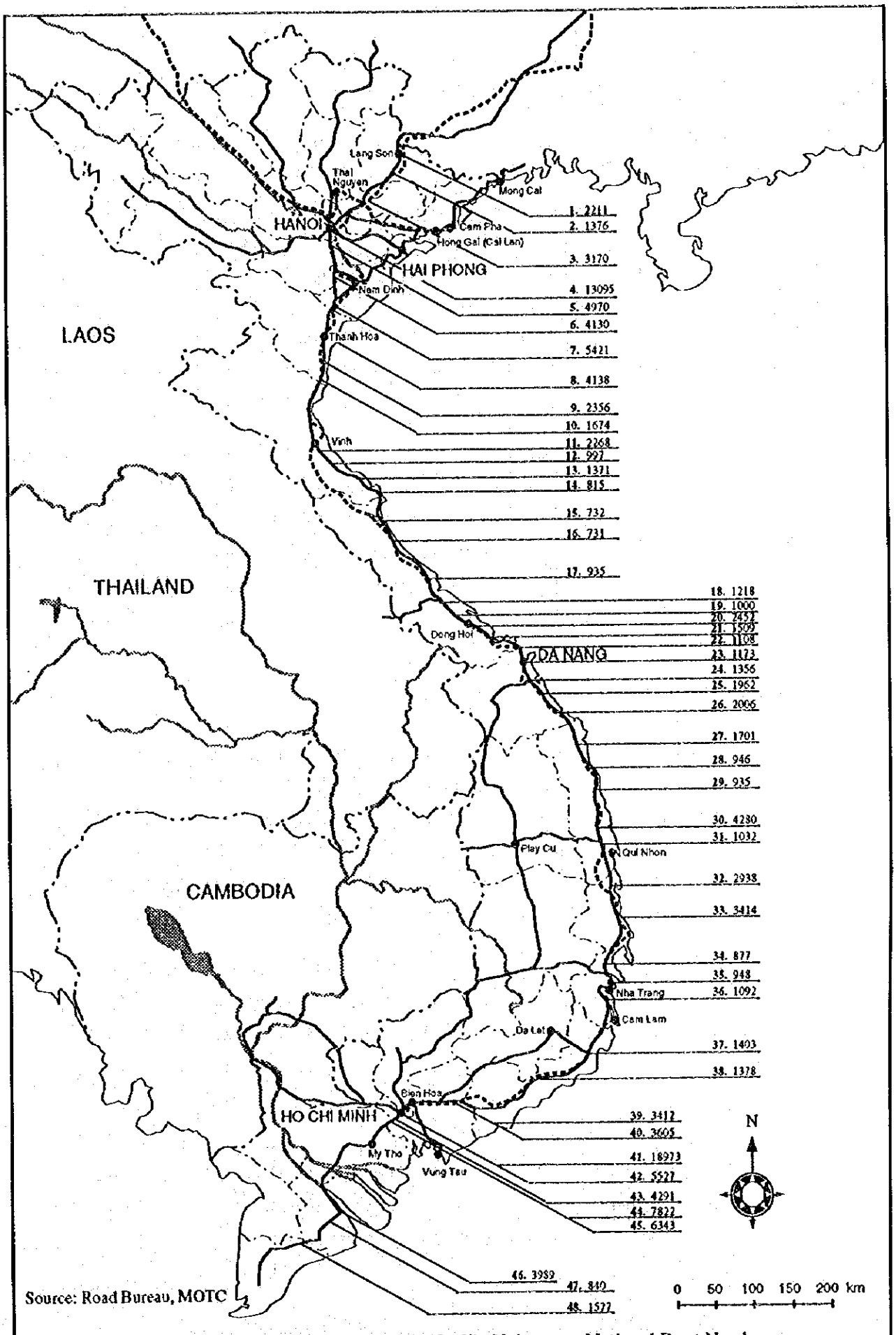


Figure 4.3.1 Average Daily Traffic Volume on National Root No. 1

4.4 Air Transportation

Airlines carried 0.25 million passengers in 1993 according to the government statistics. Major airport to airport passenger OD matrix in the year 1993 was obtained. According to the matrix, the needs of air transportation between Hanoi and Ho Chi Minh city was 180 thousand passengers in one way trip counts. The third largest airport was Da Nang. The air fare is relatively cheap, judging from the time needed for traveling, but absolutely expensive as compared with average income level of the average Vietnamese people. Thus the majority of the passengers are people with high-income, and for official purpose. But in the future this mode will be more popular as GDP per capita increase and become competitive traffic mode to land transport, especially for a long-distance trip such as trips between Hanoi - Ho Chi Minh city.

Air cargo was 1.4 thousand tons from Hanoi and 2 thousand tons from Ho Chi Minh city in the year 1993. The volume in these years are currently very small. The target demand by the government in the year 2010 is 3 thousand tons from Hanoi and 7.6 thousand tons from Ho Chi Minh city including international cargo. The small volume is not expected to increase very much by the year 2010, so it is decided to exclude air cargo from the modal split model in this study.

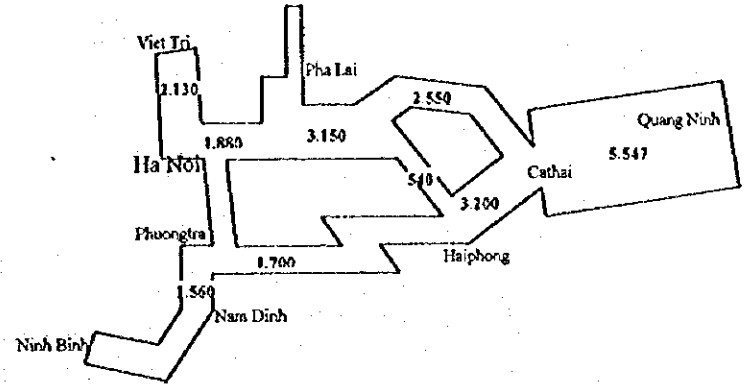
4.5 Inland waterway

The Red river delta and the Mekong river delta form important networks for cargo transportation. In the Red river delta total volume of cargo is about 8.8 million tons and in the Mekong river delta it is 7.8 million tons in the year 1995 according to the estimation by Vietnam Inland Waterway Bureau. Major items of cargo are construction materials (4.2 million tons) and coal (4 million tons) in the Red river delta. In the Mekong river delta, they are agricultural products (3.5 million tons) and construction materials (2.5 million tons).

The transport system by inland waterways is competitive with railways only in the northern regions. The route between Hanoi and Hai Phong connects with Quang Ninh through the sea and the other direction reaches to Viet Tri. The details of cargo volume in each section is shown in Figure 4.5.1.

4.6 Coastal Shipping

Total cargo volume of major coastal ports shows increase in recent years by MOT statistics. Increases amount 10 million tons in the year 1993, and consists of export/import cargo. The volume of domestic cargo is consistently about 2 million tons.



Source: Vietnam Inland Waterway Bureau

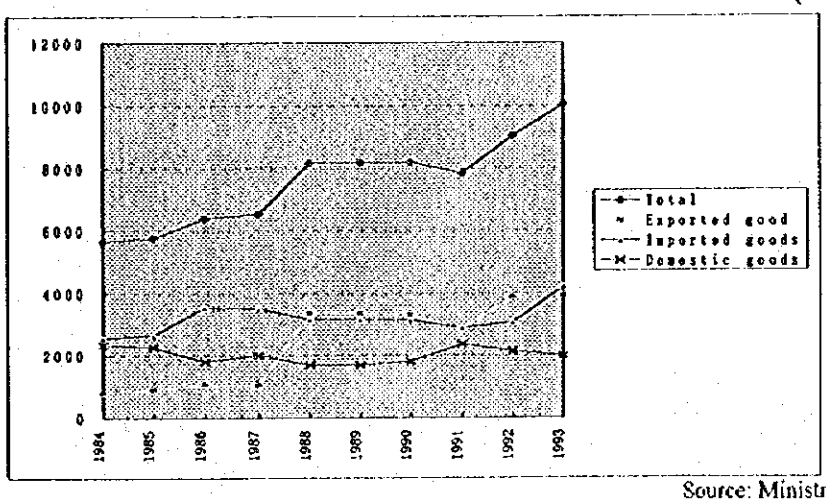
Figure 4.5.1 Cargo Flow in the Year 1995 (unit: 000 tons)

On domestic cargo, the analysis of the transport between railway and coastal shipping needs two kinds of data, the demand matrix from/to ports to/from inland and the cargo flows among ports. But these data are not available at present, so any traffic models with the demand of coastal shipping cannot be prepared until those research will be completed in the near future.

Nevertheless, export/import cargoes that build up the most of the cargoes at major ports have to be transported from the port toward inland or vice versa by road, railway or inland waterway. So it will co-exist and not compete with other traffic modes.

The demand of traffic between the port and inland towns depends on the cargo volume which each port can handle. In this study we consider the plan of Cai Lan port for demand forecast by estimating the share of railway in cargo items.

(Unit: 000 ton)



Source: Ministry of Transport

Figure 4.6.1 Cargo Volume

CHAPTER 5 CURRENT RAILWAYS PROFILE

5.1 Introduction

The existing routes, commercial distances and gauge of the Vietnam National Railways are shown in Fig. 5.1-1. The aggregate length of the meter gauge sections is 2,265.3 km while the standard gauge sections total 161.6 km. With the combined use of meter gauge and standard gauge covering 222.0 km, the total commercial distance is 2,648.9 km.

Table 5.1-1 compares the details of the Hanoi - Ho Chi Minh Railway and railway lines in northern Vietnam. From this Table, the Significance of Hanoi-Hochi Minh Line can be identified.

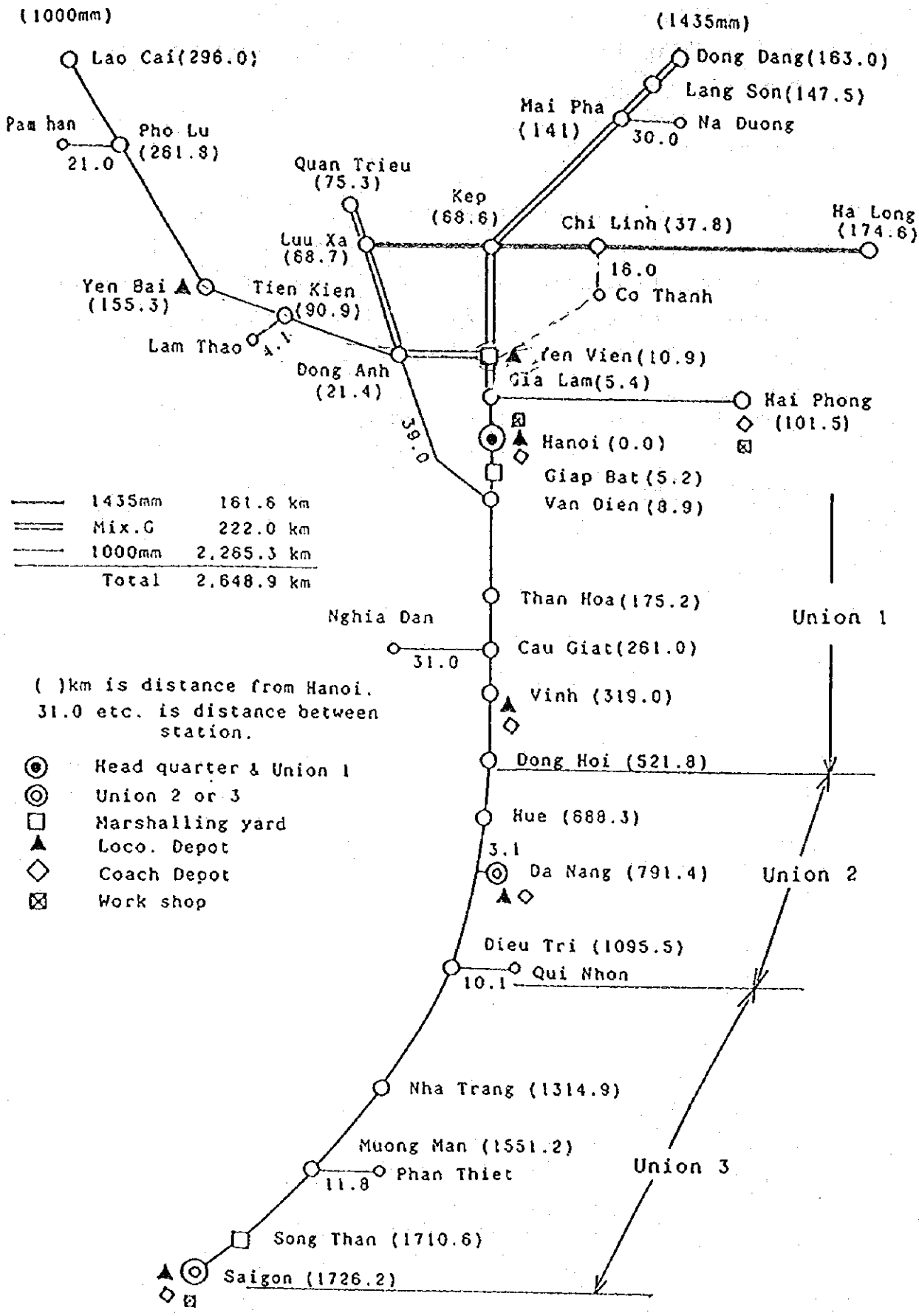


Fig.5.1-1 Railway Routes and Commercial Distances (VNR)

Table 5.1-1 Comparison Between Hanoi - Ho Chi Minh Railway and Northern Railway Lines

Item	Unit	Hanoi - Ho Chi Minh		Northern Railway Lines		Combined Total
Population Along Routes (2010)	1,000 persons	68,709	(72%)	26,291	(28%)	95,000
GDP Along Routes (2010)	million US$	56,632	(78%)	16,079	(22%)	72,711
Commercial Distance	km	1,726.2	(65%)	922.7	(35%)	2,648.9
Passenger Transportation Volume (1993)	1,000 persons	3,675	(47%)	4,118	(53%)	7,793
	million passenger-kms	1,401	(81%)	320	(19%)	1,721
Average Travel Distance	km	381		78		221
Freight Transportation Volume (1993)	1,000 tons	1,581	(50%)	1,606	(50%)	3,187
	million ton-kms	602	(62%)	376	(38%)	978
Average Haul Distance	km	381		234		307

5.2 Review of Role of Each Line of Railway Network

Table 5.2 shows the characteristics of major railway lines in Vietnam and we could see from this Table the role of each railway line.

