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Ministry of Transport, Socialist Republic of Vietnam (MOT)
Transport Development and Strategy Institute (TDSI)

THE STUDY ON THE
NATIONAL TRANSPORT DEVELOPMENT STRATEGY
IN THE SOCIALIST REPUBLIC OF VIETNAM
(VITRANSS)

Technical Report No. 6

RAILWAY

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PREFACE

During the period of the Study on the National Transport Development Strategy in Vietnam (VITRANSS), various technical papers have been prepared by different Study Team members in various occasions to facilitate the discussions with counterpart team, concerning subsector agencies and to document major findings and outputs produced in the process of the Study. These papers have been organized into a series of technical reports (See Table A below) which intend to provide more detailed background information for descriptions and discussions made on key study components and issues. These technical reports are working documents of the Study which, however, will be useful for further reference, by the counterpart team and related subsector agencies.

Table A
List of Technical Reports

No. 1	Transport Surveys and Database
No. 2	Main Commodities Analysis and Freight Transport
No. 3	Transport Cost and Pricing in Vietnam
No. 4	Transport Sector Institutions
No. 5	Road and Road Transport
No. 6	Railway
No. 7	Inland Waterway
No. 8	Port and Shipping
No. 9	Air Transport
No. 10	Rural Transport and Cross Border Transport
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5 CANDIDATE PROJECTS FOR MASTER PLAN

Glossary

CTC	Centralized Train Control
DC	Diesel Car
DL	Diesel Locomotive
DMU	Diesel Multiple Unit
EL	Electric Locomotive
EMU	Electric Multiple Unit
FC	Freight Car
HCMC	Ho Chi Minh City
HP	Horsepower
JICA	Japan International Cooperation Agency
MTT	Multiple Tie Tamper
OECF	Overseas Economic Cooperation Fund
PC	Passenger Car
PMU	Project Management Unit
SOE	State-owned Enterprise
TU	Transportation Unit (Sum of Passenger-km and Ton-km)
VND	Vietnam Dong
VR	Vietnam Railway

Notes in the chapter “Railway”

1. Currency units are calculated in the following rates .

   US$ 1 = Yen 110 = VND 14,000

2. In the construction cost, the cost for the land and site clearing (or compensation) is not included.

1 INTRODUCTION

The railway network in Vietnam is approx. 2,600 km. And on it, nearly 170 trains are running everyday and they carry 27,000 passengers and 14,000 tons of freight everyday. The transportation volume by railway occupies approx. 10.8% (passenger·km) and 4.7% (ton·km) of the total transportation (passenger·km and ton·km) of Vietnam.

The Vietnam railway (VR) is the only railway sector in Vietnam and its employees are approx. 42,000. In 1996, the Government has introduced the big two policies to the railway management. The one is the separation of the railway system into two parts, so-called the upper part and the lower part. The upper part, that is the transportation using the infrastructure and the lower part is the infrastructure itself. The upper part is run by the VR and the lower part is held and maintained by the government. The other policy is the introduction of so-called State Owned Enterprise (SOE) to the organizations in the VR. Most of the working sites and offices are converted into the SOE.

Vietnamese railway has a history over 100 years. Now the Vietnam railway is in the midst of great structural changes in many aspects. Productivity, privatization, financing, technology, investment, education, etc., there are so many problems to be solved. To have a better answer to every problem, the fundamental understanding of VR is essential. And the future plan shall be one step to the solution of those problems. In this sense, long term strategy and plans are now studied.

Vietnam is a long and narrow country of the area 330 thousand km^2 and of nearly 80 million people. VR must be an effective transportation system to the people and the society. What is the best style of VR? In this report these fundamental information for the future shall be studied.

2. REVIEW OF RELATED STUDIES/PLANS/PROJECTS

There are investigations, studies, plans and projects concerning VR and VR future. The following are such works that the team encountered during information gathering.

2.1 Past Studies and Recommendations

Many studies of VR have been made by various organizations. The following are the several studies encountered as related studies during this investigation and study.

(1) OECF (Japan)
- (i) Hanoi-HCMC Railway Bridge Rehabilitation Project

(2) JICA
- (i) Railway Rehabilitation Lao Cai/Cai Lan – Hai Phong (F/S), Hanoi – Lang Son (F/S), Hanoi – HCMC (M/P)
- (ii) Urban Transport Plan for Hanoi City (M/P)
- (iii) Modernization and Rehabilitation of Vietnamese Railway Track Lines: Preliminary Study 1992 JICA

(3) French ODA
- (i) Crane for break-down locomotives
- (ii) Out-line manufactured bogies plant
- (iii) Signals and Telecommunications systems on railways between Hanoi and Vinh
- (iV) Repairing railways tunnels at Hai Van pass
- (v) Transport Master Plan for the Central Region of Vietnam

(4) Germany
- (i) Feasibility Study on Urban Railway System of Hanoi
- (ii) Unterstutzung bei der Restrukturierung von Vietnam Railways, Jan. 1996
- (iii) The project “Rehabilitation of 15 Romanian locomotives”

In the above reports, the future plan of the Vietnam railway network is most clear in the studies of JICA teams. North – South line, Hanoi – Lao Cai line, Hanoi – Haiphong line, they were neatly studied and resulted in good reports.

2.2 On-Going and Committed Projects

VR’s projects for investment up to the year 2000 and beyond are shown in the Table 2.1.1.

Table 2.1.1
On-Going and Committed Projects

No.	Project	Estimated cost	Implementation planned
1	Machanization of track work	US$ 20 mil.	1996 - 2000
2	Upgrading Hanoi-Haiphong line	US$ 160 mil.	1996 - 2005
3	Upgrading Hanoi-Dong Dang line	US$ 200 mil.	1996 - 2005
4	Rehabilitation of 18 railway bridges on Hanoi-HCM city line	US$ 160 mil.	1996 - 2005
5	Improving line capacity of Hue-Danang section	US$ 100 mil.	1996 - 2000
6	Repairing of railway tunnels on Hanoi-HCM city line	US$ 15 mil.	1996 - 2005
7	Upgrading Hanoi-Vinh section	US$ 30 mil.	1996 - 2000
8	Upgrading Hanoi-Lao Cai line		1996 - 2005
9	Development of Urban rail transport systems for Hanoi and HCM city	US$ 1.5 bil.	1998 - 2005
10	Establishment of DEL overhauling facility	US$ 20 mil.	1998
11	Establishment of bogie manufacturing line	FF 14 mil.	1998
12	Car-body manufacturing technology transfer		1999
13	Procurement of German locomotives and carriages & spare parts	DM 170 mil.	1999
14	Procurement of 10 Czech locomotives	US$ 8 mil.	1997 - 1999
15	Procurement of push-pull trains & railcars		1998 - 2000

Source: Brochure of VR 1998

2.3 Government Plan and Policy

Vietnam government and VR intend to implement railway policy according to the following items.

(1) Upgrading the North-South line: speed up; passenger trains up to 100 – 120km/h, freight trains up to 80 – 100km/h.
(2) Upgrading West-East corridor: speed up; passenger trains up to 80 – 100km/h, freight trains up to 60 – 80km/h.
(3) Investigation of new lines: HCM city to Vung Tau, HCM city to Can Tho, Thap Cham to Da Lat, Yen Bai to Tuyen Quang to Bac Thai, and others.
(4) Survey and preparation for the connection with Trans-Asia railways and Singapore – Kunming railway link: This item enlightens the survey between HCM city to the Cambodia border and Danang to Laos border.
(5) Studying the rail based urban transport system: Hanoi and HCM city.

3 CURRENT SITUATION

3.1 Administrative Framework

VR has a railway network of approx. 2,600km and approx. 42,000 employees. Nearly 170 trains are operated every day and they carry 27,000 passengers/day and 14,000 tons/day. This transportation has been achieved by the organization below.

Vietnam Railway's organization is shown in Figure 3.1.1. VR is composed of the headquarters and several branch organizations. Headquarters is at Hanoi and 367 staffs working there. Branch organizations are categorized into 5 sections by the financing and kinds of work. They are,

I: 28 state-owned enterprises (so-called construction and installation block, industrial block and hotels-tourism-materials block),
II: 20 state-owned enterprises (so-called facilities and equipment maintenance sections; track maintenance block and signals and communication maintenance block),
III: train railway service and operation block (so called Union1,2,3)
IV: schools, health care and newspaper section and,
V: project management units.

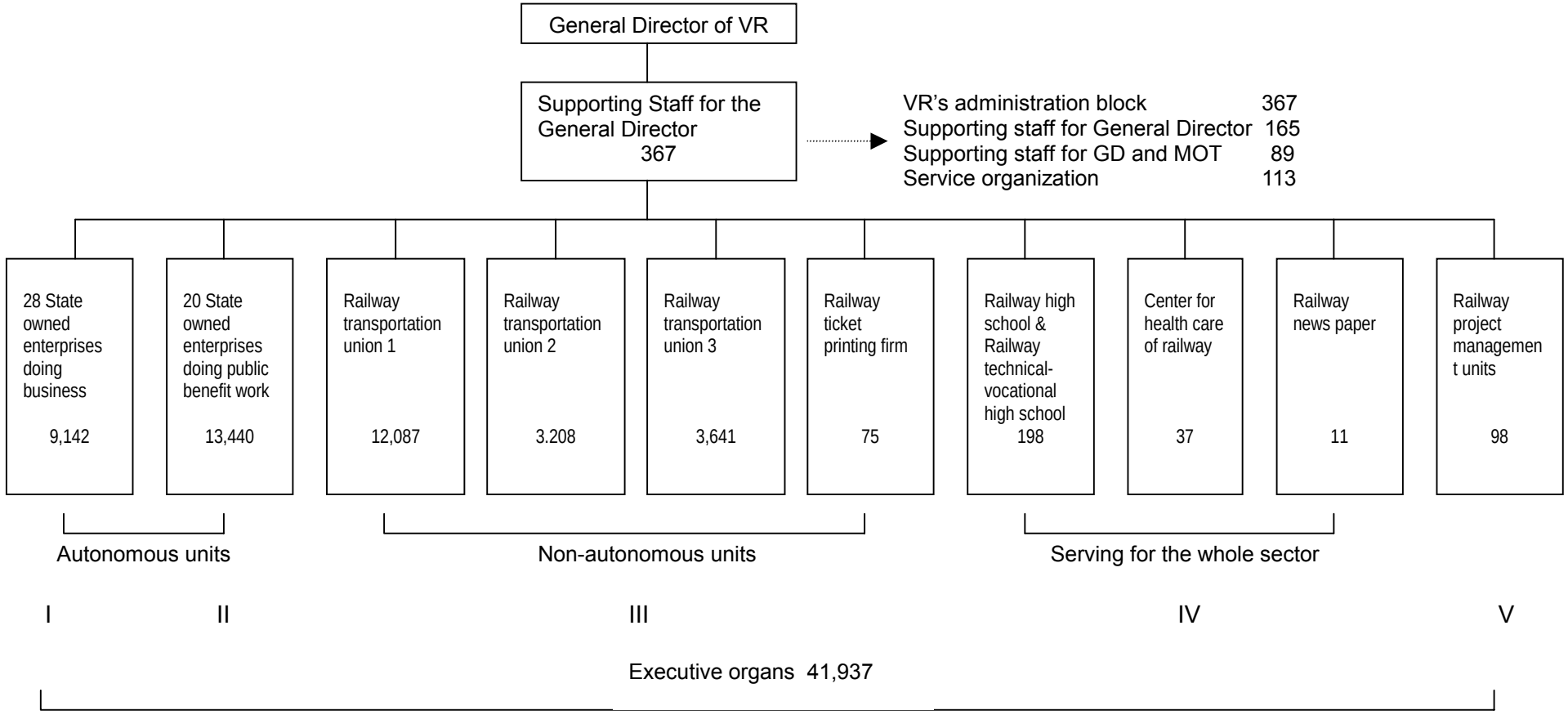
Railway service and train operation sections (category III) are 3 Unions and each head office is at Hanoi, Danang, and HCMC city, respectively.
Category I, II, IV & V sectors are closely connected with each Union. Most of their work comes from corresponding Unions.

Figure 3.1.2 shows the headquarters' sections and staff numbers. The General Director and 5 Vice Directors work with the support of the headquarters and control it.

The Vice Director of Engineering controls directly the PMU (Railway project management units) which is not included in the headquarters.

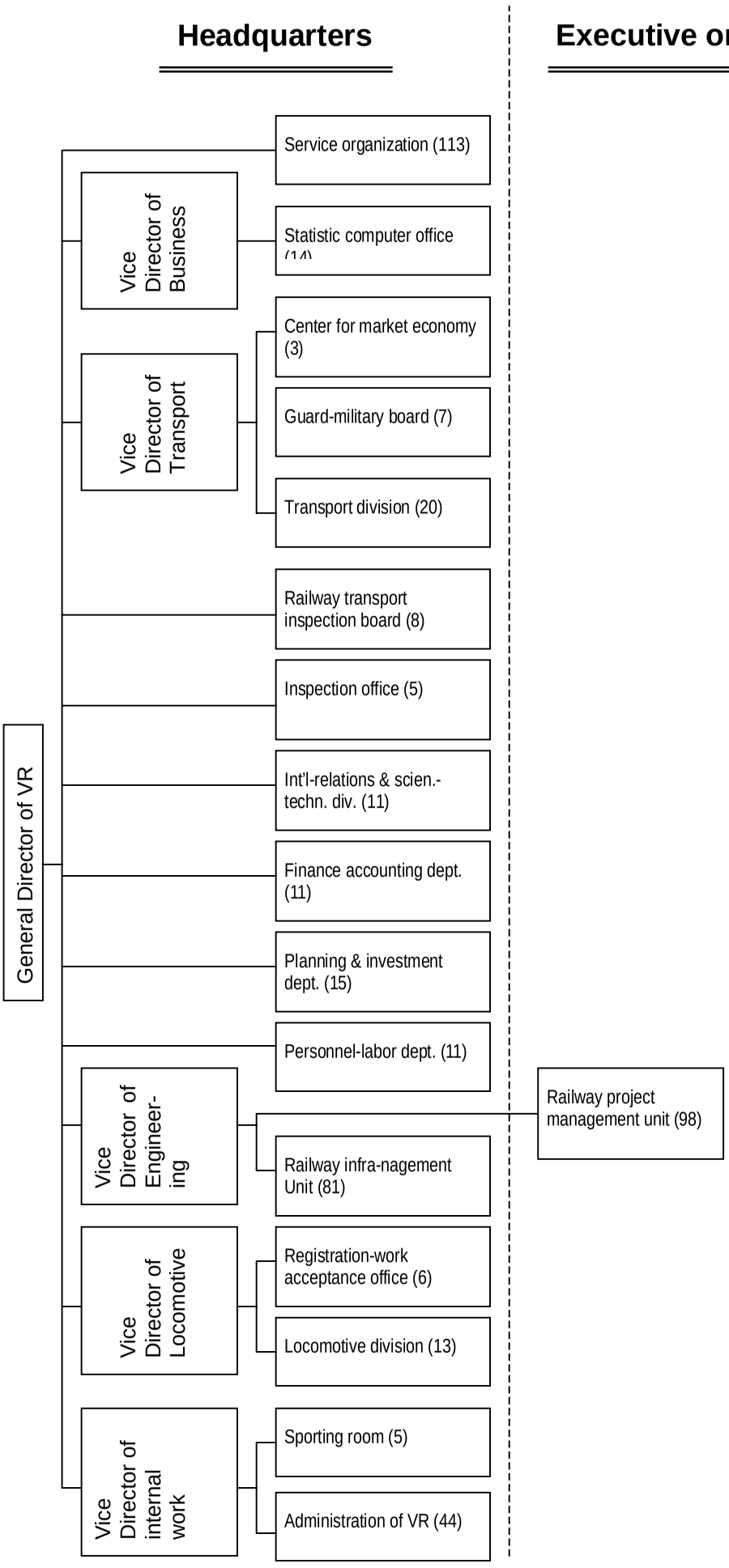
Figure 3.1.2 shows the administration block (headquarters) and the executive organs (branches) of VR. The total staffs and employees are approx. 42,000 at the end of 1998.

Figure 3.1.1
Organization of Vietnam Railway (VR)



Note: Numerical numbers show staffs and employees.

Figure 3.1.2
Organization chart of the Supporting Staff for the General Director



3.2 Network

VR has approx. 2,600 route-km of railways and the railway network is composed of 7 main lines and several branch lines. They are all single track. There is no double track section in VR. The network is shown in Figure 3.2.1 and Table 3.2.1. The railway track is composed of 1,000mm gauge width, 1,435mm gauge width and the combined dual gauge.

Table 3.2.1
Railway lines in Vietnam

Section	Distance (km)	%	Track gauge (mm)	Note
Hanoi – Saigon	1726	66	1,000	
Cau Giat - Nghia Dan	30	1	1,000	
Dieu Tri – Quy Nhon	10		1,000	
Hanoi – Dong Dang	166	6	1,000 & 1,435	Dual gauge
Yen Trach – Na Duong	31	1	1,000	
Yen Vien – Lao Cai	285	11	1,000	
Tien Kien – Lam Thao	3		1,000	
Pho Lu – Pom Han	24	1	1,000	
Gia Lam – Haiphong	91	3	1,000	
Dong Anh – Quan Trieu	54	2	1,000 & 1,435	Dual gauge
Kep – Ha Long	105	4	1,435	
Chi Linh – Co Thanh	16	1	1,435	
Luu Xa – Kep	56	2	1,435	
Van Dien – Bac Hong	41	2	1,000	
1,000mm total	2241	85.5		
Dual gauge total	220	8.4		
1,435mm total	161	6.1		
All total	2622	100		

In the above railway lines, Hanoi – Saigon line occupies 2/3 of the total. As for the operation of trains, 1,000mm-gauge train can run 94% of the whole network, and 1,435mm trains can run 15% of the whole network.

From the geographical and provincial aspect, the railway network covers 31 provinces in the whole 61 provinces (Table 3.2.2 and Figure 3.2.2). Provinces covered by railway network is 51% (31/61); It is in the other indices 57% by population ratio, 47% by land area ratio or 60% by GDP, respectively.

From the viewpoint of railway network density, VR network is most scarce in the south, esp. in the Mekong Delta region. There is no clue of railway network in Mekong Delta 12 provinces. Although the Mekong Delta's share in Vietnam is, 22% by population, 12% by land and 20% by GDP, respectively (Table 3.2.2). It is evident that the Mekong Delta region is the most productive area without railway network in Vietnam.

Figure 3.2.1
Railway Route Map

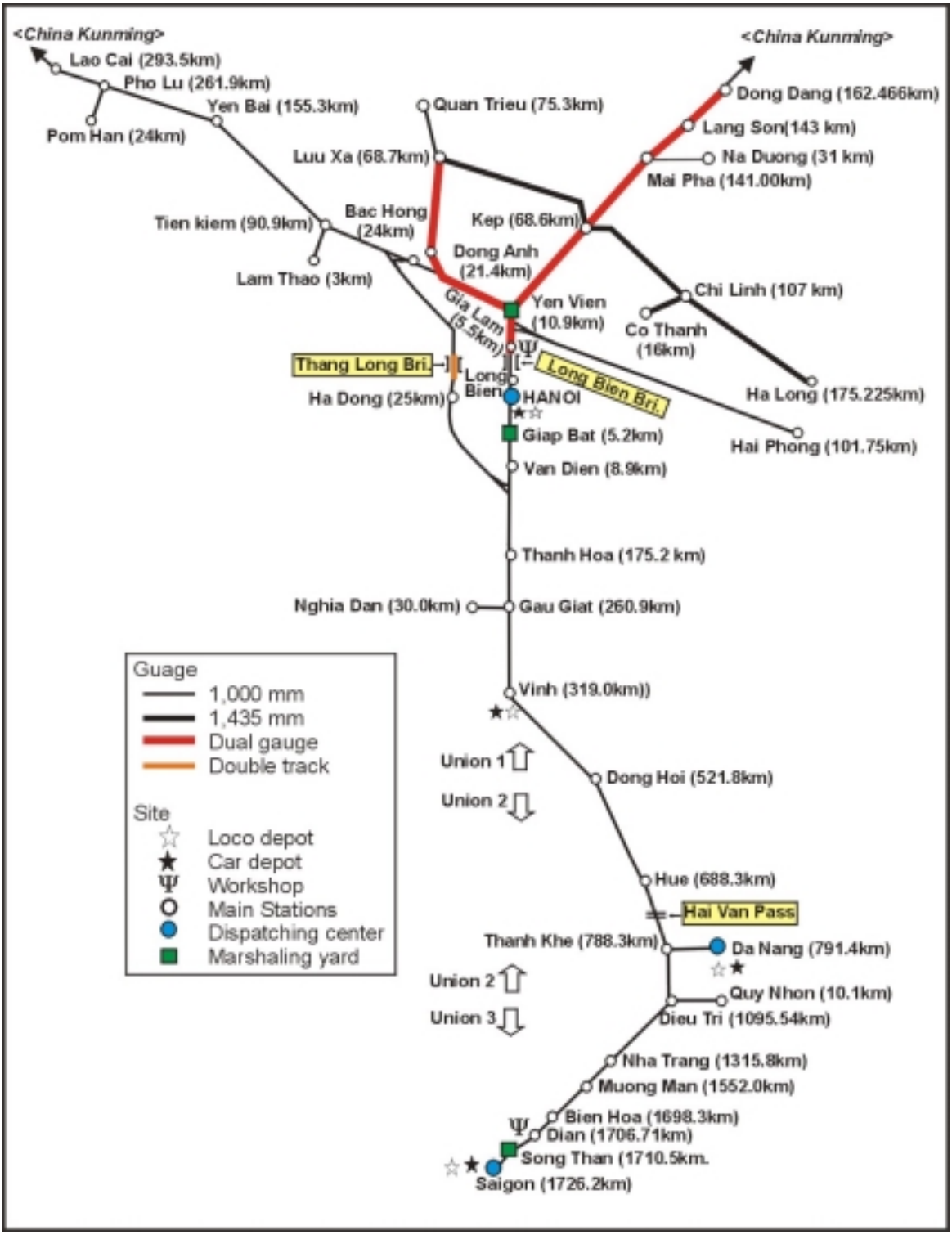


Figure 3.2.2
Railway Network and Provinces

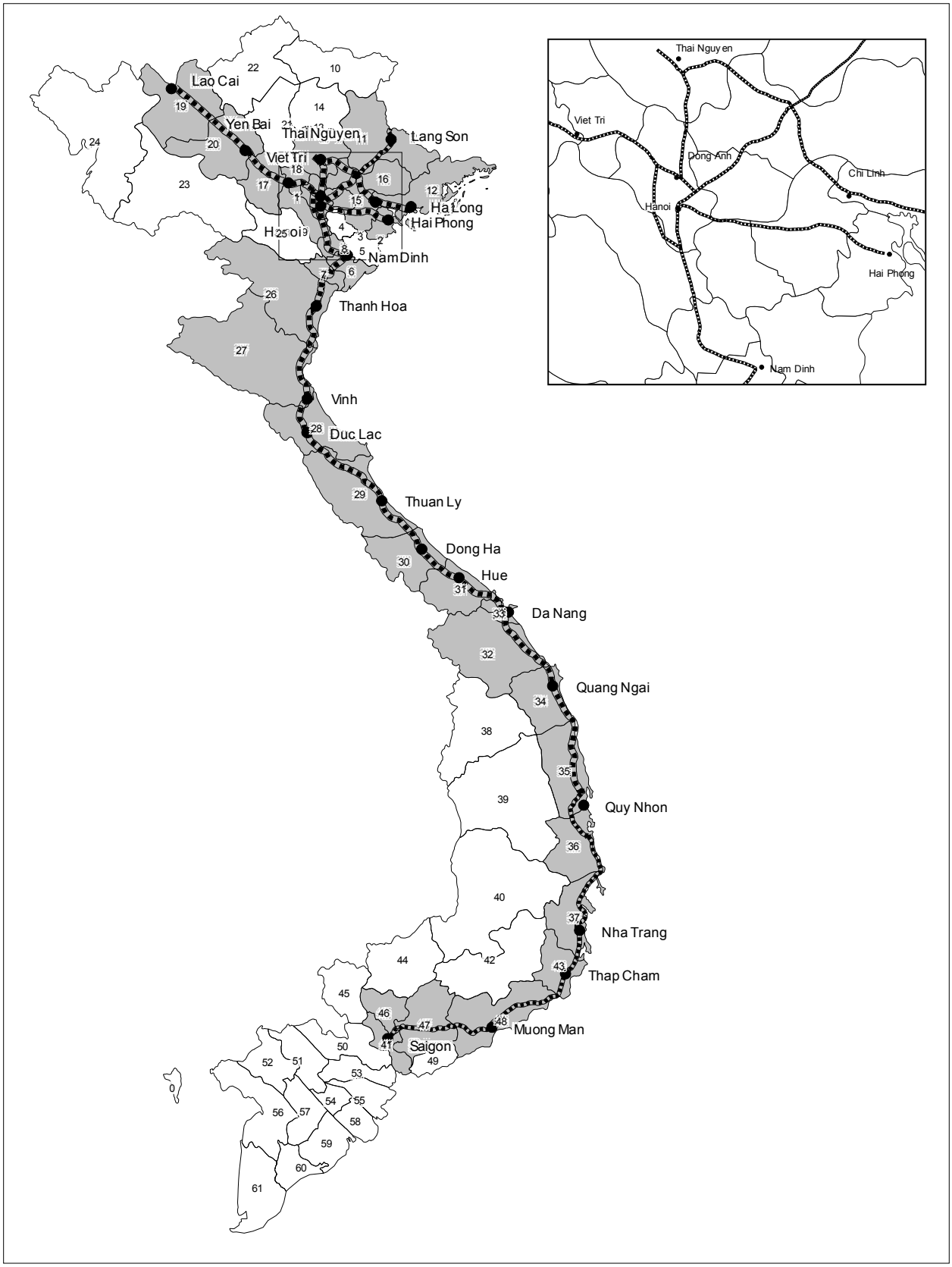


Table 3.2.2
Socio-economic Indicators (1997)