Table 5.2-1 Characteristics of Major Railway Lines in Vietnam

Item		Hanoi - Ho Chi Minh	Hanoi - Haiphong	Hanoi - Lao Cai	Hanoi - Lan Son - Dong Dang	Kep - Ha Long	Dong Anh - Quan Trieu
Commercial Distance (km)		1,726.2	101.5	296.0	163.0	106.0	53.9
Maximum Sectional Transportation Volume	Passengers (1,000 persons/year)	1,482	752	752	548	88	408
Hanoi - Ho chi Minh (1994) Northern Railway Lines (1992)	Freight (1,000 tons/year)	808	400	334	152	488	194
Major Freight Items		Gravel, Cement, Chemical Fertiliser	Oil, Cement, Construction Materials, Apatite	Apatite, Coal, Construction Materials	Coal, Cement, Timber	Coal, Cement, Machinery, Construction Materials	Coal, Iron Products, Fertiliser, Mineral Ore, Apatite
Gauge (mm)		1,000	1,000	Hanoi - Gia Lan: 1,000, Gia Lam-Dong Anh: 1,000+1,435, Dong Anh-Lao Cai:1,000	Hanoi-Gia Lam: 1,000, Gia Lam-Dong Anh: 1,000+1,435	1,435	1,000+1,435
Alignment	Masimum Gradient (‰)	17	6	0.3 (average)	17	4	
	Minimum Radius of Curve (m)	97	300	100	upto Kep 150 after Kep 100	100	
	Characteristics	Five poor alignment sections with continuous steep slopes and sharp curves, including Hai Van Pass and Kep Pass	Good alignment with little gradient as it runs through a plain	Continuous curves (R=100-200m) beyond Yen Bai due to mountainous surroundings; gentle gradient throughout as is runs along River Hong	Some sections with continuous curves beyond Don Mo due to mountainous surroundings	Two sections with continuous small curves (R=100-200m) but alignment is generally good	
Facilities	Block System	Tokenless block system (1995)	Hanoi-Gia Lam: automatic block system, Gia Lam-Haiphong: tokenless block system	Hanoi-Gia Lam: automatic block system, Gia Lam-Lao Cai: tablet block system	Hanoi-Gia Lam; automatic block system, Gia Lam-Dong Dang: tablet block system	Tablet Block system	Tablet block system
	Facility Conditions	Much deterioration due to war damage and aging; some sections liable to flooding to falling rocks	Good track conditions	Much deterioration due to war damage and aging	Good track conditions	Relatively good track conditions as it is not an old line	

Item		Hanoi - Ho Chi Minh	Hanoi - Haiphong	Hanoi - Lao Cai	Hanoi - Lan Son - Dong Dang	Kep - Ha Long	Dong Anh - Quan Trieu
Facilities	Overall Features	Traverses most major cities ad industrial zones in Vietnam from north to south; an important line playing a crucial role in Vietnam's economic development and the social and cultural integration of the North and South; both passenger and freight services of medium-distance transportation between cities are dominant.	Linking the capital of Hanoi and the major international port city of Haiphong, the line should play an important role in freight transportation to and from Port Haiphong and in passenger transportation between the two cities.	Serves as a lifeline for people living along the route due to the lack of a road network; disregarding international transportation, the present capacity can meet extra demand, making it possible to improve the line with a small amount of investment; a detailed study is required on the implications of possible mining development along the route on the railway transportation demand.	Neither the population nor industrial activities along the route are large; due to the good road network, profitable railway operation is difficult for both passenger and freight services; minimum investment should be made to maintain the current service level.	With the future expansion of Port Cai lan as a major international port to create a triangular zone formed by Hanoi, Haiphong and Quang Ninh (Ha Long) as a key development area, the volume of cargo passing through Port Cai Lan will increase; improvements should be made in line with the timing and scale of the estimated demand increase; the likely demand increase of tourists visiting Ha Long should also be considered.	The transportation volume is relatively small in terms of both the passenger and freight services; emphasis should be placed on investment to maintain a reasonable service level vis-a-vis the actual demand.

5.3 Current Situations of Hanoi - Ho Chi Minh Railway Line

Current Problems of Hanoi-Ho Chi Minh Railway are summarized in Table 5.3-1.

Table 5.3 -1 Summary of Current Problems

Item		Current Problems
Safety	Dangerous Sections	The most bridges and tunnels are posing a high risk for train operation under normal circumstances due to ageing and war damage, etc.
	Disaster Prevention Features	- Slope protection works necessitate to be constructed at sections vulnerable to collapse due to torrential rain. - Drainage channels necessitate to be constructed at places vulnerable to roadbed collapse due to poor drainage. - Protective facilities vis-a-vis falling rocks necessitate to be introduced at vulnerable places and falling rock warning devices are necessitated to stop trains to prevent major disasters.
	Track	Rails and turnouts are worn or deteriorated due to ageing and light rails.
	Signalling System	- At present, most signals are semaphore signals using a kerosine lamp and are difficult to confirm at night or during bad weather. These necessitate to be replaced by electric colour-light signals. - At present, the interlocking system between the points and signals at the station premises is inadequate. The relay interlocking system necessitates to be introduced to prevent accidents caused by mishandling. - The ATS system necessitates to be installed to prevent such serious accidents as train collisions.
	Level Crossings	A train approach warning system necessitates to be installed at those level crossings with heavy traffic to prevent accidents.
Reliability	Flood Prevention	New track necessitates to be constructed at those sections which are frequently rendered impassable for a long time due to flooding in the rainy season.
	Track	Both corrosion and abrasion of the iron sleepers are observed. In many sections, the ballast thickness is less than 20cm.
	Track Maintenance	In order to ensure reliable transportation, a high speed track inspection car, multiple tie tampers and other maintenance equipment necessitate to be introduced.
	Rolling Stock	Rolling stocks are deteriorated due to aging.
	Inspection Facilities at Workshops, etc.	The inspection facilities at workshops, etc. necessitate to be improved or replaced by new facilities. Environmental improvements should be made in regard to waste water treatment and others.
Transport-ation Capacity	Stations	New interchange stations necessitate to be constructed at those sections of insufficient track capacity due to the long distance between stations and/or bad alignment. Following the strengthening of the medium and long-distance through freight service, new storage track will be necessitated at key freight stations.
	Rolling Stock	New rolling stock will be necessitated to meet the increased transportation demand.
Service Level	Station Square	The existing station squares do not take such feeder services as buses and taxis, etc. into consideration. The stations squares necessitate to be improved to ensure a smooth inter-modal traffic flow and environmental improvements.
	Long welded Rails	The number of rail joints necessitate to be reduced to reduce noise and vibration and in view of improved comfort, maintenance and service speed.
	Low Journey speed	Train journey speed is low and should be raised to be competetive against road transport.

Item		Current Problems
Transport Efficiency	Train Operation Control, Passenger Information and Freight Information Systems	The aged communication network necessitates to be renovated to strengthen the train operation control and disaster control functions. A passenger information system necessitates to be introduced for reservation control and better passenger services. Ticket selling system should be improved and time table should be distributed among customers. The introduction of a freight information system will improve the marketing control, transportation efficiency of freight cars and services for consignors.
Manage-ment	Financial Structure	The financial statements prepared by the VNR are rather old-fashioned and require a radical revision in view of their acceptance by the international community.
	Organization	The VNR is something like a conglomerate, the activities of which will cover a group of industries, supporting railway operation, such as manufacturing, construction, services etc. Along the instruction given by the Prime Minister, on March 26, 1994, the VNR is to be reorganized as a profit-making enterprise specialized in its proper business, transportation, being relieved of the heavy capital investments on infrastructure. In this connection, it is quite natural that the VNR should have the rationalization plan of management, and seriously consider of early independence of indirect parts of business that often arrest the growth of its proper income, in parallel with a personnel reduction on the whole.
	Manpower	The present productivity of VNR based on the current manpower level is very low in comparison with other countries. It is quite necessary to improve the productivity steadily.
	Commercial and Marketing	Fare and charge system are complicated and should be simplified. Marketing system is very poor, and not convenient for customers.
	Education and Training	Current educational and training facilities and equipment are not matching with present requirement and not sufficiently equipped.

5.4 Urban Transport

5.4.1 Current Problems of Urban Transport

The main means of urban transport in Hanoi and Ho Chi Minh City today are bicycles and motorbikes. In particular, the number of motorbikes has been rapidly increasing in recent years. In contrast, public transport, including buses and the railway, plays only a minor role. The transport infrastructure in Hanoi with a population of approximately 3.15 million is far from satisfactory. Ho Chi Minh City has a population of approximately 4 million and the transport demand of local residents and tourists has been rapidly increasing. Like Hanoi, motorbikes and bicycles are the main means of urban transport, accounting for 95 - 97% of the transportation volume and leaving public transport a share of 3 - 5%.

In both cities, railway level crossing are presenting serious problems to urban transport, and the authority concerned has recently prohibited its train operation daytime within its cities (excluding Hanoi-Saigon through express trains).

The transport demand in both cities is expected to grow in the future following the economic growth of Viet Nam and there is increasing concern in regard to (1) Chronic congestion during the morning and evening rush hours, (2) Increase of the number of traffic accidents, (3) Environmental problems, such as traffic noise and air pollution and (4) Inefficient socioeconomic activities resulting from the above problems and adverse impacts on civic life.

5.4.2 Remedial Measures

It is essential to solve the problems of urban transport for the economic development of cities safe and healthy civic life. From the long-term perspective, a transport plan based on the land use plan of a given city should be prepared with a view to implementing the plan components in accordance with their priority order.

It is necessary to make public transport more attractive in terms of the service frequency, speed, punctuality, distance to nearest stop/station and fares, etc. The resulting increase of the share of public transport will help to solve the above problems.

When preparing the long-term plan mentioned earlier, it is necessary to clearly identify the relationship (or advantages and disadvantages) of different modes of transport and the roles of each mode of transport as each mode has a different transportation capacity, land

requirements, construction cost and maintenance cost, etc. An efficient transport network can be created by combining various modes of transport.

The present railway system can be vitalised by means of signal modernisation, construction of new stations, introduction of shuttle service facilities and improvement of station squares, etc. The construction of a second track and electrification of the route should be put on the agenda in the case of a substantial increase of the transportation demand in the future. Especially the grade separation of existing railway lines from major crossing roads should be seriously considered.

5.5 International Transport

The following 4 corridors (see Fig. 5.5-1) should be considered when discussing the prospect of an international link for the Viet Namese railway network.

(1) Kunming (China) - Lao Cai - Hai Phong/Cai Lan (existing line)

(2) Nanning (China) - Dong Dang - Hanoi (existing line)

(3) Bua Yai (Thailand) - Savannakhet (Lao PDR) - Cua La (new line)

(4) Bangkok (Thailand) - Poipet (border) - Phnom Penh (Cambodia) - Ho Chi Minh City (existing and new lines)

The recent drastic changes of the international political and economic environment in East and Southeast Asia, such as the normalisation of the diplomatic relationship between China and Viet Nam, the establishment of a basic framework for long-lasting peace in Cambodia and the progress towards a market economy in Lao PDR, Viet Nam and China, etc. have created bright prospects for international transport in the Asian sub-region which includes China, Viet Nam, Thailand, Cambodia, Lao PDR, Myanmar, Malaysia, Indonesia and other ASEAN countries. One advantage is that all railway track in these areas is 1,000 mm gauge except the Nanning - Dong Dang Line and that in Indonesia, allowing smooth cross-border passenger and freight traffic without changing the bogies or freight transfer at borders. The prospective development of the international transport systems will stimulate trade and personnel exchanges and will without doubt contribute to integrated social, economic and cultural development in this sub-region.