Region		Zone	Province Name	Total Population	Area(KM^2)	GDP(10^9VND)
1 Red River Delta	1	1	HANOI	2,306,498	921	20,070,838
		2	HAI PHONG	1,692,598	1,503	7,470,065
		3	HAI DUONG	1,717,198	1,661	4,830,407
		4	HUNG YEN	1,097,998	895	2,581,169
		5	THAI BINH	1,852,598	1,509	4,663,179
	1	6	NAM DINH	1,934,097	1,669	4,346,639
	1	7	NINH BINH	905,899	1,387	1,676,393
	1	8	HA NAM	824,898	823	1,621,635
	1	9	HA TAY	2,366,598	2,147	4,817,886
	(5)	(9)	**Total**	**14,698,382**	**12,516**	**52,078,211**
2 North East		10	CAO BANG	657,398	6,387	953,089
	1	11	LANG SON	728,797	8,187	1,731,231
	1	12	QUANG NINH	938,399	5,938	3,732,194
	1	13	THAI NGUYEN	966,398	3,770	2,242,002
		14	BAC KAN	256,898	4,796	353,232
	1	15	BAC NINH	939,598	799	2,019,448
	1	16	BAC GIANG	1,475,398	3,817	2,756,070
	1	17	PHU THO	1,283,500	3,465	2,836,259
	1	18	VINH PKUC	1,084,598	1,371	2,173,650
	1	19	LAO CAI	584,499	8,050	1,057,292
	1	20	YEN BAI	686,599	6,809	1,210,357
		21	TUYEN QUANG	679,798	5,801	1,221,887
		22	HA GIANG	564,297	7,831	618,741
	(9)	(13)	**Total**	**10,846,177**	**67,019**	**22,905,452**
3 North West		23	SON LA	846,897	14,209	1,247,380
		24	LAI CHAU	555,699	17,133	1,027,612
		25	HOA BINH	770,399	4,612	1,266,532
	(6)	(3)	**Total**	**2,172,995**	**35,954**	**3,541,524**
4 North Central Coast	1	26	THANH HOA	3,553,099	11,168	7,759,372
	1	27	NGHE AN	2,873,799	16,371	6,010,061
	1	28	HA TINH	1,358,599	6,054	2,615,803
	1	29	QUANG BINH	806,398	7,984	1,515,145
	1	30	QUANG TRI	562,297	4,588	1,229,938
	1	31	THUA THIEN-HUI	1,041,899	5,009	2,657,617
	(6)	(6)	**Total**	**10,196,091**	**51,174**	**21,787,936**

Table 3.2.2 continued

5 South Central Coast	1	32	QUANG NAM	1,379,399	10,737	2,903,335
	1	33	DA NANG	667,198	1,248	3,208,823
	1	34	QUANG NGAI	1,233,498	5,177	2,393,708
	1	35	BINH DINH	1,477,900	6,076	3,427,567
	1	36	PHU YEN	769,598	5,278	1,652,709
	1	37	KHANH HOA	993,497	5,257	4,028,845
	(6)	(6)	**Total**	**6,521,090**	**33,772**	**17,614,987**
6 Central Highlands		38	KON TUM	268,997	9,934	568,325
		39	GIA LAI	844,397	16,212	2,001,163
		40	DAK LAK	1,347,198	19,800	4,181,710
	(0)	(3)	**Total**	**2,460,592**	**45,946**	**6,751,198**
7 North East South	1	41	HO CHI MINH	5,050,299	2,090	54,744,453
		42	LAM DONG	854,099	10,137	2,255,238
	1	43	NINH THUAN	483,397	3,427	1,325,423
		44	BINH PHUOC	548,797	6,814	1,254,047
		45	TAY NINH	931,897	4,030	2,959,969
	1	46	BINH DUONG	649,598	2,723	3,919,193
	1	47	DONG NAI	1,964,798	5,863	9,539,211
	1	48	BINH THUAN	942,997	7,992	2,138,918
		49	BA RIA-VUNG TAU	724,197	1,965	16,528,386
	(5)	(9)	**Total**	**12,150,079**	**45,041**	**94,664,838**
8 Mekong River Delta		50	LONG AN	1,300,100	4,342	4,773,889
		51	DONG THAP	1,558,699	3,275	4,178,898
		52	AN GIANG	2,055,500	3,424	7,148,857
		53	TIEN GIANG	1,726,100	2,339	5,449,629
		54	VINH LONG	1,109,998	1,487	3,300,041
		55	BEN TRE	1,393,899	2,247	4,386,449
		56	KIEN GIANG	1,446,899	6,243	5,589,470
		57	CAN THO	1,904,599	2,962	6,546,151
		58	TRA VINH	1,003,297	2,369	3,554,776
		59	SOC TRANG	1,254,499	3,191	3,617,104
		60	BAC LIEU	783,598	2,487	1,966,290
		61	CA MAU	1,082,098	5,204	4,110,063
	(0)	(12)	**Total**	**16,619,286**	**39,570**	**54,621,617**
	(31)	(61)	**Vietnam Total (A)**	**75,664,692**	**330,992**	**273,965,763**
	(31)/(61)=51%		**Area along the Railway(B)**	42,834,046	156,192	163,362,015
			B/A	57%	47%	60%
			Area of Mekong Delta(C)	**16,619,286**	**39,570**	**54,621,617**
			C/A	22%	12%	20%

3.3 Facilities and Equipment

The railway network can be explained physically by two items, railway alignment and railway structures. These physical properties of VR are briefly stated below.

(1) Alignment

Alignment is composed of curves and gradients. Curves and gradients constrain train speed and traction power. If a train's traction power is larger, its climbing speed on a gradient becomes faster. But the train speed passing curves is mainly determined by radius of curvature, regardless of train's power. Therefore, curvature radius is more important than gradient in speed up. VR's curvatures and gradient will be stated briefly below.

(i) Curve

Small radii of curves are fatal to the speed of trains. VR's train speed limitation by curve is shown in the following:

$$V = 3.5\sqrt{R}$$

Here, V is the train speed on the curve R.
Then train speeds on various curves come as follows (Table3.3.1):

Table 3.3.1
Train Speed and Radius of Curvature

Train speed (km/h)	Radius of curvature (m)
78	500
70	400
60	300
49	200
35	100

In the following Table 3.3.2, there are many small curves and trains must follow the above speed limits. There are many small radii curvatures in 3 main lines, Hanoi – Saigon, Hanoi – Lao Cai, and Hanoi – Dong Dang. Such small radii are not dispersed equally through the network, but they are comparatively concentrated to the hilly sections or along riverside sections. For instance, in Hanoi – Saigon line, such sections are located around 370km, around 420km, around 460km, Hai Van pass, around1450km, and around 1580km from Hanoi respectively. In Hanoi – Lao Cai line, those small radii are mainly beyond 70km from Hanoi. In Hanoi – Dong Dang line, they are beyond 70km from Hanoi, too.

The distribution of curvatures in VR is shown in the following.

Table 3.3.2
Numbers and lengths of Curves in the VR lines

Curva-ture radius	Line								Total
	Hanoi – Saigon	Yen Vien – Lao Cai	Hanoi – D. Dang	L. Xa – Kep	Kep – H. Long	G.Lam – Haiphong	D. Anh – Q. Trieu	V. Dien - B.Hong	
R<100	5 (0.7)		1 (0.1)						6 (0.8)
100≤R<200	169 (19)	412 (46.3)	74 (10.6)		2 (0.8)				657 (76.7)
200≤R<300	83 (17.7)	152 (16.7)	47 (6.2)			1 (0.1)			284 (40.7)
300≤R<400	168 (37.6)	63 (6.0)	18 (3.3)		8 (2.4)	5 (1.0)	1 (0.1)		263 (50.4)
400≤R<500	125 (29.7)	27 (4.0)	43 (9.7)	1 (0.7)		6 (1.4)			202 (45.5)
500≤R<600	330 (85.6)	24 (2.5)	22 (4.8)	4 (1.5)	3 (0.4)	15 (3.0)		3 (0.6)	401 (98.4)
600≤R	831 (183.7)	64 (5.6)	57 (14.5)	39 (18.4)	64 (26.4)	56 (8.1)	24 (10.4)	2 (0.9)	1137 (268.0)
Total	1711 (373.7)	742 (81.2)	262 (49.2)	44 (20.6)	77 (30.0)	83 (13.6)	25 (10.5)	5 (1.5)	

Note: Upper figures are the number of the curvature. Lower figures in parentheses are the summed lengths of the curvatures (km)

The distribution of the curvature is not average. And the smaller curvatures R<300 are especially concentrated to some peculiar sections and the most frequently set section is the Hai Van pass. The next is the figures of Hai Van pass.

Table 3.3.3
Ratio of curvatures of the Hai Van pass section in the Hanoi – Saigon line

Curvature radius	(a) Hanoi – Saigon 1726km		(b) Hai Van pass (Thua Luu – Kim Lien 37km)		(c = b/a) ×100 Ratio of Hai Van pass	
	No.	Km	No.	Km	% (no.)	% (length)
R<100	5	0.7	5	0.7	100	100
100≤R<200	169	19	127	11.83	75	62
200≤R<300	83	17.7	13	1.74	16	10
300≤R<400	168	37.6	5	0.7	3	2
400≤R<500	125	29.7	0	0	0	0
500≤R<600	330	85.6	2	0.5	0.6	0.6
600≤R	831	183.7	4	0.14	0.5	0.1
Total	1711	373.7	156	15.6	9	4

From the above table, in the section Thua Luu – Kim Lien 37km, the summation length of curvatures smaller than 200m radius is 12.5km. It is nearly 1/3 of the total length, and their number is 132. If they are removed, 100% of R<100m curvatures and 75% of the 100<R<200 curvatures in Hanoi – Saigon line will disappear.

(ii) Gradient

The maximum gradient in main lines of VR is less than 17‰. Generally speaking, VR's gradient is very mild, and gradient more than 10‰ are rare in VR lines. The gradient is not so influential to the train operation, if it has enough traction power to climb. Table 3.3.4 shows the maximum gradient in each line.

Table 3.3.4
Max. gradient in main lines

Line	Max. gradient (mm/m)	Section
Hanoi – Saigon	17	
Hanoi – Dong Dang	11	Pho Trang – Kep
Yen Vien – Lao Cai	15.8	Vu En – Am Thuong,
Gia Lam – Haiphong	9.15	Gia Lam – Cau Bay

(2) Railway structures

Railway structures are, earth work, bridges and tunnels. On the railway structures the track structure is laid. The track structure is composed of rail, rail fastening, sleeper and ballast. Along the railway, all train operation is controlled by signals. And every information of railway from emergency train operation to every day work is performed using the communication system. VR's existing facilities and equipment are briefly stated below.

Table 3.3.5
Railway structures

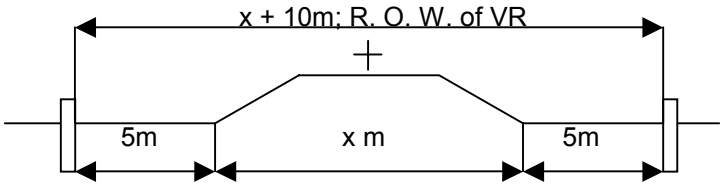
Route-km	Railway structures						
	Earth-work	Bridges		Tunnels		Culverts	
		Q'ty	km	Q'ty	Km	Q'ty	km
2,600	2,450	1,813	57	39	12	5,119	81
100%	94.2%	2.2%		0.5%		3.1%	

(i) Earth work (Embankment and cut)

From Table 3.3.5, most of the railway structures (94%) is made by earthwork. This earthwork is namely embankment or cut. Each typical section is shown in Figure 3.3.1 or Figure 3.3.2.