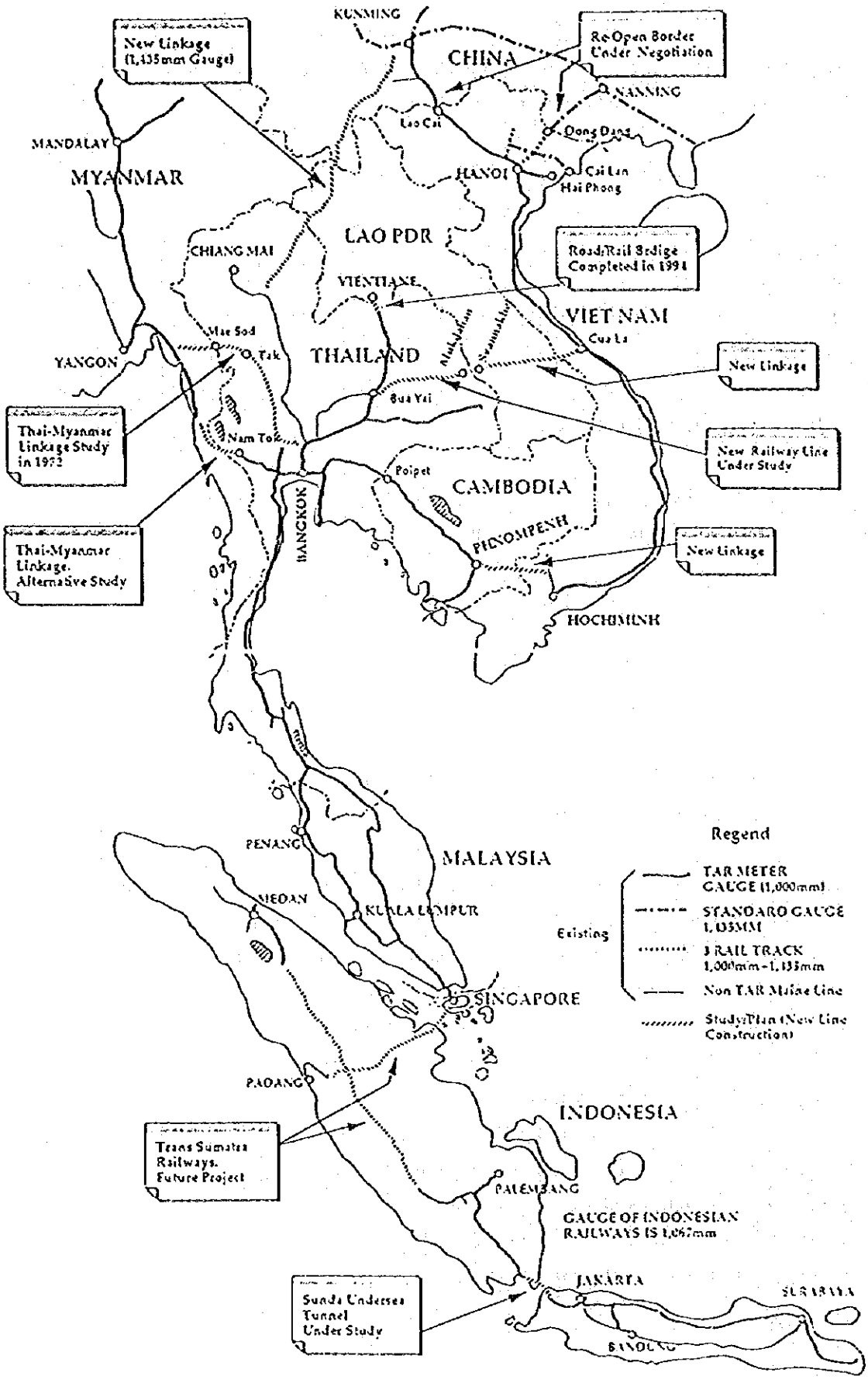


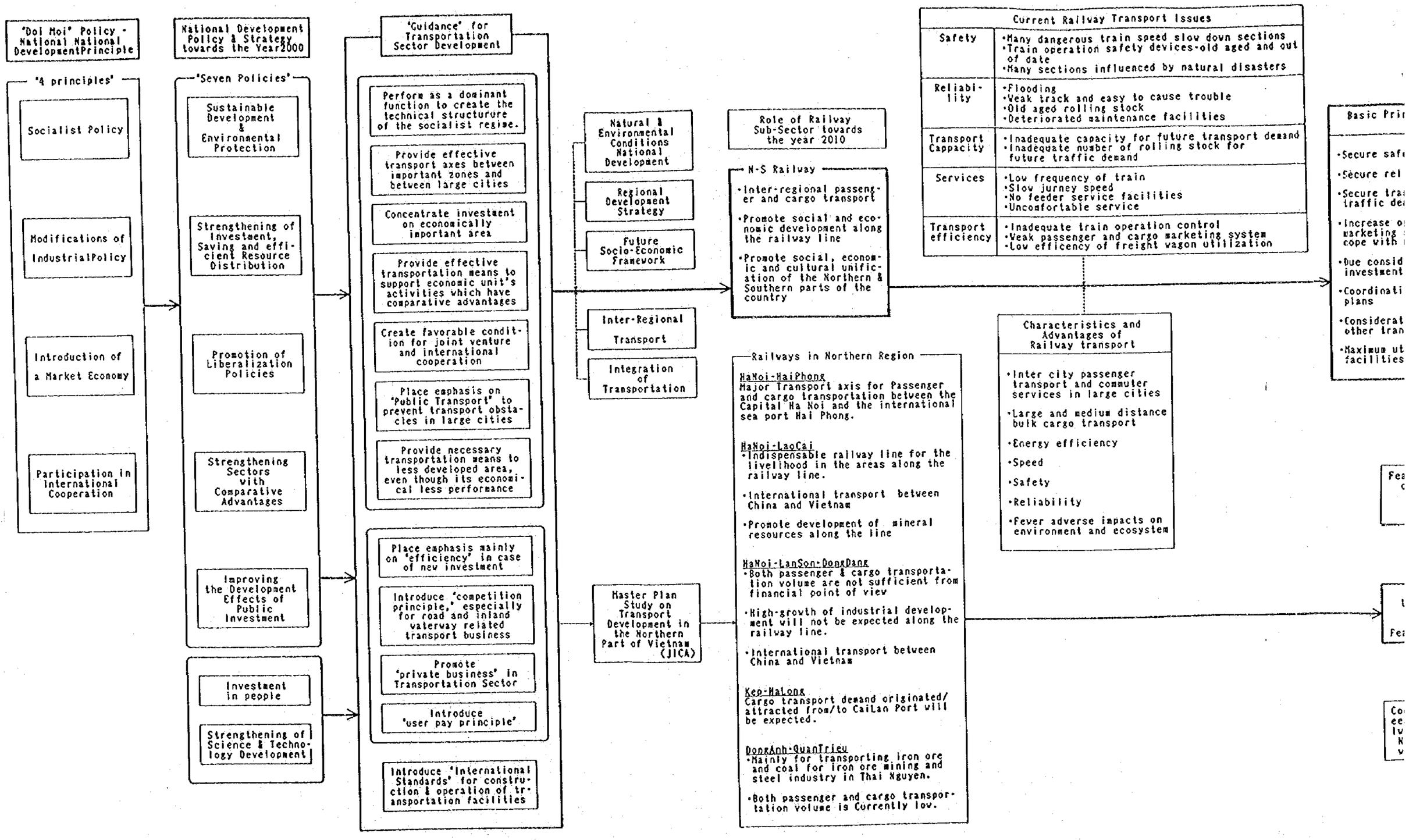
Fig. 5.5-1 Trans-Asia Railway (TAR) Map

CHAPTER 6 FORMULATION OF HANOI-HO CHI MINH RAILWAY MASTER PLAN

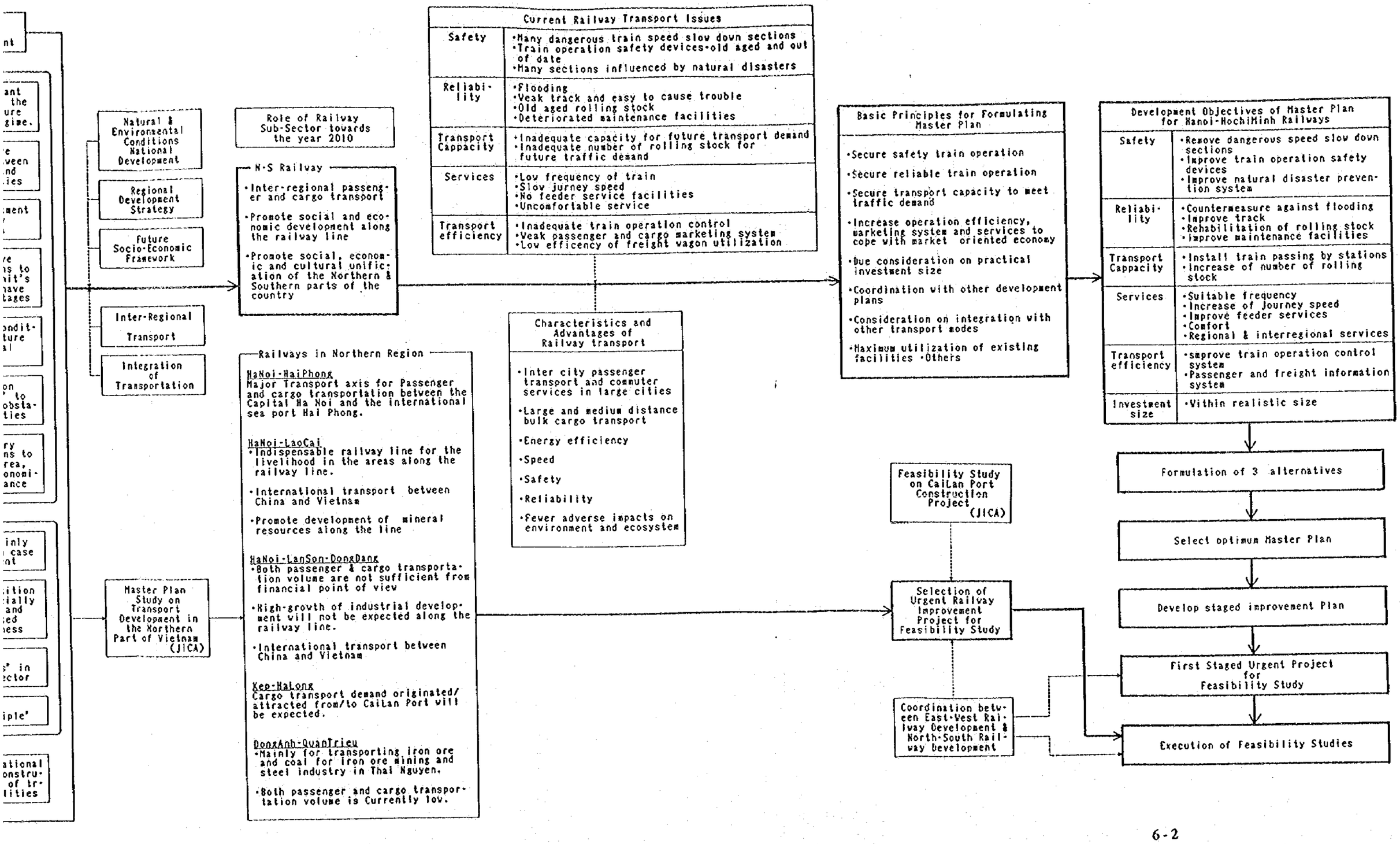
6.1 Approach for Formulating Master Plan for Rehabilitation and Improvement of Hanoi-Hochi Minh Railways

Taking the Doi Moi Policy, the Socio-Economic Stabilization and Development Strategy toward the Year 2000, the Guidance to Consolidate and Develop the Communication and Transportation Sectors from Today to the Year 2000, and also current situations and role of each railway line into consideration, the Master Plan for Hanoi-Ho Chi Minh Railway are formulated as shown in Fig. 6-1.

Fig. 6-1 Approach for Formulating Master Plan for Rehabilitation and Improvement of Hanoi-Ho Chi Minh Railways



5-1 Approach for Formulating Master Plan for Rehabilitation and Improvement of Hanoi-Ho Chi Minh Railways



6.2 Formulation of Master Plan Alternatives and Evaluation

6.2.1 Formulation of Master Plan Alternatives

(1) Basic Ideas to Formulate Alternatives

In formulating the Master Plan for the year 2010, there may be conceived many alternatives in regard to the level of envisaged improvement. One alternative is the higher improvement of the railway functions, aiming at achieving higher safety, higher reliability and higher service levels. Another is minimum improvement to establish the minimum railway functions with minimum improvement of the operation safety, reliability and service levels. Another alternative lies somewhere between the above two alternatives. The optimum Master Plan should be selected from among various alternatives of different improvement levels in terms of the safety, reliability and service levels, based on a comprehensive evaluation of each alternative involving a cost benefit analysis and both social and political evaluation of the alternatives. For the present purposes, three alternatives involving different improvement levels have been established with the agreement of the Government of Vietnam based on the development objectives referred to in 1.3 for the selection of the optimum Master Plan alternative. In addition to the above-mentioned development objectives, the following points have also been taken into consideration in the establishment of the three alternatives.

① The subject issues for improvement of each alternative are safety, reliability, transportation capacity meeting the demand, service level and transport efficiency.

② In order to make the investment size practical, alignment improvement and other work requiring huge investment should be kept to a minimum. At those sections where the current alignment poses a considerable problem, an improvement plan should be prepared for each section for examination of the appropriateness of its inclusion in the Master Plan by means of cost benefit analysis.

③ As the Master Plan envisages the state of the subject Railway in the 21st century (the target year is 2010), technical features relating to the meter gauge in foreign countries (advanced countries as well as neighbouring countries) should be taken into considered where deemed necessary.

④ Regarding the increase of the train speed to improve the service level, an increase of the journey speed is particularly important, which in turn will necessitate comprehensive examination of the desirable track, rolling stock and alignment, etc. Effective measures with the minimum investment cost should be sought to increase the journey speed. While the maximum speed of the current rolling stock is

80km/hr, a maximum speed of 110km/hr can be achieved with the introduction of high speed, light axle weight cars with slight modification of the current track structure. In neighbouring Thailand, a maximum speed of 105km/hr is permitted for light axle weight trains (120km/hr for the trains recovering delayed times). Taking the above facts into consideration, a maximum speed of 110km/hr should be permitted for some light axle weight trains.

(2) Basic Characteristics of Three Alternatives

① Alternative I

There are many slow speed sections at track, bridges and tunnels due to dangerous conditions. Alternative I envisages the realisation of a higher level of train safety and reliability by the total eradication of the current dangerous slow speed sections between Hanoi and Ho Chi Minh City and also by improving the natural disaster prevention system, track, signals, communications and rolling stock maintenance. In addition, new high speed rolling stock will be introduced with modest additional investment to achieve a maximum speed of 110km/hr for limited express passenger trains as well as for inter-regional express passenger trains. As a result of these improvement measures, the journey speed between Hanoi and Ho Chi Minh City of a limited express passenger train will be significantly increased from the present 48km/hr to 72km/hr. The improvement level is the highest among the three alternatives for the Hanoi – Ho Chi Minh Railway for 2010 within the confines of a practical investment figure.

② Alternative II

Alternative II envisages the realisation of the minimum required level of train safety and reliability by the eradication of dangerous slow speed sections of less than 40km/hr and also by improving the natural disaster prevention system, track, signals, communications and rolling stock maintenance and the rehabilitation and replacement of the current rolling stock which is capable of running at a maximum speed of 80km/hr. As a result of these improvements, the journey speed between Hanoi and Ho Chi Minh City of a limited express passenger train will be increased to 58km/hr. Alternative II represents the minimum improvement level required for the Hanoi – Ho Chi Minh Railway for 2010.

③ Alternative III

The envisaged level of improvement of the railway facilities and services is midway between that of Alternative I and Alternative II. Alternative III envisages the

realisation of safe and reliable train operation by the eradication of all dangerous slow speed sections at tunnels and slow speed sections of less than 40km/hr at bridges in addition to the eradication of all slow speed sections of which the alignment could tolerate a travelling speed of 110km/hr (excepting some 18 of them) and further by the improvement of the natural disaster prevention system, track, signals, communications and rolling stock maintenance. In addition, new high speed rolling stock will be introduced for limited express passenger trains with a maximum travelling speed of 110km/hr. The expected journey speed between Hanoi and Ho Chi Minh City under Alternative III is 69km/hr for limited express passenger trains.

(3) Detailed Components of Three Alternatives

The detailed components of the three alternatives are given in Table 6.2.1-1.

(4) Investment Size of Each Alternative

The investment size of each alternative is given in Fig. 6.2.1-1.

Table 6.2.1-1 Outline of Master Plan Alternatives

Subject	Envisaged Measures	Alternative I	Alternative II	Alternative III
Improved Safety	Elimination of Dangerous Sections	Trains are currently forced to go at a slow speed at aged or deteriorated bridges and tunnels, etc. All these dangerous slow speed sections will be eliminated to ensure operational safety.	Those aged or deteriorated bridges and tunnels, etc. where the maximum speed is set at less than 40km/hr will be improved.	In addition to those bridge sections referred to in Alternative II, all other dangerous slow speed sections where high speed operation is feasible will be improved except for some 20 sections. Slow speed tunnel sections will be eliminated
	Improved Disaster-Prevention Features	Slope protection works and/or drainage works will be introduced at major slopes and track bed which are considered disaster-prone. Together with facilities to protect the track from falling rocks, falling rock warning devices will be installed to stop trains in order to prevent major disasters.	Same as Alternative I except that the number of places for slope protection and drainage works is roughly halved as only those posing a serious threat will be dealt with.	Same as Alternative I
	Track Reinforcement	Worn or deteriorated turnouts due to aging and light rails will be replaced.	Same as Alternative I	Same as Alternative I
	Introduction of Colour-Light Signals	At present, most signals are semaphore signals using kerosine, etc. and are difficult to confirm at night or during bad weather. All signals at all stations will be changed to electric colour-light signals.	Same as Alternative I	Same as Alternative I
	Upgrading to Relay Interlocking System	At present, the points and signals on the station premises are interlocked by the Class 2 mechanical interlocking system. This will be upgraded to either the Class 1 or Class 2 relay interlocking system to eradicate human error to improve the safety of train operation.	Same as Alternative I but only three major stations will be equipped with the Class 1 relay interlocking system.	Same as Alternative II
	Installation of ATS System	In view of the single track operation, the ATS system will be installed at all stations to prevent such serious accidents as train collisions.	Same as Alternative I	Same as Alternative I
	Installation of Warning System at Level Crossings	A train approach warning system will be installed at major level crossing to prevent collisions between trains and cars.	Only major level crossings in urban areas, etc. will be equipped with the new system.	Same as Alternative II
Improved Reliability	Flood Prevention	New track will be constructed at those major sections which are frequently rendered impassable for a long time due to flooding in the rainy season to improve the transportation reliability.	Same as Alternative I	Same as Alternative I
	Track Reinforcement	Improved RC sleepers will be used with a ballast thickness of 250mm. High speed turnouts will be used for 110km/hr sections while improved and ordinary turnouts will be used for 80km/hr sections and upto 70km/hr sections respectively.	The existing concrete block sleepers will not be replaced. A ballast thickness of 200-250mm will only be adopted for 80km/hr sections. Ordinary turnouts for use upto 70km/hr will be used.	Same as Alternative I except that a ballast thickness of 200-250mm will only be adopted for 80-110km/hr sections.
	Improved Track Maintenance	In order to maintain appropriate track conditions for reliable transportation, a high speed track inspection car and miscellaneous track inspection and maintenance tools and equipment, including a multiple tie tamper, will be introduced.	Same as Alternative I	Same as Alternative I
	Rehabilitation of Rolling Stock	The rehabilitation of deteriorated rolling stock due to ageing will be conducted to ensure reliable train operation and new rolling stock will be procured to provide a faster service.	Same as Alternative I except that no new high speed rolling stock will be procured and that the existing rolling stock will be rehabilitated.	Same as Alternative I except that the volume of new rolling stock to provide a faster service will be smaller than Alternative I and that the existing rolling stock will be rehabilitated.
	Improved Inspection Facilities at Workshop, etc.	The deteriorated or outdated rolling stock inspection facilities will be improved or replaced by new facilities.	Same as Alternative I except that washing facilities for high speed new rolling stock will not be introduced due to the absence of such rolling stock.	Same as Alternative I