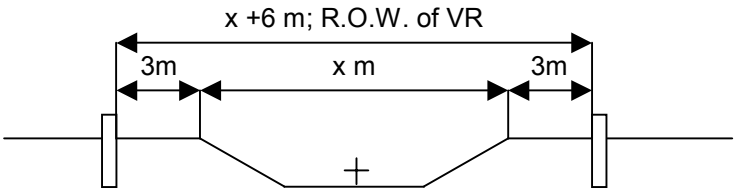
a. Embankment

Fig. 3.3.1
Embankment section of VR



b. Cut

Figure 3.3.2
Cut section of VR



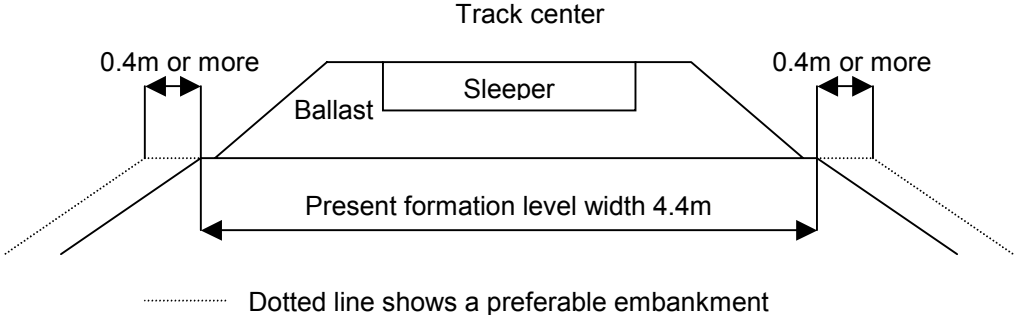
In the above earthwork sections, the formation width on the top of embankment or on the base of the cut is 4.4m wide in the most cases in VR. It is shown in the following Table 3.3.6.

Table 3.3.6
Composition of "Formation width of VR lines" (unit; km)

Formation width	Hanoi - Saigon	Yen Vien -Lao Cai	Hanoi - Dong Dang	Luu xa - Kep	Kep – Ha Long	Gia Lam - Haiphong	Dong Anh - Q. Trieu	Van Dien - Bac Hong	Total
4.4m	1726.5	273.9	5.3			90.7	6.7		2103.1
5.0 or 6.4m		10.8	160.2	55.7	104.9		47.7	41.1	420.4
Total	1726.5	284.7	165.5	55.7	104.9	90.7	54.4	41.1	2523.5

Here, most of the formation level width of VR is 4.4 m. This width causes trouble in the maintenance of track and the speeding up trains. From Figure 3.3.3 below, ballast can't ease itself on the formation level. It'll slip down on the slope of the embankment. The lack of the sufficient ballast on the edge of the sleeper weakens the reaction force against the transverse force, such as buckling. 4.4m formation width shall be improved at least 40cm or more to each sides, and it should be widened more than 4.4 + 2 $\times$0.4 = 5.2m, as the dotted lines.

Figure 3.3.3
Formation level width of VR



(ii) Bridges

Bridges are 1,813 and their total length is 57km from Table 3.3.5. In these bridges, more than 100 bridges designate special speed that trains must run lower than the section speed limitation. The section speed is determined by conditions of the section's alignment, railway structures and the rolling stock abilities. Therefore, a bridge's lower speed limitation than the section speed means that the bridge is inferior to other railway structures or alignment in the section and needs quicker renewal. Hanoi-Saigon line has approx. 90 bridges that should be repaired soon.

Table 3.3.7
Number of speed limited bridges

Line	Train speed (km/h)						Section speed limit excluding the speed limited bridges
	<40	<30	<15	<10	<5	Total	
Hanoi-Saigon	5	65	16	2	1	89	30km/h to 80km/h, most sections are 60 to 70km/h.
Hanoi-Haiphong	6					6	60 or 70km/h, 30km/h(99km-102km)
Hanoi-Dong Dang		2	3			5	30km/h to 50km/h
Hanoi-Lao Cai		3				3	40km/h to 60km/h(118km-283km), 30km/h(283km-296km).
Hanoi-Quan Trieu			1			1	Dong Anh to Quan Trieu, 30km/h.
Kep-Ha Long		1	3			4	30km/h to 60km/h
Total	11	71	23	2	1	108	

In the above table, Hanoi-Dong Dang, Hanoi-Lao Cai, Hanoi-Quan Trieu lines have lower section speed limits. Therefore, comparison of 3 lines' bridges with Hanoi-Saigon or Hanoi-Haiphong lines is difficult in the same standard.

(iii) Tunnels

Railway tunnels in Vietnam are 38 and their total length is approx. 10km. They are in 3 lines (Hanoi – Saigon, Hanoi – Dong Dang, and Kep – Luu xa). Speed limitation is applied to most of all tunnels. Speed limitation is from 5km/h to 40km/h. and it is shown in the following table.

Table 3.3.8
Table Tunnels and Speed Limitation

Speed limit (km/h)	Tunnel		Note
	Quantity	Total length (m)	
Hanoi – Saigon 5km/h	1	445	Phu giat.
15km/h	8	2,777	
30km/h	6	914	
40km/h	5	969	
No speed limit	6	2,112	
Total	26	7,217	
Hanoi-Dong Dang 40km/h	8	1,992	
Kep-Luu Xa 40km/h	4	1,141	
All total	38	10,350	

These speed-limited tunnels suffer from the deterioration. These dangerous tunnels shall be removed fundamentally.

(3) Track structure

Track is composed of rail, fastening, sleeper and ballast. VR's track structure is as follows:

(i) Rail

In VR, 27kg/m, 30kg/m, 38kg/m and 43kg/m, 4 kinds of rail are used.as for the main track rail 30, 38 and 40kg/m rails are used and their laid portions are shown in Table 3.3.9.

Table 3.3.9
Kinds of rail and their length (unit;km)

Kind of rail	Line								Total
	Hanoi - Saigon	Y.Vien – L.Cai	Hanoi - D.Dang	L.Xa - Kep	Kep – H.Long	G.L am- H.phong	D.Anh - Q. Trieu	V.Dien- B.Hong	
30kg/m	180.2	284.7	165.4	55.7	104.9	90.7	54.4	41.1	977.2
38 or 43kg/m	1546.3								1546.3
Total	1726.5	284.7	165.4	55.7	104.9	90.7	54.4	41.1	2523.5

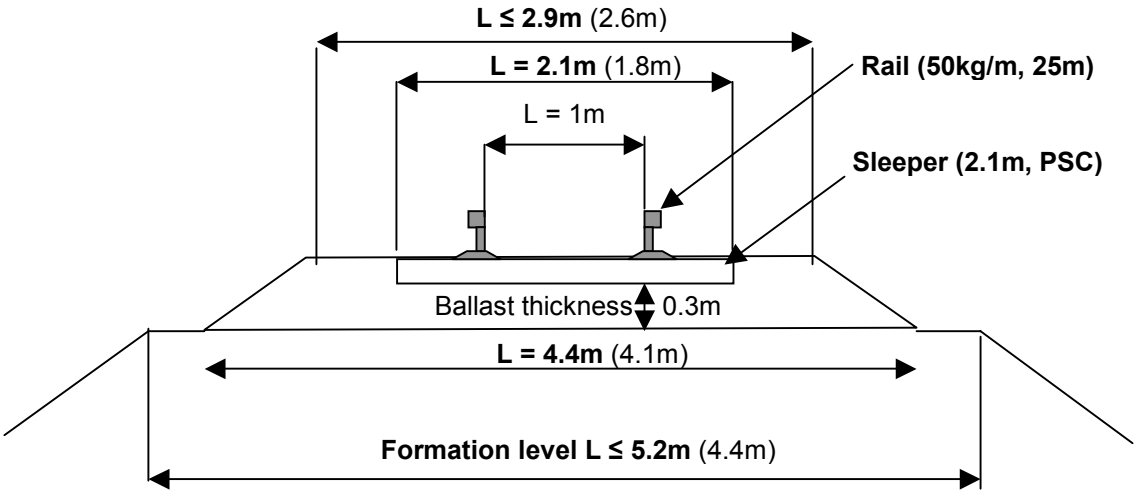
38 or 43kg/m rail is only used in Hanoi-Saigon line. It is considered that transportation volume of railway will increase and the train speed will also be up. These two reasons and lesser maintenance of track in future will cause the larger section rail to be adopted in future.

As mentioned in railway structure of the present VR, the present track structure and embankment of VR have some weakness in the higher train operation and maintenance. Therefore such structures shall be improved when the investment such as double tracking or alignment change is implemented. In the implementation, a new specification shown in the below table shall be suggested as an example.

Table 3.3.10
Comparison of structures

Item	Present application	New specification
Rail	38 or 43kg/m, 12.5m long	50kg/m, 25m long
Sleeper	1.8m long, wood, steel, 2-block concrete	2 or 2.1m long pre-stressed concrete
Fastening	Proportioned fastenings from spikes to bolts, according to the sleeper's type	Elastic fastening
Ballast	30cm thick	30cm thick
Formation width	4.4m	5.2m or more

Fig 3.3.4
New Specification of track and embankment (an example)



Note:Figures in parentheses are the present VR specification
Bold letters are a new specification (a suggestion).

(ii) Fastening

The fastenings of VR are from spikes, to elastic fastening using plate and bolts or pandrol. These fastenings are different according to sleeper types. These fastenings shall be improved when the rail, sleepers are improved according to the speed up of the train and passing tons up.

(iii) Sleeper

VR adopts 4 types of sleepers, wood, steel, two block concrete and pre-stressed concrete sleepers. And the sleeper length is 1.8 m. Bearing capacity of the track shall be up by adopting larger and heavier sleepers when the train speed and passing tons on the track be increased.

(iv) Ballast

Ballast thickness under the sleeper is 30cm by the maintenance manual. But in some sections, esp. in city sections, the thickness is under it. And the edge ballast that resists the transverse force of track, is not enough. As mentioned in the item “formation level width”, a reason of shortage of the edge ballast is a cause of inadequate width of formation level (4.4m), but also in the maintenance, there is not sufficient supply of ballast, too.

(v) Turnout (switch)

There are several turnouts that limit train speed lower than section speed limit. The case of Hanoi – Saigon line is shown below.

Table 3.3.11
Special speed limit by turnout (Hanoi-Saigon line)

Speed limit (km/h)			Quantity of turnout
<60(pass. train) or 50(fr. train)	<40	<30	
4	4	1	9

(4) Signal and Communications

(i) Signal

It occurs often that trains stop at the signal-sites without any trouble or accident in the station or yard in the scene. This phenomenon happens by having no real-time interface between signals and trains.

VR has installed automatic blocking system only between Hanoi and Yen Vien. In other sections or lines, they adopt token or semi-automatic blocking system. VR is replacing the system to token-less blocking and has plan to finish by year of 2000. VR equips color signaling and semaphore signaling which basically indicate in two ways; GO (Green) and STOP (Red). Distant signals are installed in some stations. Almost of all lines are equipped with automatic (electric) interlocking system and others mechanic system. Most of the switchboards at the stations are mechanic ones. At present, only 10 digital electronic switchboards have been installed on the Hanoi-Saigon railway line. Only Vinh station has an electric control center.

(ii) Communications

The communication system is very thin and frail. In the flood case in 1999 at Hue, most existing communication was damaged and only several mobile telephones that several staffs had were available. And the communication was very difficult or none after the disaster. Then a safe and strong communication system in such disasters shall be equipped. By the present communication system, if it is broken once, there is no way of communication. Railway telephone system is used all over the railway network and dispatcher telephone system connects dispatching centers with each station. And an aerial bare wire is used for telephone system. Now there is no km of optic cable along Vietnamese railway lines. Due to lack of an optic cable system, VR have to pay 4.5 billion VND for the Vietnam tele-communication company as subscription fee of telephones.

Table 3.3.12
Communication and Signaling of Railway Lines

line	signal system		blocking system			interlocking system	
	color	semaphore	automatic	semi-automatic	token	automatic	manual
Hanoi-Hai Phong	Z			Z		Z	
Hanoi-Dong Dang	Z Hanoi-Y.Vien	Z Y.Vien-D.Dang	Z Hanoi-Y.Vien		Z Y.Vien-D.Dang	Z Hanoi-Y.Vien	Z Y.Vien-D.Dang
Yen Vien-Lao Cai	Z Y.Vien-P.Yen	Z P.Yen-L.Cai		Z Y.Vien-P.Yen	Z P.Yen-L.Cai	Z Y.Vien-P.Yen	Z P.Yen-L.Cai
Kep-Ha Long		Z			Z		Z
Dong Anh- Quan Trie	Z D.Anh-D.Phuc	Z D.Phuc-Q.Trieu		Z D.Anh-D.Phuc	Z D.Phuc-Q.Trie	Z D.Anh-D.Phuc	Z D.Phuc-Q.Trieu
Kep-Luu Xa		Z			Z		Z
Giap Bat-Saigon	Z	Z		Z		Z	
Hanoi junction	Z			Z		Z	

3.4 Rolling Stock

Railway network of VR is composed of 1000mm gauge and 1435mm-gauge. The train·km of 1000mm-gauge trains occupies 98.5% of all train·km in VR, as shown in Table 3.4.1. So, train operation is implemented mainly on the 1000mm gauge.