Subject	Envisaged Measures	Alternative I	Alternative II	Alternative III
Expansion of Trans-portation Capacity	New interchange stations and Expansion of Yard Facilities	New interchange stations will be constructed at sections of insufficient track capacity due to the long distance between stations and/or bad alignment (4 sections). Following the strengthening of the medium and long-distance through freight service, new storage track will be introduced at key freight stations. It must be noted that Alternative I will generate the highest transportation demand as its service level is the highest among the three alternatives.	Same as Alternative I except that only one interchnage station will be constructed. It must be noted that Alternative II will generate the least transportation demand as its service level is the lowest among the three alternatives.	Same as Alternative I except that only two interchange stations will be constructed. It must be noted that Alternative III will generate a medium level transportation demand as its service level is halfway between that of Alternative I and that of Alternative II.
	Increased Rolling Stock	New high speed trains will be procured to meet the increased transportation demand.	Instead of introducing new high speed trains, the new rolling stock will be the same models as the existing rolling stock.	The volume of new high speed trains to be procured will be smaller than that of Alternative I in response to the smaller transportation demand planned.
Improved Service Level	Station Square Improvement	The existing station squares do not take such feeder services as buses, taxis and motorcycles, etc. into consideration. The station squares of major stations will be improved to ensure a smooth inter-modal traffic flow and environmental improvements will also be conducted.	Same as Alternative I	Same as Alternative I
	Use of Long Welded Rails and Speeding-Up	The number of rail joints will be reduced through the use of long welded rails to reduce noise and vibration in view of improved comfort and maintenance. Long welded rails will be used at those sections where the radius curve is more than 600m.	Same as Alternative I except that long welded rails will be used for 80km/hr sections only.	Same as Alternative I except that long welded rails will be used for 80-110km/hr sections only.
	High Speed Trains for Speeding-Up and Improved Comfort	New high speed trains (Vmax = 110km/hr) will be introduced to serve as limited express trains and inter-regional express trains for a faster service and improved comfort.	No new high speed trains will be procured. The train speed will be increased through improving of the existing rolling stock and track. The existing rolling stock will be rehabilitated to provide improved comfort on limited express trains and inter-regional express trains.	New high speed trains (Vmax = 110km/hr) will be introduced to serve as limited express trains for a faster service and improved comfort. The comfort level of inter-regional express trains will be improved through the rehabilitation of the existing rolling stock.
Improved Transport Efficiency	Improvement of Train Operation Control, Passenger Information and Freight Information Systems	The aged communication network will be renovated to strengthen the train operation control and disaster control functions. A passenger information system will be introduced for reservation control and better passenger services. The introduction of a freight information system will improve the marketing control, transportation efficiency of freight cars and services for consignors.	Same as Alternative I except that the capacity of the underground cable and fibre optics cable will be reduced and that a telephone switchboard will only be installed at key stations.	Same as Alternative II
Travelling Time (Hanoi – Ho Chi Minh City)		The travelling time between Hanoi and Ho Chi Minh City will be 24 hours (journey speed: 72km/h) for a limited express passenger train and 40 hours for a through freight train. Due to the commitment to a practical investment size, the technological level of Alternative I is not necessarily on a par with the meter gauge technology of advanced countries. Nevertheless, from the viewpoint of a practical investment size in Vietnam, Alternative I proposes the highest improvement level for the Hanoi – Ho Chi Minh Railway in the year 2010 among the three alternatives.	The travelling time between Hanoi and Ho Chi Minh City will be 30 hours (journey speed : 58km/h) for a limited express passenger train and 43 hours for a through freight train. Alternative II proposes the minimum improvements necessary for the Hanoi – Ho Chi Minh Railway.	The travelling time between Hanoi and Ho Chi Minh City will be 25 hours (journey speed: 69km/h) for a limited express passenger train and 41 hours for a through freight train. Alternative III proposes intermediate improvement prospects between Alternative I and Alternative II.

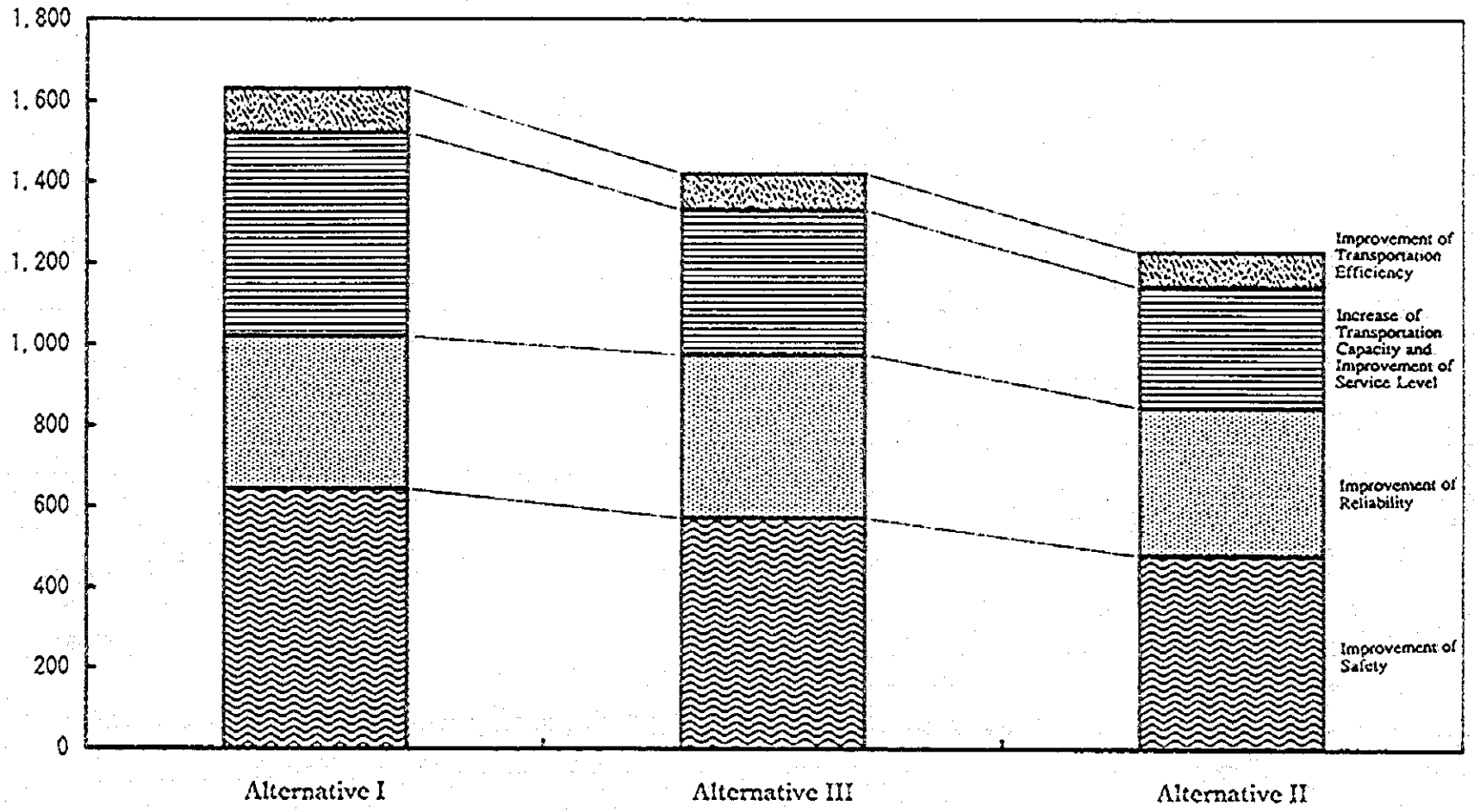


Fig. 6.2.1-1 Comparison of Investment Amount of Each Alternative of Master Plan for Hanoi - Ho Chi Minh Railway

6.2.2 Overview of Future Traffic Demand

Demand forecast in this section was carried out to identify the best alternative among three i.e. Alternatives I, II and III. The data involved in this forecast are those up to the year 1993, and all the calibration works had been completed by October 1994. This forecast was revised with the latest traffic data in 1994 at the following study stage when the best alternative was evaluated in depth.

(1) Travel Demand in the Year 2010

Projection results of annual inter zonal traffic demand (road and railway) in 2010 is summarized in Table 6.2.2-1, and Figures 6.2.2-1 and 6.2.2-2 illustrate a loaded spider networks in 2010 for person trip and cargo trip respectively. Highest traffic demand is concentrated on the two economic zones; the Hanoi-centered area and Ho Chi Minh-centered area. These are followed by the Da Nang-centered area.

(2) Railway Demand

The passenger and cargo OD matrices (road and railway) are decomposed into the trips of road and railway by employing the diversion models. Travel time by road is based on the design speed of the National Road 1 rehabilitation plan.

Travel time of each alternative between Hanoi and Ho Chi Minh City is summarized in Table 6.2.2-2. Planned travel speed of railway varies due to the three alternatives. In calculating the railway travel time for alternatives I and III, a speed of express train was adopted. However, since alternative II plans to introduce many local trains compared with other alternatives, an average speed was adopted. As for other zone pair, individual time distances are calculated and applied to diversion model.

Table 6.2.2-2 Time Distance between Hanoi and Ho Chi Minh City

(unit; hours)

	by Road	by Railway			
		Alt. I	Alt. III	Alt. II	Without Case
Passenger	45	24	27	30	same as 1994
Cargo	50	40	41	43	same as 1994

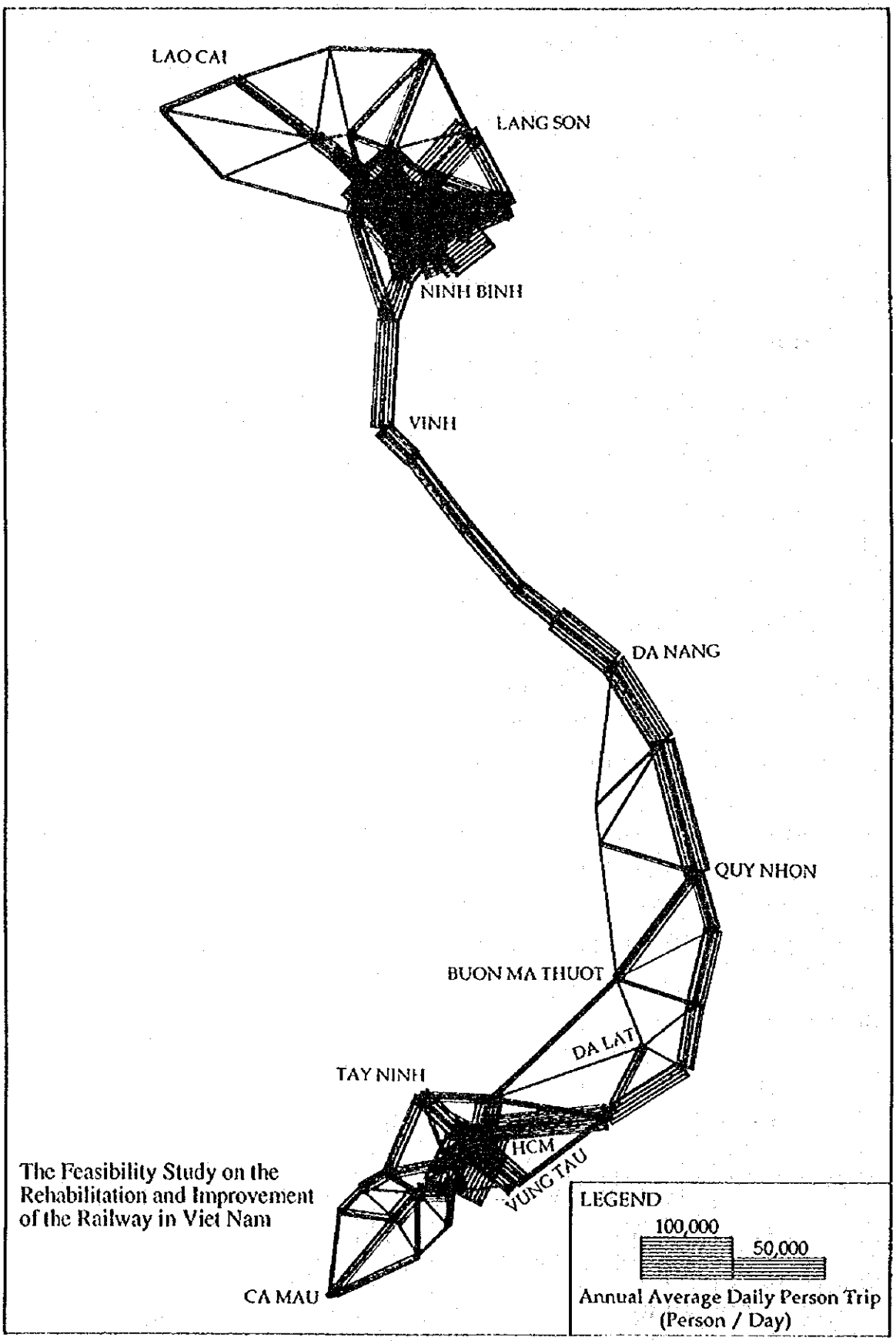


Figure 6.2.2-2 Loaded Spider Network (Person Trip in 2010)

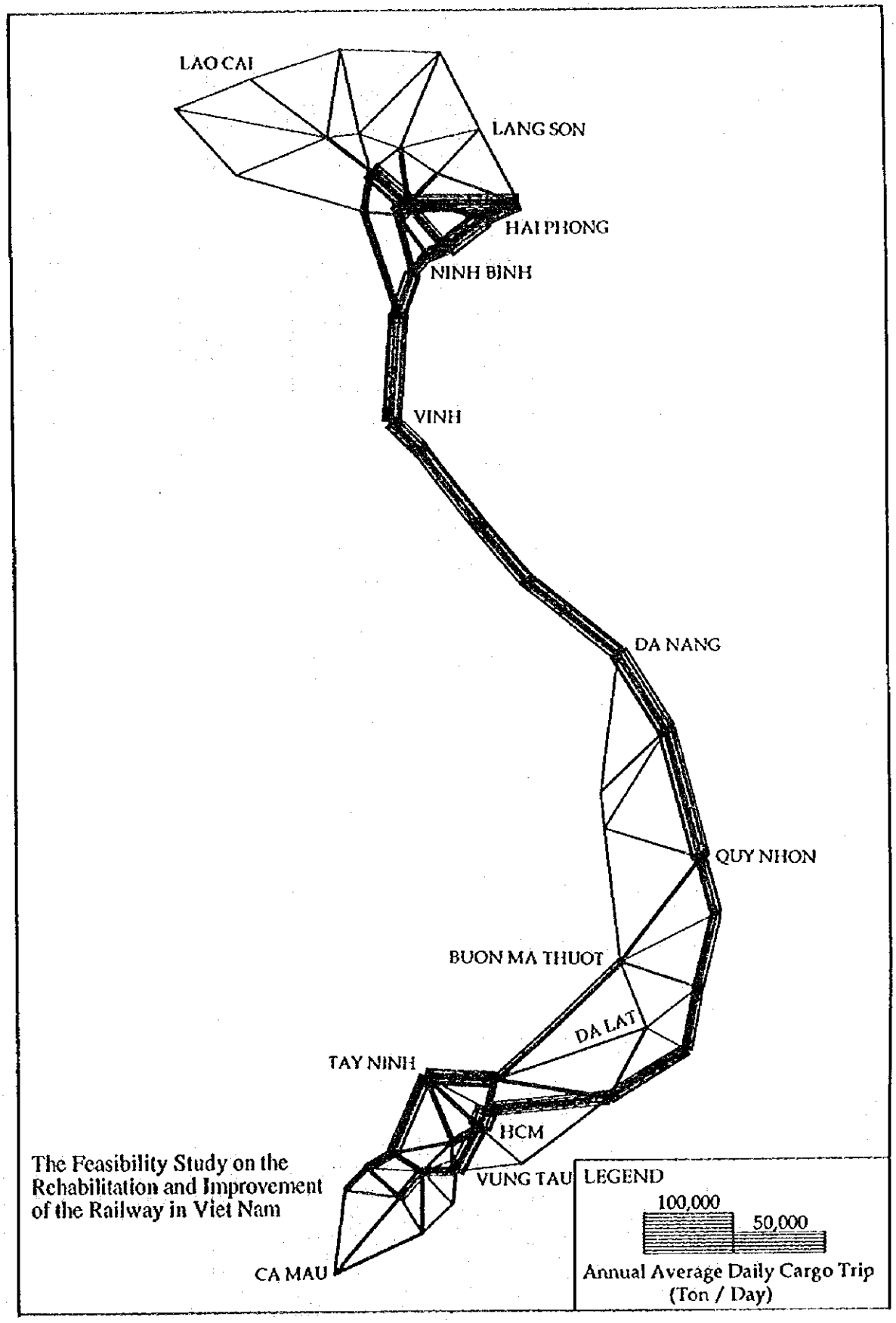


Figure 6.2.2-3 Loaded Spider Network (Cargo Trip in 2010)

*) Total trips = (Generated+Attracted)/2

		Passengers (Persons/Year)	(2010/1994)	Cargo (Tons/Year)	(2010/1994)
1	Ha Giang	3,527,332	7.74	258,498	14.13
2	Tuyen Quang	9,213,385	10.21	330,462	14.36
3	Cao Bang	8,401,121	11.01	307,553	20.55
4	Lang Soc	23,011,814	8.03	783,314	2.50
5	Lai Chau	5,594,718	15.41	317,416	19.14
6	Lao Cai	8,858,479	13.55	446,363	3.44
7	Yen Bai	4,859,789	5.72	783,745	4.03
8	Bac Thai	12,234,704	3.73	2,068,813	3.02
9	Son La	2,738,259	5.00	433,362	---
10	Hoa Binh	11,114,930	5.32	860,580	3.05
11	Vinh Phu	23,761,832	6.65	6,787,469	2.62
12	Ha Bac	54,898,220	8.32	2,722,301	4.43
13	Quang Ninh	22,190,821	7.36	14,434,653	2.52
14	Hanoi Capital	142,308,744	4.94	16,264,770	4.98
15	Hai Phong	48,790,020	7.34	13,104,483	5.38
16	Hai Hung	35,955,165	8.13	5,409,310	5.54
17	Ha Tay	74,941,354	7.95	4,710,497	4.65
18	Thai Binh	12,145,444	7.29	1,264,850	6.76
19	Nam Ha	28,962,952	5.22	5,786,577	4.07
20	Ninh Binh	13,538,234	5.84	1,416,495	3.02
21	Thanh Hoa	6,796,006	6.45	4,299,487	2.79
22	Nghe An	4,703,115	5.48	1,780,408	5.36
23	Ha Tinh	3,820,555	10.59	1,321,604	13 23
24	Quang Binh	2,076,325	3.42	592,876	5.99
25	Quang Tri	1,888,155	6.81	746,147	4.80
26	Thua Thien - Hue	4,778,900	3.24	1,194,816	9.27
27	Quang Nam - Da Nan	14,596,586	5.57	6,291,296	9.25
28	Quang Ngai	3,415,925	3.59	1,233,775	3.60
29	Binh Dinh	6,619,766	3.87	2,820,338	4.54
30	Phu Yen	3,260,751	4.66	1,073,034	10.85
31	Khanh Hoa	8,102,832	4.08	3,448,638	5.27
32	Ninh Thuan	4,762,741	9.40	1,595,257	5.19
33	Binh Thuan	4,120,009	5.43	1,897,309	5.99
34	Gia Lai	2,832,163	3.28	1,015,131	4.71
35	Kon Tum	1,742,203	6.11	885,154	5.92
36	Dac Lac	4,902,093	5.75	3,307,515	3.22
37	Lam Dong	6,548,696	3.29	2,016,294	6.76
38	Ho Chi Minh City	76,132,717	2.00	19,644,147	4.76
39	Song Be	3,781,170	2.54	1,120,846	3.30
40	Tay Ninh	7,247,399	1.63	1,691,193	3.76
41	Dong Nai	17,354,361	5.12	10,777,048	4.78
42	Ba Ria - Vung Tau	15,238,799	1.10	721,067	1.54
43	Long An	7,011,478	2.63	2,396,556	4.63
44	Dong Thap	5,217,892	7.25	1,617,141	6.78
45	An Giang	9,128,117	5.90	4,086,620	4.79
46	Tien Giang	15,507,381	1.47	3,437,530	2.94
47	Ben Tre	5,271,826	3.81	939,386	7.42
48	Vinh Long	5,601,877	7.58	1,440,659	4.29
49	Tra Vinh	3,311,192	5.54	801,652	3.94
50	Can Tho	10,450,170	7.01	4,768,494	5.97
51	Soc Trang	5,102,467	5.29	1,946,362	4.54
52	Kien Giang	5,991,706	5.73	2,626,951	6.08
53	Minh Hai	7,528,924	4.55	2,899,711	6.96
	Total	831,891,559	4.44	174,925,940	4.31

Table 6.2.2-1 In ter Province Trips by Road and Railway ; 2010

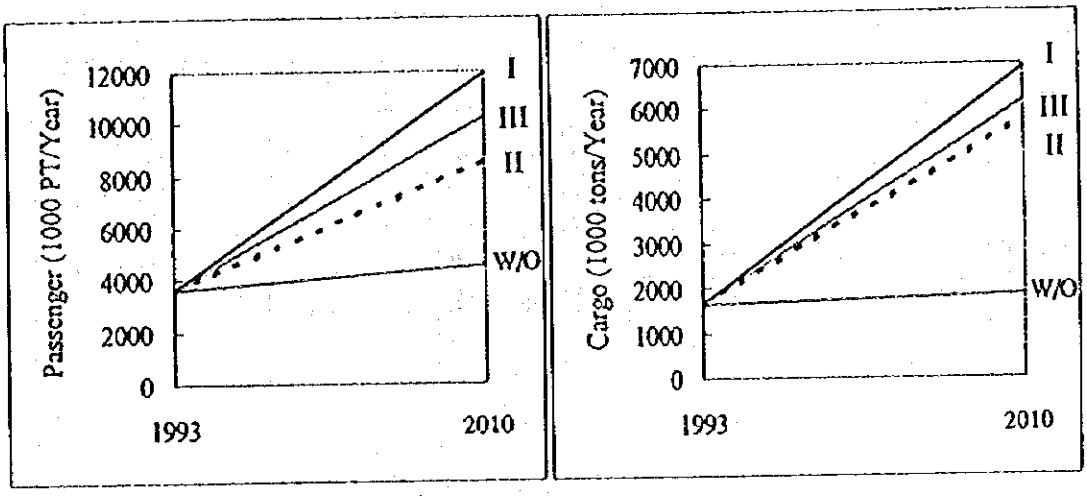


Fig. 6.2.2-3 Number of Trips by Alternative

Fig. 6.2.2-3 shows total trips of passenger and cargo in the years 1993 and 2010. The highest figure is recorded by Alternative I, followed by Alternative III, Alternative II, and "without case" shows the lowest traffic volume. Passenger of Alternative I in 2010 is estimated to expand 3.8 times as much as that in 1993. Expansion ratio of Alternative III is 2.8, and Alternative II is 2.4. On the other hand, cargo transport in Alternative I is to expand 4.3 times as much as that in 1993, and followed by 3.8 times for Alternative III, and 3.6 times for Alternative II.

Cargo demand shows higher rate of growth than that of passengers. This is attributable to the fact that transport demand of cargo is more sensitive to economic growth, and that travel demand of passenger is less sensitive to economic activities.

(3) Assigned Railway Traffic in the Year 2010

The person and cargo traffic demand are assigned to the road and railway networks. Assignment results (passenger) both for the Hanoi - Ho Chi Minh railway line and the National Root I are presented in Table 6.2.2-3. The present average passenger occupancy ratio, 4.17 person/pcu, is used for calculation of share for National Road 1.

It is proved that in Alternative I, 16% of passengers will use the railway. However, the present share of 5.5% will be kept constant in the future if it will not be improved.

Table 6.2.2-3 Share of Railway and Road : Passenger

	Railway (000 person-km/year)	Vehicles by Road (000 person-km/year)	Share of Railway (%)
Alternative I	6,299,344	33,170,941	16.0%
Alternative III	5,118,790	34,359,249	13.0%
Alternative II	3,945,186	35,540,660	10.0%
Without Case	2,179,076	37,253,232	5.5%

Traffic volume of cargo by railway will increase remarkably. As shown in Table 6.2.2-4, railway share is expected to be 2.6% for alternative I, 2.3% and 2.1% for Alternative III and II respectively. However its share of railway will not increase in parallel with the total cargo volume of railway because total land traffic volume will also extremely increase at the same time. Cargo share of railway is estimated approximately 2-3%. When railway share is calculated, 4.28 ton/vehicle is adopted.

Table 6.2.2-4 Share of Railway and Road : Cargo

	Railway (000 ton-km/year)	Vehicles by Road (000 ton-km/year)	Share of Railway (%)
Alternative I	2,799,600	104,868,937	2.6%
Alternative III	2,448,956	106,319,810	2.3%
Alternative II	2,243,561	107,170,909	2.1%
Without Case	621,033	113,698,046	0.5%

The results of demand forecast reveals that the railway will not loss its share so drasticcally in future compared with the present status, even though facing a sever competition with the road traffic. This figure is a quantitative results of the direct effect attributable to saving in traveling time, and is also an effect that the proposed plans of rehabilitation and improvement can generate.

6.2.3 Economic and Financial Evaluation

6.2.3.1 Economic Analysis

(1) Basic Conditions

- EIRR was adopted for economic evaluation index.
- Investment period ; 1996 - 2010
- Evaluation period ; 1995-2030
- Opportunity cost of capital ; 8.4% (same as the interest rate of "Capital Formation Loan," offered by Industrial and Commerce Bank of Viet Nam

(2) Economic Cost

In estimating economic cost, the followings were considered:

- shadow price for labor cost: real average productivity of labor force set at 80% of moral wage.
- 3% of turn-over tax ratio was considered for market price of all domestic materials.
- foreign exchange rate is completely dependent on market mechanism
- use life was suitably set for each investment items.
- residual values was suitably set

(3) Economic benefit

The following economic benefits were considered:

- Saving in Travel Time of Railway Passengers
- Saving in Travel Time of Railway Cargo
- Saving in Capital Cost of Road Passenger Traffic
- Saving in Capital Cost of Road Cargo Traffic
- Saving in Operation and Management Cost of Railway

(4) Evaluation

Calculated EIRR are shown in Table 6.2.3-1.

Table 6.2.3-1 EIRR and Results of Sensitivity Analysis

Benefit \ Cost	+20%	+10%	Normal	-10%	-20%
Alternative I					
-20%	na		5.3%		
-10%		5.5%	6.5%		
Normal	5.7%	6.6%	7.6%	8.8%	10.1%
+10%			8.7%		
+20%			9.7%		
Alternative II					
-20%	na		3.4%		
-10%		3.6%	4.5%		
Normal	3.8%	4.6%	5.4%	6.4%	7.5%
+10%			6.3%		
+20%			7.1%		
Alternative III					
-20%	na		3.6%		
-10%		3.8%	4.6%		
Normal	3.9%	4.7%	5.5%	6.5%	7.5%
+10%			6.4%		
+20%			7.2%		

Note 1; na means "less than 0."
Note 2; Period of service disruption is not clear and thus a full scale of benefit is incorporated in calculating EIRR. However, there remains about 100km of flood prone railway section, and actual economic benefit and EIRR would be lower than this figure according to the duration of service disruption.

6.2.3.2 Financial Analysis

(1) Basic conditions

- FIRR was adopted for financial evaluation index.
- investment and evaluation periods are the same as those used for economic evaluation.

(2) Revenue and expenditure

- Investment to infrastructure was excluded from expenditure (because of being borne by the government, but not by VNR)

- use life and residual value for each investment items used are the same as those used for economic analysis.
- operation and maintenance cost was estimated based on productivity improvement and increase amount of passengers' demand (passenger-km) and freight demand (ton-km).
- revenue was estimated considering passenger fare increase depending on speed up.
- 8% of sales tax was considered.

(3) Results of evaluation

FIRRs calculated for each alternative are given in Table 6.2.3-2.

Table 6.3.2-2 FIRR

From Start of Investment	Alternative I	Alternative II	Alternative III
15 years	8.51%	6.84%	8.61%
25 years	10.09%	7.72%	9.87%
35 years	10.61%	8.15%	10.34%

6.2.4 Environmental Assessment

The items of environmental examination of each alternative are listed in Table 6.2.4-1.