Table 3.4.1
Train・km of VR railway network

Passenger		Freight		Total
1000mm	1435mm	1000mm	1435mm	
8469.0	117.9	6948.0	111.9	15646.8
54.1%	0.8%	44.4%	0.7%	100%

Note 1) Figures are of trains hauled by diesel locomotives.
2) Figures are as of year of 1997.

(1) Locomotive

VR owns 339 diesel locomotives in all. Out of which, 332 locomotives are for 1000mm gauge and 7 locomotives are for 1435mm gauge. The kind and number of diesel locomotives are shown in Table 3.4.2.

Diesel locomotives are used for all trains. The locomotives were imported from ex-USSR, Australia, USA, Rumania ex-Czecho, India and Belgium. Their manufactured ages are from 1963 to 1990 and old enough. Then their operating conditions are inadequate and some of them are deteriorated. For example, while the type D4H is main locomotive of VR, 10% of it are not operable because of their deterioration. Their design speed is low (50km/h) and their HP is only 400 HP. So, on several occasions, they have to be double headed

Table 3.4.2
The Kind and Number of Diesel Loco for Meter Gauge

as of 31.Dec.19

Specification	D4H	D5H	D9E	D11H	D12E	D13E	D18E	Total
Manufacturing country	USSR	Australia	USA	Romania	Czecho.	India	Belgium	
Year of manufacturing	1975/88	1966/70	1963/65	1980	1986/90	1984/85	1984/85	
Rated power (HP)	400	500	900	1,100	1,000	1,350	1,800	
Design speed (km/h)	50	65	114	100	80	96	105	
Type of transmission	H	H	E	H	E	E	E	
Tare weight (ton)	24	41	52	54	56	72	84	
Weel arrangement	Bo-Bo	Bo-Bo	Bo-Bo	Bo-Bo	Bo-Bo	Co-Co	Co-Co	
Axle load (ton)	6	10/16	13	13.5	14	12	14	
Number of owned	199	13	32	18	40	14	16	332
Number of operable	183	13	32	18	40	14	16	316
Overall length (m)	9.59	11.10	11.64	14.00	13.20	14.32	15.23	
Width (m)	2.55	2.82	2.74	2.78	2.74	2.73		
Height (m)	3.56	3.81	3.77	3.65	3.87	3.63		

note1) VR owns three D16E type Locos for the standard gauge
note2) VR owns four TGM diesel Locos for the standard gauge

(2) Passenger car

VR owns 794 passenger cars in all. Out of which, 785 cars are for 1000mm gauge and 9 cars are for 1435mm gauge. The kind and number of passenger cars are shown in Table 3.4.3. Most of passenger cars are manufactured in 1960's or 1970's. They are deteriorated and their maintenance is inadequate because of lack of spare parts. Renewals of passenger cars are urgent and crucial. Some of the PCs are manufactured in the workshops.

Table 3.4.3
The Kind and Number of Passenger Cars for Meter Gauge

as of 31.Dec.1998.

Kind of car	Bed car	Ordinary coach				Dining car	**Baggage**	**Mail car**
Type	1st	2nd	1st	2nd	3rd			
Tare weight (ton)	32/34	30/32	30/34	30/32	25/30	30/34	30	32
Load (ton)	10	10	10	10	10	10	10/15	10
Body length (m)	19	19/20	19	19/20	16/19	19	19	19
Overall length (m)	19,7	20/21	19,7	20/21	19,7	19,7	19,7	19,7
Passenger capacit	24/28	42	64	80	64			
Max. speed (km/h)	100	100	100	80/100	80	100	100	100
Number	71	116	105	243	164	42	14	30

note: VR owns nine passenger cars for the standard gauge

(3) Freight car

VR owns 4368 freight cars in all. Out of which, 3831 cars are for 1000mm gauge and 537 cars are for 1435mm gauge. The kind and number of passenger car are shown in Table 3.4.4. Most of freight cars are manufactured in 1960's or 1970's. They are deteriorated and their maintenance is inadequate because of lack of spare parts.

Table 3.4.4
The Kind and Number of Freight Cars for Meter Gauge

as of 31.Dec.1998.

Kind of car	coverd wagon		sided wagon		flat wagon		tank wagon	Total
Tare weight (ton	15,7	19,8	15	17	15	17	15/18	
Load (ton)	30	35	30	40	25	35	25/30	
Body length (m)	12	13/14	12	14	11,5	12,8	10/11,5	
Overall length (	12,9	14,9	13	15	12,3	13,6	10,8/12,3	
Max. speed (km	80	80	80	80	80	80	80	
Number	1566		1672		404		189	3831

note: VR owns 537 freight wagons for the standard gauge

3.5 Operational Characteristics

(1) Train Operation

Trains operation is summarized in Table 3.5.1. Roughly there are 3 kinds of trains; through train, inter-union train and local train.

(i) Passenger Train

The trains are operated from Hanoi, as it is a center of 6 lines. Train frequency is highest in the section Hanoi-Saigon and Hanoi-Haiphong. This train operation seems to be reasonably planned in proportion with transport density. Hanoi, HCMC, Danang are most densely populated areas in Vietnam, but in these areas VR does not have any commuter trains.

Table 3.5.1
Number of Passenger Trains operated by Line

line	Through train	Inter-union train	local train
Hanoi-Saigon	5	7	16,3
Hanoi(L.Bien)-Lao Cai	3,9	2	4
Hanoi(G.Lam)-D.Dang	6		
Hanoi(L.Bien)-H.Phong	12		2
Hanoi-Q.Trieu	2		
G.Lam-Ha Long	2		
Hanoi-D.Anh(Y.Bai)			2

note: The number of train includes scheduled train and non-scheduled train.

(ii) Freight Train

Freight trains are operated most frequently in the lines bound for Lao Cai , Saigon, and Dong Dang . This train operation seems to be reasonably planned in proportion with transport density. Some freight trains are influenced by fluctuation of freight. The short-cut route from Dong Anh to Van Dien is not fully used. There are no freight trains. (Only one pair of passenger trains is operated.)

The departure or arrival stations of freight trains are different from those of passenger trains in several cases because some freight terminals are located at the mine or industry districts.

Table 3.5.2
Number of Freight Trains operated by Line

line	Through train	Inter-union train	local train
Hanoi(Y.Vien)-Saigon(S.Than)	4	6	12
G.Bat(Y.Vien)-P.Lu(P.Han)	2	12	6
G.Bat(Y.Vien)-D.Dang(D.Mo)	2		22
G.Bat(Y.Vien)-H.Phong	8		
Hanoi-Q.Trieu			
Y.Vien-M.Khe	2		5
Hanoi-D.Anh(Y.Bai)			

note? The number of train includes scheduled train and non-scheduled train.

(2) Train speed and required time

(i) Passenger Train

The required time and average speed of the fastest passenger train are shown in Table 3.5.3. The average speed of passenger train is very low. Slowing down at sharp curves, bridges, tunnels and switches are the main causes. Especially, in the section around Hai-Van pass or sections beyond Viet-Tri on the Lao Cai line, the train speed is restricted low because of frequent sharp curves.

Table 3.5.3
Required Time and Average Speed of Passenger Cars

line	required time (hours & minute)	average speed (km/h)
Hanoi-Saigon	33h50m	50
Hanoi-Lao Cai	9h40m	30
Hanoi-Dong Dang	7h05m	23
Hanoi-Hai Phong	2h00m	50
Hanoi-Quan Trieu	3h32m	21

(ii) Freight train

The required time and average speed of the fastest freight trains are shown in Table 3.5.4. On the whole, they are lower speed than those for passenger trains because of their long stopping time.

Table 3.5.4
Required Time and Average Speed of Freight Trains

line	Required time (hours, minute)	average speed (km/h)
Hanoi-Saigon	30h27m	57
Hanoi-Lao Cai	17h50m	17
Hanoi-Dong Dang	9h00m	18
Hanoi-Haiphong	6h15m	16
Hanoi-Quan Trieu		
Hanoi(Y.Vien)-Ha Long(M.Khe)	5h15m	22

(3) Operation Control system

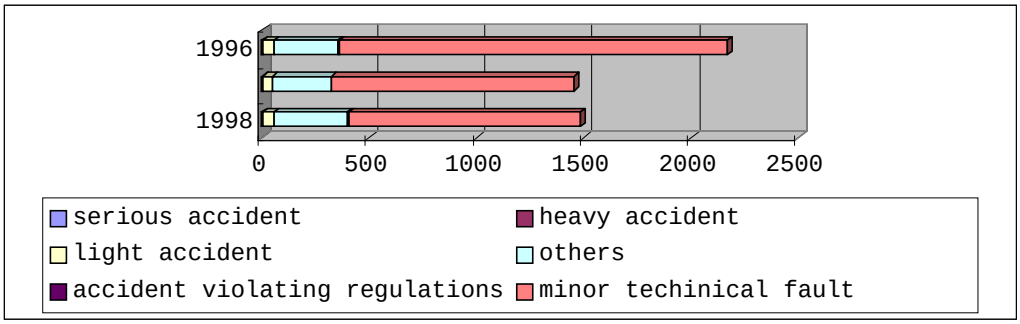
The daily train operation is carried out by the dispatching centers at each union. The dispatching rooms are prepared corresponding to each lines or sections of Hanoi- Saigon line. The dispatchers receive reports from stations and give instructions about train control through train dispatcher telephone. But train drivers or conductors don't have any means to contact with stations or dispatching center in case of emergency. The dispatcher telephone system is out of date. VR should introduce computerized real time dispatching or train-control system like CTC (Centralized train Control system).

(4) Accident

The total number of accidents has been dramatically decreased from 2171 in 1996 to 1452 in 1997. In this period, number of minor technical fault decreased. Most of all accidents are not serious but light and minor.

Table 3.5.5
Railway Accidents in VR

type	1998		1997		1996	
	number	share	number	share	number	share
serious accident	1	0.1	3	0.2	1	0
heavy accident	0	0	2	0.1	3	0.1
light accident	56	3.8	44	3	54	2.5
others	342	23	277	19.1	297	13.7
accident violating regulations	9	0.6	0	0	6	0.3
minor techinical fault	1079	72.6	1126	77.5	1810	83.4
total	1487	100	1452	100	2171	100



Main causes of accidents related to rolling stock and accumulated train delay time is large. It accounts for 49% of all accidents. These originate in trouble of deteriorated rolling stocks.

Table 3.5.6
Railway Accidents Classified by Cause (1998)

accident causes	number	share	train delay
station	42	2.8%	11h13m
locomotive	272	18.3%	313h13m
bridge/track	57	3.8%	95h43m
wagon	457	30.7%	168h03m
signal&comunicatio	31	2.1%	3h14m
facility	8	0.5%	7h59m
external cause	614	41.3%	516h01m
unclear	6	0.4%	6h56m
total	1487	100%	1122h22m

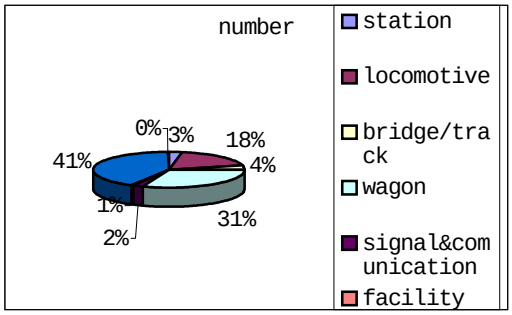


Table 3.5.7
Definition of Accidents

type	disruption of service	casualities	damage to rollimgstocks
serious accident	24H or more	2 or more people killed	sever
heavy accident	12-24H	up to 2 people killed	moderate
light accident	up to 12 H	noone killed	none

The number of human accidents is very serious. Most of them are collisions. Some safety measures like setting crossing-bars on both sides of crossing or making fences along railway line should be planned and implemented immediately as the train operating speed is expected to become higher in near future.

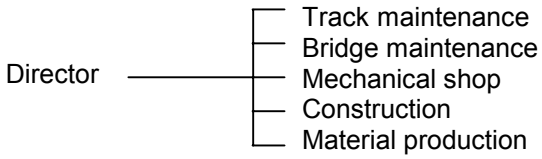
Table 3.5.8
Human Accident (1998)

	incident	died	wounded
collision	322	122	213
falling from train	2	0	2
jumping up to train	4	0	4
throwing stone to train	2	0	2
others	12	7	5
total	342	129	226

3.6 Maintenance

(1) Facility maintenance

Infrastructures including track structure, they are mainly maintained by the site organizations, called “the railway management enterprise”. A management enterprise has its determined maintaining section, for instance, Ha Hai management enterprise has its maintaining responsibility along 142km railway infrastructure and track structure in Hanoi region The enterprises like Ha Hai railway management enterprise are 15 in the whole VR. The management enterprise is composed of as shown below.