Table 6.2.4.-1 Environmental Items of Each Alternative on Environmental Examination

Major Policies	Alternative I		Alternative II		Alternative III		Related Environmental Items
Maximum train speed or shortest arrival time*1	MTS*1 110 km/h 80 km/h	SAT*1 24 h 40 h	MTS 80 km/h 80 km/h	SAT 30 h 43 h	MTS 110km/h 80 km/h	S.A.T. 25 h 41 h	At operation: Economy, train noise and vibration.
Rehabilitation and improvement of track facilities	Replacing with 43kg rails, improved RC sleepers. Long rails for sections where they can be laid.		Replacing with 43kg rails and using existing RC sleepers. Long rails for efficient sections on alignment.		Replacing with 43kg rails and RC sleepers. Long rails for sections where they can be laid and train speed is 80~110 km/h.		At construction: Waste, air or water pollution, noise and vibration. At operation: Train noise and vibration.
Rehabilitation and improvement of damage preventing facilities	Damage preventing facilities (slopes, rockfalls and flood submergence).		Almost same as Alternative I but smaller investment.		Same as Alternative I.		At construction: Hazards, noise and vibration At operation: Hazards
Rehabilitation and improvement of bridge and tunnel	Improvement of bridges and tunnels which have safety problems or restricts train speed.		Improvement of bridges and tunnels which have safety problems or at which train speed is not over than 40 km/h.		Same as Alternative I for about 1000 km and same as Alternative II for other sections.		At construction: Waste, air or water pollution, noise and vibration At operation: Landscape
Rehabilitation and improvement of rolling stocks	Introduction of new rolling stocks for limited express and local express.		Use of existing rolling stocks.		Introduction of new rolling stocks for limited express.		At operation: Public health, train noise and vibration

Table 6.4.5-1 (continued)

Major Policies	Alternative I	Alternative II	Alternative III	Related Environmental Items
Rehabilitation and improvement of workshops and depots	Pollutants treatment facilities at Gia Lam Workshop and Hanoi, Vinh, Da Nang, Nha Trang and Saigon Depot. Waste water treatment facilities at each workshop and depot.	Same as Alternative I excluding facility for new rolling stocks.	Same as Alternative I.	At construction: Waste, air or water pollution, noise and vibration At operation: Waste, water pollution
Others	Provision of plazas in front of major stations (Hanoi, Vinh, Hue, Da Nang, Nha Trang and Saigon)	Same as Alternative I.	Same as Alternative I.	At Construction: Air pollution, noise and vibration At operation: Landscape

Notes: As for *1, M.T.S.*1 and S.A.T.*1 show Maximum Train Speed and Shortest Arrival Time for limited express passenger (the upper) and direct freight (the lower), respectively.

Environmental examination is conducted based on the field survey and an analysis of expected environmental impacts attributable to each alternative. In executing the rehabilitation and improvement project, there are anticipated no significant difference from the present conditions and no serious adverse effects are expected. Therefore, each alternative is acceptable in terms of environmental examination.

Some environmental mitigating measures will be required both at construction and operation stages. In feasibility study stage, the measures should be studied with due attention with respect to the following items.

(1) Environmental Impact Assessment (E.I.A.)

Environmental impact assessment (E.I.A.) is required for the definite plan at a feasibility study stage. This is a pre-requisite of the project execution, and in this Study the E.I.A. is planned at the stage of feasibility study.

(2) Social Environment

1) Houses near the Railway Track

2) Traffic Facility

3) Public Health

4) Waste

(3) Natural Environment

1) Landscape

(4) Pollution

1) Air Pollution

2) Water Pollution

3) Noise and Vibration

6.2.5 Overall Evaluation

(1) Quantitative Evaluation

The most standard methods of quantitative evaluation are to use the national economy viewpoint indices of EIRR, CBR and NPV etc. to evaluate the Master Plan, and to use corporate financial viewpoint indices such as the FIRR etc. to evaluate the financial standing of the VNR which is the subject of the Master Plan.

EIRR gives Alternative I the best evaluation followed by III and II, whereas FIRR gives Alternative I and III the better evaluation than II which is the lowest. The Project aims to draw up a Master Plan for the rehabilitation and improvement of a north-south railway between Hanoi and Ho Chi Minh by the target date of 2010. As was described in 5.2.1, this will be a main railway line which will act as the backbone of Vietnam in supporting the nation's social and economic development. It is felt that evaluation of the Master Plan should be conducted from the national economic viewpoints. Moreover, it should be mentioned that the financial analysis assumes that the government will provide all of the VNR infrastructure investment, and thus financial evaluation does not take the state investment into consideration.

Another factor in the quantitative analysis is that the scale of investment should be realistic for Vietnam. The Master Plan for the restoration and modernization of VNR in 2010 must not be unrealistic and the scale of investment needs to be examined based upon the true potential of the scope of the Vietnamese economy and the scale of investment into the transport infrastructure.

Based upon ample consideration of the economic development of Vietnam by 2010 and the share of investment into the transport infrastructure and the railway system (see the Section 3.2), the JICA Study Team regards a figure of US$ 1,876 million to be a guide for the maximum amount of investment into Viet Nam railways by 2010. In terms of

scale of investment, Alternative II is the most inexpensive followed by III and I, however it may be possible to regard all three as being realistic. In summing up the quantitative evaluation, considering that the Project is a national project and that each of the Alternatives is realistic in terms of scale of investment, Alternative I is recommended as the Master Plan due to having the highest EIRR or national economic evaluation index value.

(2) Qualitative Evaluation

The basic policy in compiling the Master Plan for the restoration and modernization of the Hanoi-Ho Chi Minh Railway was described in Chapter 6. The qualitative evaluation shown in Table 6.2.5-1 indicates the evaluation of each alternative in terms of the items contained in the basic policy. Regarding items (4)-(9) of the nine items, each alternative was found to be more or less the same. However in terms of item (1) or social impact and indirect benefits (development along the line, industrial effect, expansion of employment etc.), Alternative I, which entails the biggest investment, the fastest trains and the safest and most reliable train services, was judged to be the best.

In terms of item (2) or train service efficiency, safety and reliability too, Alternative I was judged to be best due to the fact that it eliminates all slow speed sections and includes the biggest investment into improvement of interlocking devices, disaster prevention measures and level crossing warning systems etc.

Alternative I was also judged to be the best in terms of item (3) or investment into developing railway characteristics because, of all the alternatives, it improves the railway characteristics of speed, safety and reliability etc. the most.

(3) Overall Evaluation and Selection of Optimum Plan

Based upon the above quantitative and qualitative evaluation, the JICA Study Team recommends Alternative I as the Master Plan for the Hanoi-Ho Chi Minh Railway in 2010.

(4) Other

A plan, that is similar in the content to Alternative III, to dig a tunnel through the Hai Van Pass was also examined. The tunnel digging would lead to an increase in investment, however in order to limit such an increase, 110 km/hr train operation sections would be decreased by 20 km and slow speed sections in 110 km/h operation sections would be increased in number by two compared with Alternative III.

Apart from this, all other items and improvement contents are the same as in Alternative III. The travelling time of limited express passenger trains between Hanoi and Ho Chi Minh is 25 hours and the service time of direct freight trains over the same route is 41 hours, both of which are the same as under Alternative III. The amount of investment is some US$ 35 million more than in Alternative III and the EIRR value is lower than the other Alternatives. The FIRR value is roughly the same as for Alternative III, however in terms of overall evaluation this plan receives a lower value than Alternative III.

Appendix 6.4.6-1 of Volume I indicates travelling time reductions and countermeasure and improvement works costs for major areas of poor alignment such as Hai Van and Keness Passes. Such countermeasures should not be considered in terms of time reduction alone, but need to be examined amply from the viewpoint of increased transportation capability. In case the section of Hue and Da Nang happens to have a specific need to increase more the transport capacity, the cost/benefit analysis of digging a tunnel through Hai Van Path may become more advantageous than the analysis made here. The Master Plan is a long term plan having 2010 as its target year and as such will need to be reviewed after an appropriate term (may be 5 years in consideration of economy in transition in Vietnam) in line with the state of economic development in Vietnam at that time. It is hoped that the alignment improvement areas will either be integrated into the Master Plan at the time of its review, or implemented after its completion in 2010 depending on the progress of economy and the need of increasing transport capacity.

Table 6.2.5-1 Overall Evaluation Table

Evaluation Item \ Alternatives	I	II	III
A. Quantitative Item			
(1) EIRR	◎ (7.64)	○ (5.42)	○ (5.53)
(2) FIRR	◎ (10.61)	○ (8.15)	◎ (10.34)
(3) Realistic Investment Size (million US$)	○ (1630)	◎ (1227)	○ (1419)
B. Qualitative Item			
(1) Social impact, indirect benefit, environment	◎	△	○
(2) Efficient, reliable and safe train operation	◎	△	○
(3) Investment so as to make railway to display its advantageous characteristics	◎	△	○
(4) Formation of Integrated Transport System	○	○	○
(5) Investment on priority basis	○	○	○
(6) Stress on domestic technology	○	○	○
(7) Balanced improvement of railway system	○	○	○
(8) Compatibility with other development plans	○	○	○
(9) Compatibility with Master Plan in the Transport Development in the Northern Part in Vietnam by JICA	○	○	○
Total Evaluation	◎	△	○

Legend: ◎ Evaluated as best
○ Good / Evaluated as medium
△ Evaluated as lowest

6.3 Revised Future Demand

Upon the request of the Vietnamese Government, the JICA Study Team revised the Annual growth rate of GDP in finalizing the Master Plan. Based on the revised growth rate of GDP and making use of the latest traffic data in 1994, demand forecast was revised for the optimum alternative for the Master Plan as shown in the following.

(1) Passenger Traffic

Tables 6.3.1 and 6.3.2 show the total amount of passenger traffic. The total amount of passenger traffic is estimated to be 384 million trips in the year 2000 and 1,094 million trips in the year 2010. The annual growth rates are 12% for the period 1994-2000, 11% for the period 2000-2010. The larger growth in the earlier stage is caused by the rapid Increase in population until the year 2000. These also show that the trips are centered around Ho Chi Minh City, Hanoi, and Da Nang. These figures trace only inter-provincial traffic, and not include intra-provincial traffic.

The traffic mode diversities are shown in Tables 6.3.3 (with-project) and 6.3.4 (without-project). Table 6.3.3 shows the growth in the case of the railway rehabilitation done, showing increase in passengers from 8.8 million trips in 1994 to 12.4 million trips in the year 2000, and 23.1 million trips in 2010. Table 6.3.4 shows the growth in case that the reformation is not performed. There will be a slight increase because the total number of person trips will increase as the population increases, but the share of railway travelers will go down significantly. The rehabilitation and improvement of railway infrastructure and operation will prevent its share from going down rapidly.

Railway passenger trips in 1994 is 4.6% of total trips. But in 2010, this will turn to be 2.1% because an advancement in air traffic and road conditions result in higher growth rates of these modes, leaving the railway a subtle 2.1% in the year 2010.

Table 6.3.1 Forecast of Passenger Trips in the Year 2000

(unit: 000 persons)	1	2	3	4	5	6	7	Total
1 Northern Upland	8,840	27,260	638	147	34	135	6	37,060
2 Red River Delta	27,478	61,111	5,984	1,833	374	1,338	252	98,369
3 North Central	654	5,922	6,646	3,997	280	1,347	93	18,939
4 Central Coast	138	1,778	3,939	10,476	2,515	7,735	784	27,364
5 Central Highlands	32	374	273	2,508	115	2,596	151	6,048
6 Southeast	123	1,278	1,303	7,726	2,563	91,238	34,190	138,422
7 Mekong River Delta	5	234	89	769	150	34,241	22,943	58,431
Total	37,271	97,958	18,871	27,455	6,031	138,630	58,419	384,634

Table 6.3.2 Forecast of Passenger Trips in the Year 2010

(unit: 000 tons)	1	2	3	4	5	6	7	Total
1 Northern Upland	24,620	69,619	2,493	491	148	310	10	97,690
2 Red River Delta	69,684	143,201	18,531	4,712	1,451	2,720	604	240,904
3 North Central	2,530	18,335	21,498	12,567	1,297	3,340	312	59,880
4 Central Coast	4s60	4,640	12,418	27,532	10,417	20,008	2,461	77,936
5 Central Highlands	137	1,470	1,273	10,354	809	9,597	606	24,246
6 Southeast	281	2,630	3,354	19,961	9,459	293,254	89,270	418,209
7 Mekong River Delta	9	568	300	2,403	600	89,554	81,839	175,272
Total	97,722	240,462	59,866	78,021	24,181	418,782	175,102	1,094,137

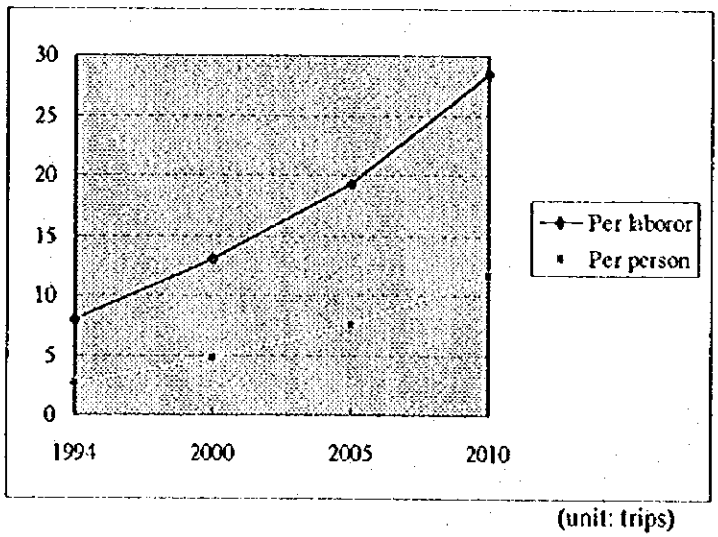


Figure 6.3.1 Passenger Trips per Person

Table 6.3.3 Mode Share of Passenger Traffic (With Project)

		Year 1994	Year 2000	Year 2005	Year 2010
Passenger Trips	Total	191,247,726	384,634,395	659,719,208	1,094,136,576
	Railway	8,807,434	12,416,816	17,040,539	23,119,926
	Road	181,527,512	370,381,435	639,307,353	1,063,572,945
	Air	912,780	1,836,144	3,371,317	7,443,706
Ratio (%)	Total	100.0	100.0	100.0	100.0
	Railway	4.6	3.2	2.6	2.1
	Road	94.9	96.3	96.9	97.2
	Air	0.5	0.5	0.5	0.7

Table 6.3.4 Mode Share of Passenger Traffic (Without Project)

		Year 1994	Year 2000	Year 2005	Year 2010
Passenger Trips	Total	191,247,726	384,634,395	659,719,208	1,094,136,576
	Railway	8,807,434	9,894,442	11,064,520	11,222,673
	Road	181,527,512	372,839,234	644,780,172	1,072,297,377
	Air	912,780	1,900,719	3,874,517	10,616,527
Ratio	Total	100.0	100.0	100.0	100.0
	Railway	4.6	2.6	1.7	1.0
	Road	94.9	96.9	97.7	98.0
	Air	0.5	0.5	0.6	1.0

But these numbers are based on the current preference of transportation model. If railways can prove that they are much more comfortable and convenient than using airplanes or buses, there is a possibility that the preference model itself may change. The quality of service is another key factor in increasing railway demand, in addition to time savings and cost saving factors that we have previously observed.

Table 6.3.4 (without-project) shows that demand for air travel will increase to 11 million trips. However the Vietnam Aviation Bureau only plans for expansion to 7 million trips, which means that demand overflows the supply. The excess passengers will convert to road traffic, according to our estimates.

(2) Cargo Transportation

The total amount of cargo transportation is 58 million tons for 1994, and estimates that it will reach 96.8 million tons in the year 2000, and 209.4 million tons in the year 2010. The growth rate behind these numbers are 8.7% from 1994 to 2000 and, 8.0% from 2000 to 2010. The larger growth rate in the earlier section reflects that the current traffic demands have not yet grown to the size appropriate for the economic activities of this country, and model shows a rapid growth achieved. Tables 6.3.5 and 6.3.6 do not include intra province trips. In comparison with passenger traffic data which showed a large amount of movement inside the large zones, cargo freight traffic shows large transactions between neighboring large zones. Cargo traffic also centers around Ho Chi Minh City, Hanoi and Da Nang.

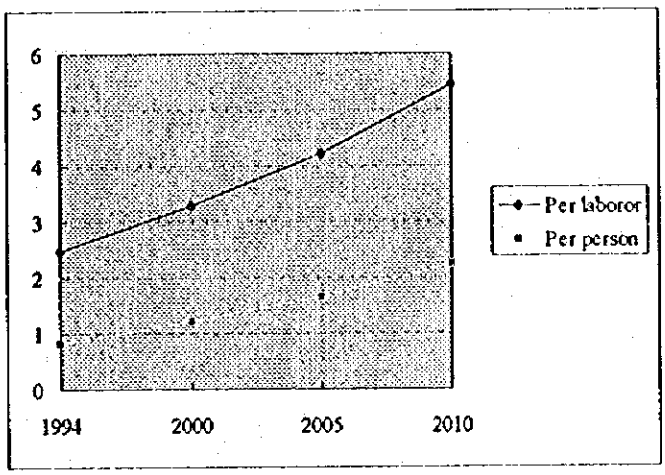
The number of cargo trips per person was 0.8 tons in the year 1994 and will be 1.2 tons and 2.2 tons in the years 2000 and 2010 respectively. The growth ratio is forecast to sharply go up. As shown in Figure 6.3.2, the ratio after the year 2000 is higher than that before the year 2000. Observing the data from another angle, the number is about 2 tons - 3 tons per GDP (US$1,000). The per GDP ratio will decrease slightly because the growth ratio of GDP is very sharp.

Table 6.3.5 Forecast of Cargo Trips in the Year 2000

(unit: 000 persons)	1	2	3	4	5	6	7	Total
1 Northern Upland	6,066	15,773	1,496	320	22	191	3	23,871
2 Red River Delta	9,881	4,910	1,695	444	0	138	31	17,099
3 North Central	1,402	2,591	2,332	1,180	54	244	15	7,818
4 Central Coast	436	573	1,107	2,784	882	1,476	178	7,436
5 Central Highlands	28	0	59	903	2	450	98	1,541
6 Southeast	227	804	280	1,504	475	6,490	11,052	20,833
7 Mekong River Delta	5	49	15	179	100	12,005	5,892	18,244
Total	18,046	24,700	6,984	7,314	1,535	20,994	17,271	96,843

Table 6.3.6 Forecast of Cargo Trips in the Year 2010

	(unit: 000 tons)	1	2	3	4	5	6	7	Total
1	Northern Upland	10,795	28,313	2,711	438	58	354	7	42,676
2	Red River Delta	19,781	10,257	3,526	679	0	314	46	34,604
3	North Central	3,130	5,542	5,086	2,092	141	595	27	16,612
4	Central Coast	941	1,205	2,276	4,690	1,779	3,531	298	14,720
5	Central Highlands	100	1	171	1,815	7	1,414	219	3,726
6	Southeast	582	2,254	790	3,381	1,420	21,141	27,530	57,098
7	Mekong River Delta	15	100	22	277	223	28,278	11,019	39,934
	Total	35,343	47,673	14,582	13,372	3,628	55,626	39,145	209,370



(unit: ton)

Figure 6.3.2 Cargo Trips per Person

The demand forecast of cargo trips by each traffic mode gets the results as shown in Table 6.3.7 (with-project) in case that the railway infrastructures are rehabilitated according the plan in this study. Table 6.3.8 (without-project) represents mode share of cargo in the case of without-project.

Total volume of cargo trips by railway will grow up to 4.7 million tons in the year 2000 and 14.8 million tons in the years 2000 and 2010 respectively, from 3 million tons in the base year 1994. And the share will also increase in the case of improvements. However without improvements of railway, the cargo volume will grow slowly because the growth ratio of cargo demand is totally high but the share of railway cargo will gradually decrease.

Table 6.3.7 Mode Share of Cargo Trips (With Project)

		Year 1994	Year 2000	Year 2005	Year 2010
Cargo Trips	Total	58,575,307	96,843,098	143,394,707	209,369,882
	Railway	3,182,951	4,654,907	8,644,116	14,831,757
	Road	40,085,187	68,772,556	105,516,391	160,131,563
	River	15,307,170	23,415,635	29,234,200	34,406,562
Ratio (%)	Total	100.0	100.0	100.0	100.0
	Railway	5.4	4.8	6.0	7.1
	Road	68.4	71.0	73.6	76.5
	River	26.1	24.2	20.4	16.4

Table 4.3.8 Mode Share of Cargo Trips (Without Project)

		Year 1994	Year 2000	Year 2005	Year 2010
Cargo Trips	Total	58,575,307	96,843,098	143,394,707	209,369,882
	Railway	3,182,951	3,525,095	6,491,746	8,406,388
	Road	40,085,187	70,110,882	108,080,702	167,422,468
	River	15,307,170	23,207,121	28,822,259	33,541,026
Ratio	Total	100.0	100.0	100.0	100.0
	Railway	5.4	3.6	4.5	4.0
	Road	68.4	72.4	75.4	80.0
	River	26.1	24.0	20.1	16.0

6.4 Treatment of Service Improvement and Coastal Shipping in Demand Forecast

In this section, the revised demand forecast is explained under the above considerations.

The revised factor on passenger trips is frequent service. However the analysis of the survey in June 1995 could not get the sufficient result for developing discrete choice model on service factors.

We will also revise the competition model of Cargo trips. The current model already incorporates the road transportation and the inland waterways, so only problem to be added is the competition rates with coastal shipping.

Table 6.4.1 shows the contents of railway cargo freight in 1994. Cement and coal are the items that face competition from coastal shipping, but the trips for these goods are relatively short-distance, and intra-region demands. Studies in other countries show that long-distance trips have a trend to shift to coastal shipping. For example, cargo freights in Southern Bangkok show that rail and coastal shipping each own half of the total demand, and in Japan, the volume of long-distance railway cargo and coastal shipping became equal in 1960, then shifted to shipping.

Considering the above fact, we estimated a 10% amount of long-distance cargo to be shifted to shipping for cement, coal, stone and wood. For fertilizers and foodstuff, long distance freights (75%-80%) are predicted to shift to shipping. For other products, it is forecast that all trips exceeding 600 kilometers will shift to coastal shipping.

Summing up these factors, we forecast that 30% of railway cargo will shift to coastal shipping. However, the economic growth rate suggests that it will take more than 10 years for all the ports and ships to be prepared, and for shipping to be competent with the land opponents. It is decided not to modify the forecast for the year 2000, but reconsider that there will be a 30% decline in railway cargo demands for the year 2010.

Table 6.4.1 Trip Length of Railway Cargo and the Modal Split to Coastal Shipping

Item	Share of Item	Trip Length and Share of the Distance	
Cement	27.5	100-346km(82%)/100-175km (74%)	About 10% of these items will be transported by ship.
Coal	13.9	less 175km(92%)	
Stone/ Gravel/ Sand	24.2	less 260km(76%)/80-425km (87%)	
Wood/ Furniture	5.7	220-530km (67%)	
Fertilizer	10.6	500-1726km(75%)	These trips have long distance. Coastal shipping is strong for long trips.
Food Stuff	3.6	1460-1726km(85%)	
Mineral/Salt/Apatite		less 600km	The role of railway will be the same.
Others		12% of all cargo (over 600km)	This part also will be transported by ship.
Total			30%

CHAPTER 7 KEY COMPONENTS OF SELECTED MASTER PLAN ALTERNATIVE

7.1 Major Contents of Master Plan

Major content of selected optimum Master Plan alternative is given in Table 7.1-1.

Table 7.1-1 Major Content Master Plan

Item		Major Content of Master Plan
Safety; Reliability; Speed-Up	Commercial, Transportation, Management	• Establishment of advance ticket booking and sales system • Establishment of cargo information system • Transportation management; analysis of train accidents; guidance and training • Strengthening of central management functions in relation to above issues
	Track; Stations	Track: 43 kg/m rails (25m) Long rails (R > 600m) Improved RC sleepers: 1,660 per km Improvement of fasteners Ballast: 250 mm or more Replacement of turnouts: High speed turnouts (80 - 110 km/h) Improved turnouts (≤ 80 km/hr) Ordinary turnouts (≤ 70 km/hr) Improvement of paving at all level crossings Construction of 4 new signal stations Increase of storage siding
	Subgrade Improvement	Those sites posing a problem for train operation or maintenance
	Cant; Transition Curve	Adoption of appropriate cant and prolongment of transition curve in response to degree of speed-up to be adopted
	Maintenance Facilities	High speed track inspection car; MTT; stone crushing facilities; track maintenance tools and equipment
	Station Square	At Hanoi, Vinh, Hue, Da Nang, Nha Tran and Ho Chi Minh
	Bridges; Tunnels	• All slow speed sections to be eradicated • Sites with safety hazards to be improved • Bridges longer than 20m, which are to be improved, to be raised avoiding flooding
	Signalling System	Token-less block system (to be completed in December, 1995) Introduction of colour-light signals and electric power supply unit at all stations Introduction of ATS at all stations Introduction of interlock devices Class 1 relay: 10 stations Class 2 relay: all others Approaching train warning system at 200 level crossings

Item		Major Content of Master Plan	
Safety; Reliability; Speed-Up	Communication	Underground cable to replace overground open wire line (8C + 30P) Introduction of optical transmission system (180 CH) Creation of telephone exchange network (14 switchboards and 16 sub-switchboards) New installation of data communication system Improvement of terminal facilities (centralised telephone system and yard telephone, etc. at all stations)	
	Rolling Stock		
	Limited Express Passenger Service	New high speed trains (axial load: 11 tons)	
	Inter-Regional Express Passenger Service	New high speed trains (axial load: 11 tons)	
	Local Passenger Service	Rehabilitation of present engines and addition of new engines (D12E)	
	Through Cargo Service	Rehabilitation of present DELs and addition of new DELs (D18E); addition of new wagons (roller bearing)	
	Inter-Regional Cargo Service	Rehabilitation of present DELs and addition of new DELs (D18E); addition of new wagons (roller bearing)	
	Local Cargo Service	Rehabilitation of present DELs and addition of new DELs (D12E); addition of new wagons (roller bearing)	
	Rolling Stock Maintenance	• Improvement of Gia Lam Workshop - Maintenance facilities for DELs and PCs for high speed trains - Maintenance facilities for DELs - Spare parts for repair of DELs • Improvement of DEL maintenance depots • Improvement of PC and wagon maintenance workshops and depots	
	Disaster Prevention		
	Slope Improvement	Slopes posing a safety hazard for train operation	
	Prevention of Falling Stones	Sites posing a safety hazard for train operation (guardfences; warning signals)	
	Drainage Facilities	Sites posing problems in terms of train operation, safety and the environment	
	Banking to Avoid Flooding	Total length of sections vulnerable to flooding: 57 km (new high banked track)	
Service Standards	Maximum Speed/ Travelling Time	Vmax	Travelling Time
	Limited Express Passenger Service	110 km/hr (new trains)	24 hours
	Inter-Regional Express Passenger Service	110 km/hr (new trains)	
	Local Passenger Service	75 km/hr (existing rolling stock)	
	Through-Stop Cargo Service	80 km/hr	40 hours
	Inter-Regional Cargo Service	80 km/hr	
	Local Cargo Service	70 km/hr	
Environmental Measures		Waste water from workshops and depots to be treated Mitigating measures on train noise in large cities	
Training Facilities		Reinforcement of existing practical training facilities of railway colleges in Hanoi and Ho Chi Minh City	
Investment Amount (million US$)		1688.9	

7.2 Cost Estimate

The planned investment size under the Optimum Alternative is shown in Table 7.2-1. Compared with Alternative I (Table 6.4-2 of Vol. I), the total cost has increased by 20.5 million US$, mainly because of the review of the rolling stock plan based on revised demand forecast.

This increase, however, has no bearing on the selection of the Optimum Alternative from the 3 available alternatives and Alternative I is still considered to be the Optimum Alternative.

Table 7.2-1 Investment Size Under Optimum Alternative

Item	Optimum Alternative (million US$)
Track Stations Disaster Prevention	413.30
Bridges	427.60
Tunnels	56.30
Signalling	62.10
Communication	108.50
Rolling Stock	556.10
Workshops and Depots	65.00
Total	1,688.9

7.3 Economic and Financial Evaluation

Table 7.3-1 summarizes the results of economic analysis. Its absolute level is a bit lower than the opportunity cost of capital.

Table 7.3.1 EIRR of Selected Master Plan and Results of Sensitivity Analysis (based on Phased Improvement Plan)

Cost / Benefit	+20%	+10%	Normal	-10%	-20%
Alternative I					
-20%	na		6.1%		
-10%		6.3%	7.2%		
Normal	6.5%	7.3%	8.3%	9.3%	10.6%
+10%			9.2%		
+20%			10.1%		

Sensitivity analysis proves that the EIRR is the mot sensitive to the reduction of cost and the reduction of benefit. The latter will lower the EIRR up to 6.1% if the benefit is reduced by 20%. It is judged that benefit reduction attributable to the slower economic growth will affect the viability of the project if it occurred. and the observation of economic trend is especially significant in this project.

The financial evaluation results are shown in Table 7.3.2.

Nine different sensitivity analyses were conducted for the Base Case, representing ±10% and ±20% changes of the income and operation cost.

In conclusion, management of the Hanoi - Ho Chi Minh Railway is fairly sensitive to financial conditions. Given such sensitivity, extra management efforts will be required to achieve a higher income an lower cost than the target figures indicated by a long-term plan. To be more precise, the basic business strength of the Hanoi - Ho Chi Minh Railway should be improved to bring about a FIRR of 10% or more as in the case of Sensitivity Analyses Marked*.

Table 7.3.2 Sensitivity Analysis (FIRR for 35 Years Evaluation)

Cost / Benefit	+20%	+10%	Normal	-10%	-20%
-20%			4.1%		
-10%		5.7%	6.9%		
Normal	7.2%	8.3%	9.4%	10.5%	11.6%
+10%			11.9%		
+20%			14.4%		

CHAPTER 8 PHASED IMPROVEMENT PLAN

8.1 Introduction

Phased Improvement Plan for the optimum Master Plan (Alternative I) is described below and the following target values for each stage and phased development contents have been established through discussions with the Vietnamese side.