The track maintenance is mainly executed by hand tools, beaters, and hand tie tampers. Only the track inspection is converted to the mechanized checking using the track inspection car “MATISA”. As for the track maintenance work itself, the mechanization shall be the next stage.

(2) Signals and communication maintenance

Signals and communications are maintained by signaling and communication enterprises and they are 5 in the whole VR. They inspect and repair periodically signals, telecommunication network, switchboards and so on.

(3) Rolling stock maintenance

(i) Inspection and Overhaul

Maintenance for locomotives, passenger and freight cars are divided into two kinds according to their running distances. They are (a) inspection & repair and (b) overhaul. Inspection & repair is performed at depots and overhaul at workshops. Those intervals are, on the whole, shorter than cases of Japanese Railway. One of the causes is due to deterioration of locomotives and cars. The maintenance cycle is shown in Table 3.6.1-3.

Table 3.6.1
Locomotive Maintenance Cycle

RO(km)	RT(km)	R1(km)	R2(km)	R3(km)	RK(km)	RG(km)
						overhaul
depot	depot	depot	depot	depot	depot	workshop
1,000 ±20%	5,000 ±20%	10,000 ±20%	30,000 ±20%		60,000 ±10%	240,000 ±10%
	5,000	10,000	40,000		120,000	480,000
	5,000	25,000	50,000	100,000	200,000	600,000
1,000 ±20%	10,000 ±20%	30,000 ±20%	10,000 ±20%		20,000 ±20%	800,000 ±20%
	5,000	25,000	50,000	100,000	200,000	600,000
4,000 ±20%	12,500 ±20%	25,000 ±20%	75,000 ±20%	125,000 ±20%	250,000 ±20%	800,000 ±20%
2,500	10,000	30,000	75,000		200,000	600,000

Table 3.6.2
Passenger Car Maintenance Cycle

Type of maintenance	Maintenance cycle	Place of maintenance
Yearly maintenance (km)	150,000±10%	depot
	300,000±5%(new car)	
Overhaul (km)	750,000±10%	workshop

Table 3.6.3
Freight Car Maintenance Cycle

Type of maintenance	Maintenance cycle	Place of maintenance
Yearly maintenance	1year±2months	depot
	2years(new car)	
Overhaul	5years(plain bearing)	workshop
	6years(roller bearing)	

(ii) Locomotive depot

The locomotive depots are located at Yen Bai, Hanoi, Vinh (union1), Danang (union2) and Saigon (union3). The inspections & repairs of the locomotives are implemented at these depots. The maintenance is planned to be carried out on the schedule because of inadequate supply of imported parts and short of budget. And the facilities and equipments for maintenance remain old condition and deteriorated too. The implementation of maintenance for locomotives is showed in Table-3-30. The number of purchased locomotives is very few. And the maintenance cost is showed in the Table-3-31. It is very small. On the other hand, VR is planning to purchase 20 DL locomotives (2000HP) from Germany and 10 DL locomotives from Czecho.

(iii) Car depot

The passenger car and freight car depots are located at Hanoi, Vinh (union1), Danang (union2) and Saigon (union3). The inspection & repair of the cars are implemented at these depots. These depots have the same

difficulties as locomotive depots. The implementation of maintenance for cars and maintenance cost is shown in Table-3-30, 31.

(iv) Workshop

The workshops are located at Gia Lam (union 1) and Di An (union 3). The overhauls of the locomotives and cars are implemented at these workshops. And in these workshops, making new cars and affiliated business using the railway technique (ex. boiler making) are carried out. But these workshops have trouble of inadequate budget for maintenance, spare parts and deteriorated facilities & equipments as same as depots. The implementations of maintenance and maintenance cost are shown in Table 3.6.4-5.

Table 3.6.4
Investment for Rolling Stocks

		1996	1997
DL	Purchesed (from China)	0	3
	Recover	13	5
	Overhaul	15	18
FC	Newly-built or Recover	37	28
	Rechange	47	107
	Overhaul	901	
	Upgrade & Renewal	16	
	Equip ball-bearing	20	
PC	Overhaul	170	

(note) Recover=big repair,newly build=manufactured in workshop
Rechange=reconstruction from old to new or FC to PC
Upgrade & Renewal=reconstruction from low to high-class

Table 3.6.5
Investment for Rolling Stocks

(unit 10^9VND)

		1995	1996	1997
1 Locomotive				
	annual repair	18	20	24
	every 4 year repair	18	29	23
	every 8 yaer repair	25	29	20
2 PC				
	annual repair	25	16	14
	every 8 yaer repair	8	12	17
3 FC				
	annual repair			
	every 8 yaer repair	37	40	22

3.7 Traffic Demand

(1) Overall Demand Characteristics

VR shares 10.8 % in passenger·km, and 4.7 % in ton·km in the total Vietnam transportation in 1997. Passenger and freight traffic volumes are shown in the following table.

Table 3.7.1
Traffic volume of VR (passenger and freight)

	1985	1990	1994	1995	1996	1997	1998	Unit
Passengers	19.1	10.4	7.9	8.8	8.5	9.3	9.7	10^6
	In 1987 passengers scored maximum 24×10^6							
Passenger·km	3,359	1,913	1,796	2,133	2,267	2,444	2,540	10^6
	In 1987 passenger·km scored maximum $4,854 \times 10^6$							
Average km of a passenger	176	184	227	242	267	263	262	
Tons	4.05	2.42	4.00	4.52	4.40	4.7	4.88	10^6
Ton·km	869	847	1,370	1,751	1,684	1,526	1,323	10^6
Average km of freight	215	348	343	388	383	325	271	

Long travel distance; the average km of a passenger is more than 260km. This shows that in Vietnam the railway is used as long distance transportation. This fact clearly shows that the railway is not used as a short distance transportation, such as the mass transportation in big cities.

VR summarizes all freight into 16 items. The best five items by transport charge are, ore (18%), foodstuff (16%), fertilizer (11%), cement (10%), and coal (7%). Foodstuff earns by long transportation of 1040km, on the contrary coal earns by volume (tons) and its transportation distance is only 100km. These 5 items cover more than 60% of the all freight income. Average transportation of freight is 320km or so. Generally speaking, VR's freight transportation characteristic is to transport items of raw or low value-added materials.

Table 3.7.2
Freight Transportation by Item (1997)

Type of freight	loading ton	ton-km	average transport	transport charge	ranking
	103	106	(km)	(10^9VND)	
1 Coal	894,161	92,109,104	103	29,108,584,440	5
2 Petrol,Oil,grease,Gas	89,803	44,572,310	496	11,884,491,250	
3 Ore	1,139,663	267,583,752	235	74,257,187,351	1
4 Metaware,Mchinerry,Tool	257,094	82,896,276	322	23,967,387,542	
5 Chemicak substance	123,810	68,873,928	556	17,873,847,229	
6 Fertilizer	453,559	183,784,371	405	43,585,702,088	3
7 Cement	615,522	148,988,872	242	41,507,297,490	4
8 Land,Stone,sand	563,457	62,305,197	111	16,559,997,395	
9 Lime,Brick,Tile,Glass	25,886	13,894,618	537	3,746,685,500	
10 Wood,Wooden materials	124,686	59,211,806	475	15,090,525,790	
11 Agriculture&Forestry products	70,387	103,517,519	1,471	27,422,598,560	
12 Food	43,222	20,736,584	480	5,778,093,270	
13 Food stuff	235,097	244,434,947	1,040	65,926,169,210	2
14 Cotton,Fiber,Textile material	9,401	13,249,291	1,409	3,456,598,320	
15 General goods	72,211	96,272,719	1,333	26,373,003,125	
16 Other goods	33,977	30,854,847	908	7,368,688,865	
total	4,751,936	1,533,286,141	10,123	413,906,857,425	

(2) Characteristic by Line

The following table is the figures of passenger·km and ton·km, and transported density of each line.

Table 3.7.3
Transport Density by Line (1997)

	Dist.	Pass.km		Ton.km		Density(Pass.)	Density(Fr.)
Hanoi-Saigon	1726	2047	83	919	60	3249	1459
Hanoi-Lao Cai	296	218	9	398	26	2018	3684
Hanoi-Haiphong	102	140	6	65	4	3760	1746
Hanoi-Dong Dang	162	45	2	92	6	761	1556
Hanoi-Quan Trieu	75	11	0	22	1	402	804
Kep-Ha Long	106	8	0	38	2	207	982
Hanoi-Bac Hong	44	7	0	1	0	436	62
Kep-Luu Xa (not used)	55						
Total	2511	2476	100	1535	100	2702	1675
unit	km	$*10^6$	%	$*10^6$	%	pass./km/day	tons/km/day

Route·km of Hanoi-Saigon covers 2/3 of the total VR lines.

In passenger·km, Hanoi-Saigon line has 83% share of all VR, Hanoi-Lao Cai line 9%, Hanoi-Haiphong line 6%, and Hanoi-Dong Dang line 2%, respectively.

In freight transportation, Hanoi-Saigon shares 60% of the total, Hanoi - Lao Cai shares 26%, Hanoi-Haiphong 4% and Hanoi-Dong Dang 6%.

Figure 3.7.1
Route·km Share of Each line in VR

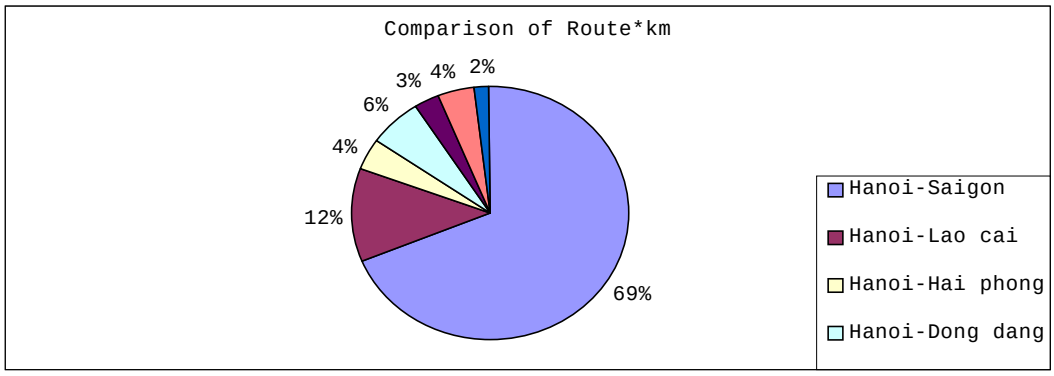


Figure 3.7.2
Passenger·km Share by Line

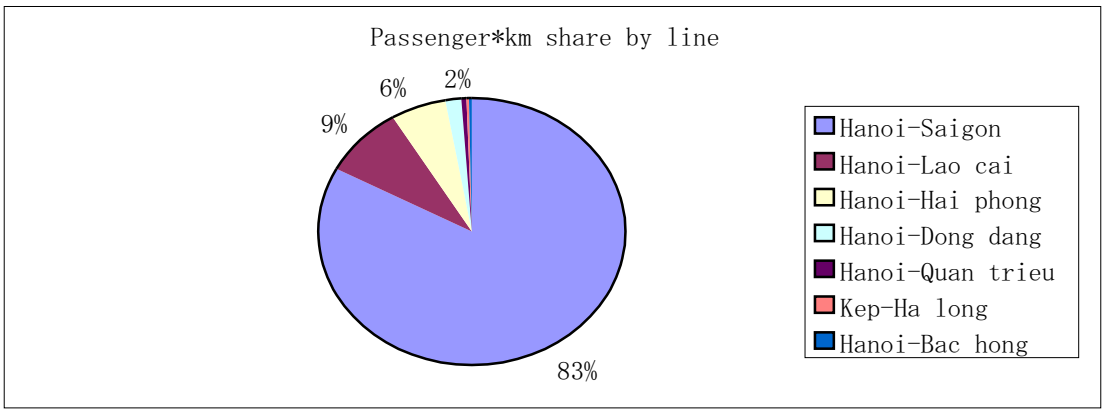
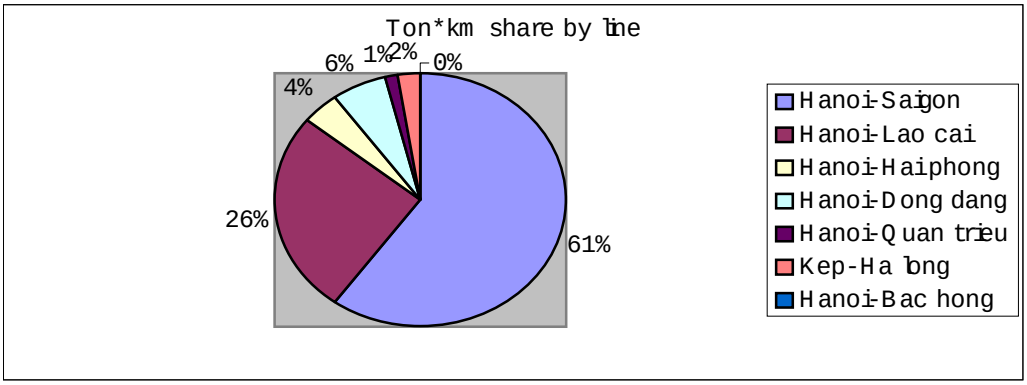
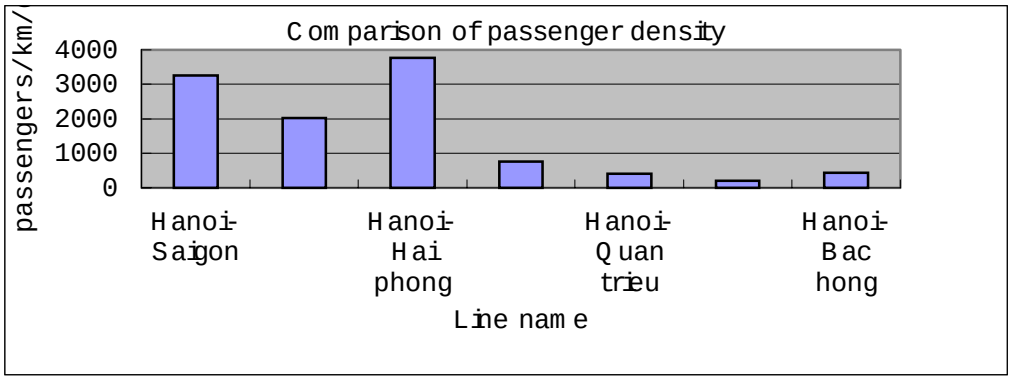