Despite the established contents and targets for each phase, the feasibility study for Phase 1 has examined the possible investment deferment for some of the components of Phase 1 to the Phase 2 period and for some of the components of Phase 2 to the Phase 3 period based on strict assessment of the investment necessity and likely cost of each component in each phase.

8.2 Establishment of Quantitative Targets for Each Phase

As easily understandable improvement indices for each phase, the travelling times of limited express passenger trains and direct freight trains between Hanoi and Ho Chi Minh City are set as described below. Naturally, it is necessary to take reliability and service safety into proper consideration. The target values are given for each phase for the basic items relating to safety and reliability.

The target values for each phase shown in Table 8.2-1 has been changed during the feasibility study process for Phase 1, where new idea of selecting priority sections in Hanoi - Hochi Minh Line and of placing emphasis on management improvement has been introduced in addition to improving safety and reliability and services.

Table 8.2-1 Targets of Each Phase

	Type of Service	Phase 1 - 2000	Phase 2 - 2005	Phase 3 - 2010	Remarks
Safety and Reliability (key items only)	Reduction of slow speed sections at bridges and tunnels	23%	40%	37%	
	Introduction of colour-light signals	all stations			
	Introduction of relay interlocking together with power supply	2nd class relay inter-locking for all stations, excluding stations where 1st class relay inter-locking is introduced		1st class relay interlocking 10 stations	
	Introduction of ATS	38%	62%		
Travelling Time	Limited Express Passenger Trains (Hanoi - Ho Chi Minh City)	32.5 hours	28.0 hours	24.0 hours	Inclusive of some 70 minutes for stoppages (7 stations) and spare time
	Direct Freight Trains (Giap B. - Ho Chi Minh City)	46.0 hours	43.0 hours	40.0 hours	Inclusive of some 13 hours for stoppages (14 stations) and spare time

Notes
1. The line conditions for each phase are given by the phased improvement plan for track, etc.
2. The maximum train speeds are 110 km/hr for limited express passenger trains and 80 km/hr for through freight trains.

8.3 Preparation of Phased Improvement Plan

The Phased Improvement Plan shown in Table 8.3-1 has been prepared based on the following principle. Investment in Phase 1 will be concentrated on those items with high priority in terms of both safety and reliability improvement while investment in items of lesser priority will be conducted in Phase 2 or Phase 3.

Table 8.3-1 Outline of Phased Improvement Plan

	First Phase					Second Phase					Third Phase				
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Commercial, Transportation, Management															
Establishment of advance ticket booking and sales system															
Establishment of cargo information system															
Transportation management; analysis of train accidents; guidance and training															
Strengthening of central management functions in relation to above issues															
Track and Stations															
Track Reinforcement		Track reinforcement extension 530 km						Track reinforcement extension 580 km					Track reinforcement extension 666 km		
Rails 43 kg/m rails															
25 m, long rails															
Turnouts															
Sleepers															
Track bed															
Level Crossing Improvement		205 places						322 places					334 places		
Roadbed Improvement															
Cant and Transition curve Improvement															
Curvature Improvement															
Maintenance Facilities															
Track inspection car						○ 1									
MTT					○	2			○ 2				○ 2		
Ballast equipment	○ U-3					○ U-2					○ U-1				
Other tools and equipment															
Training Facilities															
New Signal Stations		3 stations						4 stations					3 stations		
Increase of Storage siding															
Station square improvement									2 stations				4 stations		
Investment Sub-Total		129.1						93.4					86.8		
Bridges															
Bridge rebuilding in sections of Stage 1 track reinforcement (excluding the following)		56 places, 2.2 km													
Rebuilding of all L ≥ 20 m, V < 30 km/h bridges															
Rebuilding of L ≥ 20 m, V ≥ 30 km/h bridges (in the same sections and stages as track reinforcement)		26 places, 3.5 km						84 places, 4.9 km					122 places, 6.6 km		
Rebuilding of all L < 20 m, V < 50 km/h bridges															
Rebuilding of L < 20 m, V ≥ 50 km/h bridges (in the same sections and stages as track reinforcement)		68 places, 0.6 km						162 places, 1.0 km					108 places, 0.9 km		
Training Facilities and Measuring Instruments															
Investment Sub-Total		142.5						142.5					142.5		
Tunnels															
Rebuilding of all V < 30 km/h tunnels		10 places, 2.8 km													
Rebuilding of V ≥ 30 km/h tunnels (in the same sections and stages as track reinforcement)								10 places, 3.7 km					7 places, 1.3 km		
Training Facilities and Measuring Instruments															
Investment Sub-Total		22.5						24.9					8.0		

	First Phase					Second Phase					Third Phase				
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Signals															
Colourlight signals		139 stations													
Improvement or introduction of Class 2 relay interlocking devices and power units and signal stations		162 stations + 3						4					3		
ATS system installation			62 stations				100 stations								
Introduction of level crossing approach warning system			57 places				143 places						10 stations		
Introduction of class 1 relay interlocking devices															
Training Facilities															
Investment Sub-Total	28.2					21.7					12.2				
Communications															
Laying of communication cable		792 km					934 km								
Installation of transmission devices				10 places					8 places						
Installation of data transmission facilities									2 sets						
Renewal of switchboards													14 places		
Renewal of terminal facilities (including new signal stations)													172 stations		
Training Facilities															
Investment Sub-Total	40.4					56.9					11.2				
Rolling Stock															
New high speed trains			5 trains					22 trains					17 trains		
New D18Es			33 cars					12 cars							
New D12Es			16 cars												
New passenger car			21					56					68 cars		
New freight cars		661 cars PC 20 cars					1791 cars						2860 cars		
Rehabilitation		D1H 10 cars					D13E, D15E 30 cars						D12E 40 cars		
Investment Sub-Total	121.7					223.0					211.4				
Workshops and Depots															
Improvement of Workshop															
Gia Lam Workshop	Building, facilities, machinery, equipment and tools, sewage disposal facility etc.										Effluent treatment plant				
						More circulatory spare parts for DEL maintenance									
Dian Workshop						Machinery, equipment, tools etc.					Effluent treatment plant				
Improvement of Depot															
Hanoi, Vinh, Da Nang, Nha Trang, Saigon Depot				Sewage disposal facility											
DL Depot								Machinery, equipment, tools etc.							
PC FC Depot										Building, machinery, equipment, tools etc.					
DL PC FC Depot											Effluent treatment plant				
Investment Sub-Total	36.0					11.7					17.3				
Disaster Prevention Measures															
Slope improvements															
Protection from falling rocks															
Drainage facilities															
Investment Sub-Total	10.0					23.0					12.0				
Banking to prevent flood															
Investment Sub-Total						17.0					42.0				
Investment Total (million US$)	530.4					614.1					544.4				

CHAPTER 9 SELECTION OF FEASIBILITY STUDY PROJECTS

9.1 Selection of Feasibility Study Projects based on Hanoi – Ho Chi Minh Railway Master Plan

The subject of the F/S is in principle the Phase I of the Phased Improvement plan of Master Plan with a target year of 2000.

Feasibility study has been carried out with due consideration not only on safe and reliable train operation but also on management analysis and improvement, and marketing. Further three priority sections were selected in the line where investment and services were intensified with a view to present a demonstration effect.

In addition, the investment necessity for improvement items in Phase I has been further examined as part of the relevant F/S to strictly determine the required investment amount, transferring some improvement items from Phase I to Phase II, or from Phase II to Phase III.

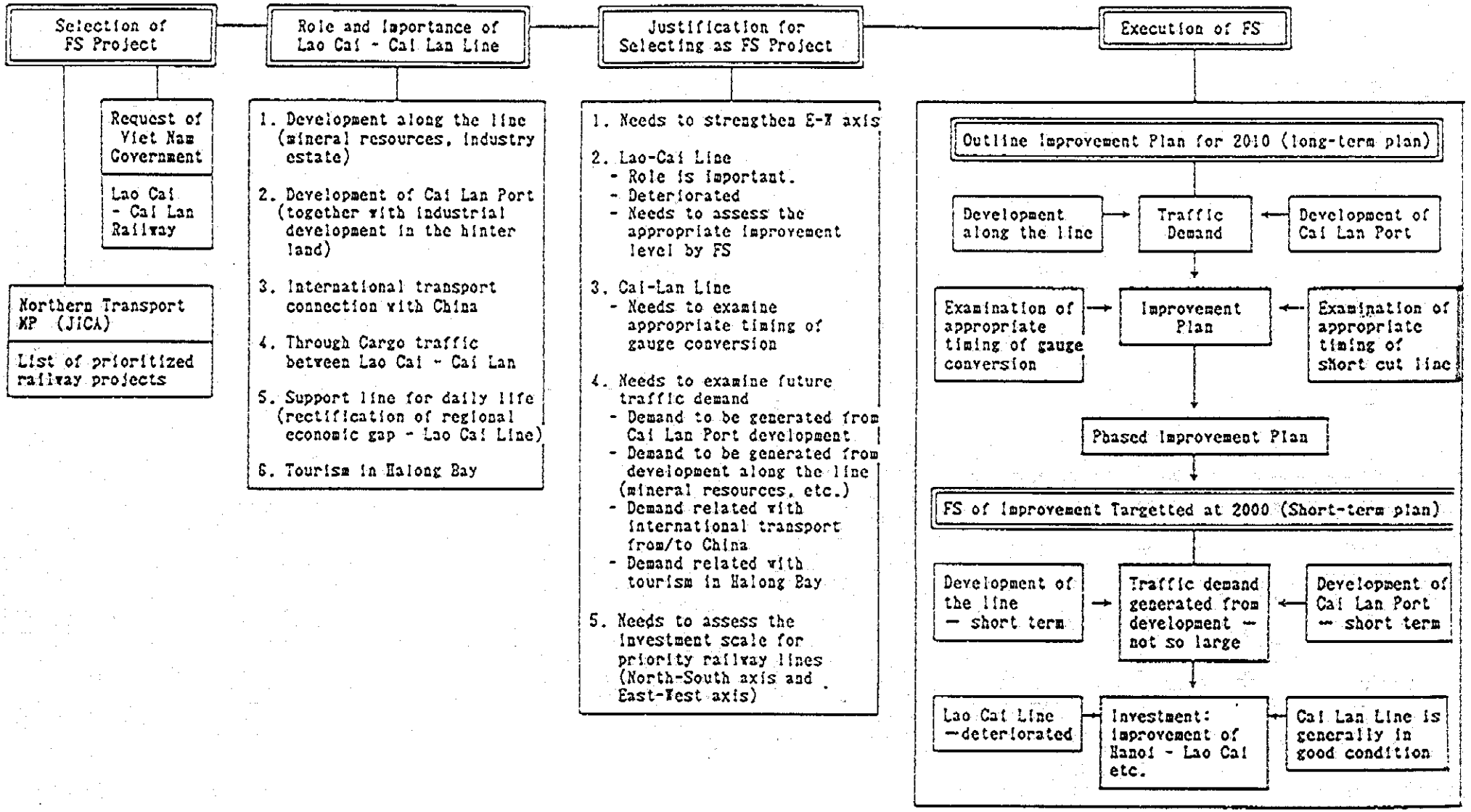
9.2 Selection of Lao Cai – Cai Lan Line as Feasibility Study Projects

The Study Team was required to select an urgent project for a feasibility study through consultations with the Ministry of Transport and Communications of Vietnam based on the Master Plan Study on Transport Development in the Northern Part of Vietnam (JICA) (hereinafter referred to as the Northern Transport M/P) within the given Scope of Work.

Lao Cai - Cai Lan Line was selected for a feasibility based on the mutual agreement between Vietnamese government and JICA.

The selecting process and concept of how to execute the feasibility study is shown in Fig. 9.2.

Fig. 9.2 SELECTION OF FS PROJECT IN THE NORTHERN AREA AND EXECUTION OF FS



CHAPTER 10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions and Recommendations

The most standard methods of quantitative evaluation are to use the national economy viewpoint indices of EIRR, CBR and NPV etc. to evaluate the Master Plan, and to use corporate financial viewpoint indices such as the FIRR etc. to evaluate the financial standing of the VNR which is the subject of the Master Plan.

EIRR and FIRR of the Master Plan are provided in 7.3. The Project aims to draw up a Master Plan for the rehabilitation and improvement of a north-south railway between Hanoi and Ho Chi Minh by the target date of 2010. This will be a main railway line which acts as the backbone of Vietnam in supporting the nation's social and economic development. It is felt that evaluation of Master Plan should be conducted from the national economic viewpoints. Moreover, it should be mentioned that the financial analysis assumes that the government will provide all of the VNR infrastructure investment, and thus financial evaluation does not take the state investment into consideration.

The EIRR value for the Master Plan provided in 7.3 is not so large. Normally, the feasibility of projects in terms of national economy is evaluated with the EIRR and judgment of economic feasibility is made depending on whether or not the EIRR value is greater than the country's capital opportunity cost (Capital opportunity cost varies depending on the economic conditions of a country).

Only quantitative benefits such as time and transportation cost benefits are considered in EIRR calculations (there is a possibility that the EIRR value would increase if other quantitative benefits such accident benefits (the benefits obtained from reduced accidents), which were not included in these calculations due to no data being available, were included). However, many indirect and unquantifiable benefits are not taken into consideration in calculating EIRR. In this regard, the Master Plan Project should not be evaluated by EIRR alone.

The Project is a national project designed to achieve the restoration and modernization of the Hanoi-Ho Chi Minh Railway. By fully developing the functions of the said railway, the Project achieves (1) stimulate socio-economic development along the line, (2) induce beneficial effects for related industries, (3) expand employment through investment, (4) form an efficient and integrated transport system in Vietnam together with improvements in road,

air, sea and other transport system, and (5) promote north-south integration in Vietnam which had previously been politically, socially and economically divided.

Considering these and other indirect benefits of the Project which cannot be measured in quantitative terms, it is recommended that the Project Master Plan should be implemented immediately as a significant transport infrastructure that will support economic development of Vietnam.

In realizing the Master Plan of Hanoi-Ho Chi Minh Railway, improvement should be made step by step. In this regard, JICA Study Team has drawn up the phased improvement plan under close cooperation of the Counterpart.

10.2 Recommendations for Improvement After 2010

The JICA Study Team has now proposed the Hanoi - Ho Chi Minh Railway Rehabilitation and Improvement Master Plan with a target year of 2010. In preparing this Master Plan, strict emphasis was placed on a realistic investment size. As a result, the Master Plan does not necessarily include the world's latest railway technologies relating to meter gauge. A further improvement plan for the VNR beyond 2010 has been recommended, taking the world's latest railway technologies into consideration. These recommendation include various aspects of management and operation, transportation plan, railway civil and electrical facilities, rolling stock and workshops, environmental conservation, speeding up, electrification, doubling of track etc. When the long term Master Plan will be reviewed after 5-10 years, these recommendation suggested to be introduced after 2010, may be reviewed for introduction depending on the economic situation of Viet Nam.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