Figure 3-11
Ton.km share buy line



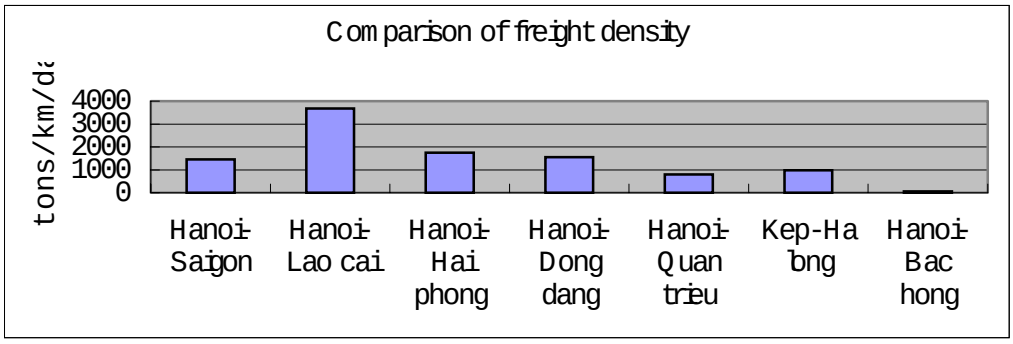
Transportation density per km by lines are compared both about passenger·km and ton·km in the following:

Figure 3.7.4
Passenger Density in Each Line



As for the passenger transportation density, Hanoi-Haiphong line is No.1 and the second comes Hanoi-Saigon line, the third is Hanoi-Lao Cai line.

Figure 3.7.5
Freight density in each line



In freight transportation, Hanoi-Lao Cai line is No.1, the second is Hanoi-Haiphong, the third are Hanoi-Dong Dang and Hanoi-Saigon, then come Kep-Ha Long and Hanoi-Quan Trieu. From the passenger·km & ton·km and transportation density/km, the most important lines should be said that Hanoi-Saigon, Hanoi-Haiphong, and Hanoi-Lao Cai lines, then Hanoi-Dong Dang line. This result would have a different evaluation when each line is divided in shorter sections.

(3) Transportation Density by Section

Transportation density by sections are shown in Figure 3.7.6 and Figure 3.7.7.

a. In passenger transportation, more than 2,000 passengers/km/day covers all the Hanoi-Saigon line, Hanoi-Haiphong line, Hanoi-Yen Vien of Hanoi-

Dong Dang line and Yen Vien-Yen Bai of Hanoi-Lao Cai line. And they are 18 sections. As for other sections, the passenger×km of Hanoi-Dong Dang line beyond Yen Vien is nearly 1,000, and that of Hanoi-Lao Cai line beyond Yen Bai is also nearly 1,000. The maximum density of passenger ×km is the section of Hanoi-Gia Lam and it is 4,500 passengers/km/day.

b. In freight transportation, the sections up to Lang Giang of Hanoi-Lao Cai line boast more than 2,000 tons/km/day and the maximum section is Yen Vien-Dong Anh and its volume is more than 3,000 tons/km/day. 2 branch lines on Hanoi-Lao Cai line (Pho Lu-Pom Han, Tien Kien-Lam Thao) show larger figures and importance. Hanoi-Haiphong line is the second and its density is nearly 1,600 tons/km/day.

c. Summary of the present transportation characteristic

From the above, the following characteristic shall be said:

- From the total transportation (passengers and freight), the importance of the 3 lines (Hanoi – Saigon, Hanoi- Lao Cai, and Hanoi – Haiphong) is evident.
- There is no short distance passenger. In another words, the VR doesn't do any commuter transportation.
- Main five items of the Freight are ore, foodstuff, fertilizer, cement and coal. These five items occupy 3/4 of the total freight income.

Figure 3.7.6
Cargo Transport Density by Section (1997)

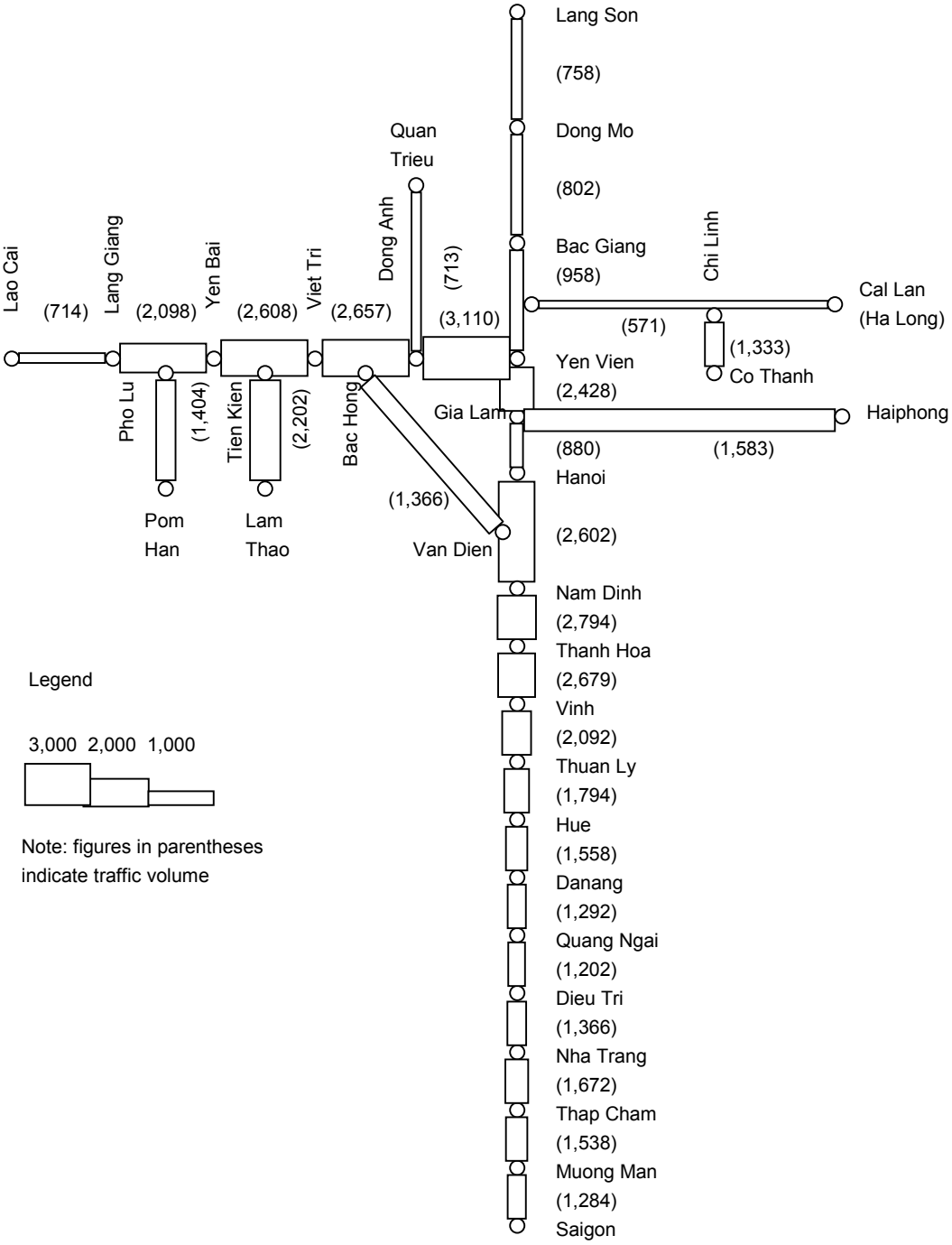
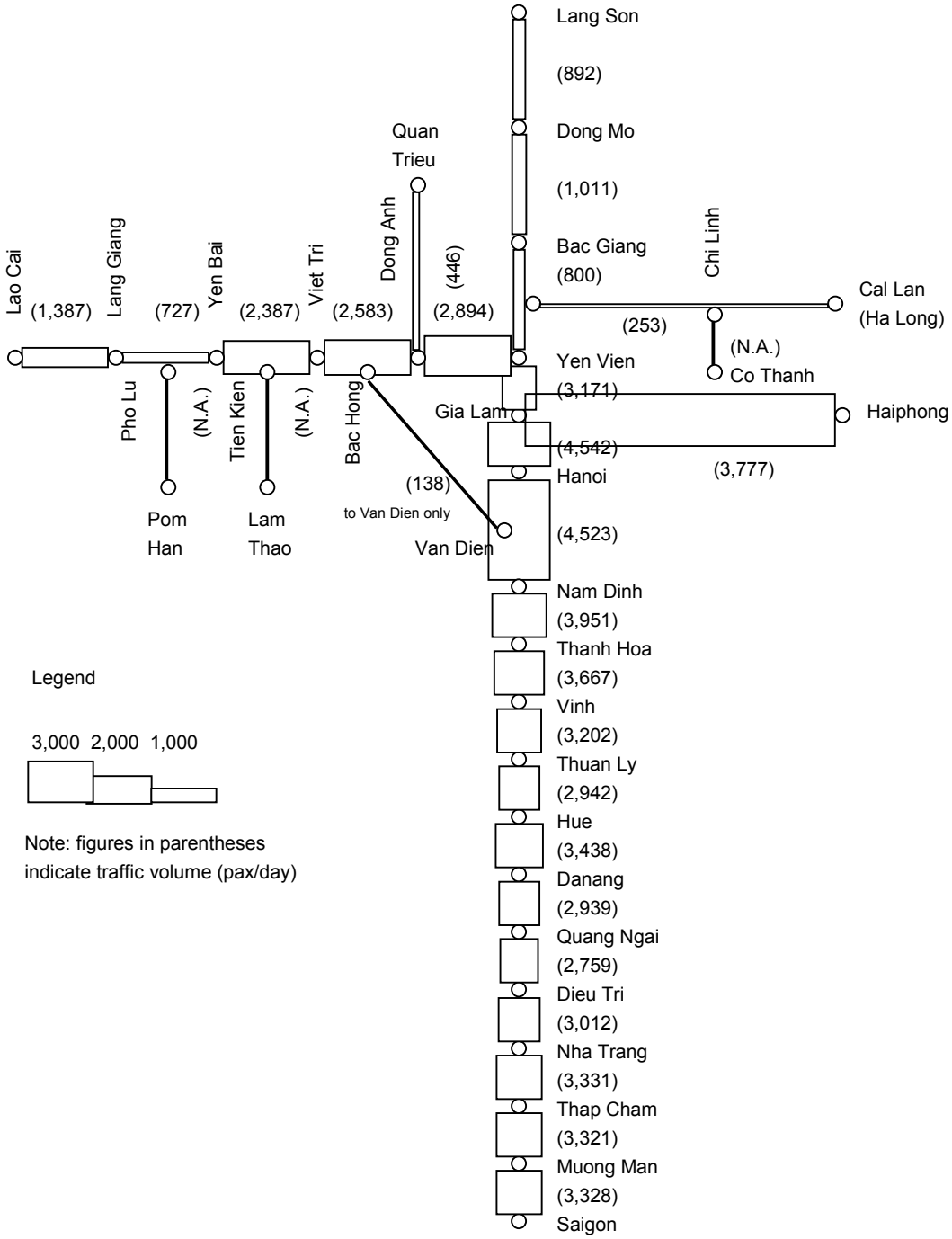


Figure 3.7.7
Passenger Transport Density by Section (1997)



3.8 Finance and Management

In 1995, Vietnam government decided to separate the financial responsibility into 2 parts. One was the finance of infrastructure and the other was that of rail operation. Vietnam government is now responsible for the finance of infrastructure and that means the maintenance and renewal of railway infrastructure is the governmental responsibility. VR now pays annually infrastructure charge to the government. The charge is 1/10 of the total income.

Revenue and Expenditure

(1) Transport section (operation)

The following table shows the chronicle of income and expenditure of VR. This is the so-called “upper part” figures. The approx. finance of VR is VND 1 trillion/year. Then the charge for using railway infrastructure is then VND 100 billion/year.

Table 3.8.1
Income and Expenditure of VR (unit; 10^9 VND)

	1990	1994	1995	1996	1997	1998
Income	**143.1**	**606.0**	**808.7**	**899.3**	**948.0**	**933.8**
Pass. income	74.0	271.8	427.2	466.1	424.9	537.9
Fr. Income	59.1	301.3	343.8	407.1	496.4	369.0
Baggage income	6.1	26.9	30.0	26.0	26.7	26.8
Others	3.9	5.9	7.8			
Expense	**158.9**	**712.9**	**780.5**	**869.2**	**910.2**	**924.0**
Salary	33.7	245.7	171.4	193.4	200.9	201.2
Social Insurance		19	9.2	13.5	17.6	17.7
Materials	26.4	156.2	129.6	139.9	143.1	141.3
Fuel	23.3	71.2	94.7	105.2	121.6	114.2
Electricity		6.3	6.3	9.6	25.9	35.9
Basic depreciation	12.0	20.0	81.5	99.1	139.0	119.8
Large Repair	26.3	97.7	72.0	82.1	65.7	59.4
Others		77.8	99.7	100.1	101.6	118.3
Collection on capital		19.0	35.3	36.4		
Infrastructure tax			80.9	89.9	94.8	116.0
Revenue tax	6.3	17.9	23.5	26.6	29.4	30.0
Total expense		**730.8**	**804.0**	**895.8**	**939.6**	**954.0**

From the above table, the expenditure and the income is proportioned and there seems no discrepancy in VR budget.

(2) Infrastructure (Investment and maintenance)

The Government is responsible for the maintenance and investment for the railway facilities.

(i) Maintenance

20 SOEs (State Owned Enterprises) in VR are responsible for the maintenance of the railway infrastructure and their expense is as follows:

Table 3.8.2
Infrastructure maintenance (10^9 VND)

Year	1995	1996	1997	1998
Expense of 20 SOEs	295	265	289	297
VR payment	79	86	99	112
Gov. payment	226	179	190	185

The above table shows the past four years expense of the railway infrastructure maintenance. VR payment is the infrastructure tax in the table 3-35. Then the Government must compensate the shortage of the expense. It is approx. 200×10^9VND. a year.

(ii) Investment

The Government is also responsible for the infrastructure investment. PMU (Project Management Unit) is responsible for the railway infrastructure investment. Its budgets in recent years are as follows:

Table 3.8.3
Infrastructure investment (10^9 VND)

Year	1995	1996	1997	1998
Gov. budget	200	142	119	120
ODA budget				100
Total	200	?	?	220

From the above table, the investment of the Government to the railway infrastructure is assumed approx. 200 billion VND a year, in recent years.

Tariff

Railway fare is determined in passenger and freight as follows:

(1) Passenger

On the Hanoi-Saigon line, the fare system is complicated to customers. First, the tariff is based on the kind of accommodation; hard seat, soft seat, soft seat with air-conditioner, sleep hard deck1, 2, 3, sleep soft, sleep hard 2beds and sleep soft with air-conditioner. And second, the fare is different with travel time. Namely, the fare of faster trains is higher and that of local trains is lower. So the fare is almost different by trains. On the other lines, as there are not so many train kinds and classes of accommodation, fare system is relatively simple.

The fares are shown as reference in Table 3.8.4.

Table 3.8.4
Comparison of Fare, Required Time and Frequency

(as of Mar.1999)

section	railway						bus			airline		
	type	fare			R.T.	Freq.	fare	R.T.	Freq.	fare	R.T.	Freq.
		hard	soft(air cond.)	sleep soft(air cond.)								
Hanoi-HCMC (1726km)	**S1**	370	546	744	33:50	5	185	48	N.A.	1000	2	6
Hanoi-DaNang (791km)	**S1**	169	250	373	15:56	6	76	26	N.A.	480	1:00	1
Hanoi-HaiPhong (102km)	**HP1**	20	22	N.A.	2:00	12	18	2:30	N.A.	N.A.		
Hanoi-LaoCai (294km)	**LC2**	57	N.A.	111	9:40	6	53	14	N.A.	N.A.		
Hanoi-LangSon (150km)	**HD1**	20	N.A.	N.A.	6:26	6	25	3:50	N.A.	N.A.		
Hanoi-BacGiang (50km)	**HD1**	7	N.A.	N.A.	1:55	6	10	1:10	N.A.	N.A.		

?) The fare is 1000VND, Frequency unit is per day ,required time is hours and minutes
2) Abbreviations;R.T=required time,N.A.=not available
3)R.T. is that of the fastest train. (shown in column ? type?)
4) Distance in parentheses is by railway km from Hanoi
5) Frequency is for one-way regular-trains from Hanoi

(2) Freight

Freight charge is determined by each freight item. And they are classified into 3 categories, and the charge ration is decreased proportional with the distance. General charges are shown in the following:

Table 3.8.5
Freight charge (available from Jan. 1999, unit; VND/ton×km)

Charge category	Transportation distance (D)			
	D<100km	100<D<700	700<D<1300	1300<D
1	270	210	195	180
2	310	250	235	220
3	350	290	275	260

Notes; 1/ Above charges have another extra charge by size, overweight, etc.
2/ Some examples of each freight category are as follows;
Category 1; Peat, crude oil, ore, sand, stone, brick, fire wood, straw, water, vegetables,
Category 2; coal, charcoal, product petrol, ore, iron, steel and product, fertilizer, cement, tiles, wooden products, agricultural harvests, cotton
Category 3; Fish sauce, soy sauce, silk, canned food, pottery, high-grade wooden products, high-grade textiles,

Average Railway Charge/km

As for the average charge of railway, the calculation from the total income of passengers & freight and the total passenger·×km & ton·×km will be most fit. They are as follows from 1998 figures:

Table 3.8.6
Average railway charge

	Income (A)	Transportation volume (B)	Average charge (C=A/B)
Passenger	VND538×10^9	2540×10^6 pass·km	VND212/pass·km
Freight	VND369×10^9	1323×10^6 ton·km	VND279/ton·km

The average passenger charge or freight charge at 1999 is approx. VND210/passenger·km or VND280/ton·km, respectively.

3.9 International Comparison

Many VR aspects have been studied and discussed. Here, several VR figures shall be compared internationally. Table3.9.1 shows several facts as follows:

Vietnam has the land as large as Japan, Italy, and Germany in the order of approx. 300×10^3 km^2. And the population density is nearly equal to India, Britain, Italy and Germany in the order of approx. 200 persons/km^2. And its railway density is nearly equal to that of China and Thailand, approx. 5 to 10 m/km^2. And railway usage ratio is not high.

The main peculiarities of VR figures are as follows:

(1) Low railway density in the country.

The length of the route-km of VR is approx. 8m/km^2. If you pick up any 1km^2 of Vietnam country, the railway length in that 1km^2 is 8m. This is the same density order with that of China (6m/km^2) or Thailand (8m/km^2). But the population density of China or Thailand is lower than that of Vietnam. So actually the railway network in those countries is more distributed than that of Vietnam (twice as much).

(2) Short railway length per people

The railway route length per people is 3.5 cm/person. This length is in the same order with India (6.8cm), China (4.4cm), Thailand (6.5cm) and Java Island (4.3cm). In these countries, Java Island must be omitted because of its high density of population. Vietnam has the similar population density with India, Britain, Italy and Germany. In these countries, India has nearly twice railway route density of Vietnam.

(3) Low usage of railway especially in passenger train

People in Vietnam use train 0.11 times/ year, in average. The people of China and Java Island use the railway 0.8 times/year. The figure is almost 8 times of the Vietnam's figure.

In freight, people in Vietnam carries goods by rail 0.06 tons/year. In Thailand or in Java Isl., it is 0.13 tons/year or 0.14 tons/year, respectively. They are twice of that of Vietnam. In Thailand, people use train 13 times, and in Java nearly 8 times of that of Vietnam, respectively.

(4) Low transportation density of railway

- Passenger transportation density: Average transportation density of railway in Vietnam is 2380 passengers/km/day. This figure is especially low in Asia, regardless its lower railway density. Even the European countries that have railway network over saturated and car civilization are prevailing have more transportation density. Their figures are twice of that of Vietnam.
- Freight transportation density: As for the freight, the transportation density of Vietnam is **1800tons/km/day** and it is in the same level with Japan (2500tons/km/day), India (1200), Thailand (2200), Java Isl.(2200), and Britain (2000). But all countries have more transportation density of passengers as stated above. The lowest of them, India has 6.3 times passenger transportation density of Vietnam's.

(5) Big potentiality of railway demand both passenger and freight transportation

China and Thailand are the countries of the same railway density with Vietnam. As stated in item 1. Vietnam has more population density and lower GDP at present. If all the conditions that surround the railway are totally the same (competitive transportation conditions, socio-economic conditions including GDP, etc.), Vietnam Railway has much potentiality of transportation, both passengers and freight. Thailand and China have 5 to 8 times of passenger density/km/day and 1.2 to 4 times of freight tons/km/day, regardless their fewer population densities. This fact shows that Vietnam Railway has huge potential transportation demand.

Table 3.9.1
Peculiarity of VR in several figures

Item	**Vietnam**	Japan	India	China	Thailand	Java Isl.	Britain	Italy	Germany	Notes
Area (a)	**332**	**378**	3288	9597	513	127	244	**301**	**357**	$10^3 km^2$
Population (b)	**75.2**	126	939	1232	60.0	115	58.8	57.4	81.9	10^6
Population density c = b/a	**227**	333	**286**	128	113	906	**241**	**190**	**230**	$p./km^2$
GDP per capita (d)	**0.27**	36.6	**0.36**	0.57	3.02	(1.15)※1	19.7	21.2	28.72	10^3
Railway route-km (e)	**2600**	27230	62915	54000	3870	4967	16536	16005	40826	
Railway density f =e/a	**7.8**	72	19	**5.6**	**7.5**	39	68	53	114	m/km^2
Route-km/people g =e/b	**3.46**	21.6	**6.8**	**4.4**	**6.45**	**4.3**	28.1	27.9	49.8	cm
Railway passengers (h)	**8.4**	22674	4153	1021	87	94.5	702	1284	1393	10^6
Frequency of people's ride to rail =h/b	**0.11**	180	4.42	0.83	1.45	0.82	11.9	22.4	17	
Passenger •km(i)	**2.259**	402.2	343.7	354.6	14.5	12.224	30.0	50.4	62.1	10^9
Passenger •km/people j = i/b	**30.0**	3195.2	365.9	287.8	205.0	106.3	510.3	878.0	758.2	
Average passenger density/km/day =i/e/365	**2380**	40467	14967	17991	10265	6742	4970	8627	4167	
Railway's share % in total transportation passenger↕km (k)	**9.6**	34.5					**6**		**7**	
Railway tons (l)	**4.4**	74	409	1658	7.6	15.7	97	80.4	287.9	10^6
Railway tons/people =l/b	**0.058**	0.587	0.435	1.346	0.127	0.137	1.65	1.401	3.515	
Ton•km (m)	**1.678**	25	27.9	1287	3.1	3.96	12.3	24.0	67.37	10^9
Ton•km/people n =m/b	**22.3**	198	**29.7**	1045	51.2	34.4	209.2	418.1	822.6	
Average freight (ton) density/km/day =m/e/365	**1768**	**2515**	**1215**	65300	**2195**	**2184**	**2038**	4108	4521	
Railway' share % in total transportation ton↕km	**5.0**	**4.4**					**6**		19	%

The figures of Passengers, passenger• km, tons, ton• km of Britain, Italy, Germany are from 1998 data, from Railway Directory; Railway Gazette year book.
※ [1]GDP of Java Isl. is not available. The figure is that of Indonesia

3.10 Summary of Identified Problems and Issues

Identified problems and issues facing VR are briefly summarized as follows:

(1) Poor State of Existing Facilities

- Lack of investment; Deterioration prevents higher speed service of railway. Especially some bridges are under speed limit of trains in order not to damage them.
- Low or old technical standard; prevents the higher, safer, more effective transportation and better maintenance. Some of the current facility- or equipment-standard shall be revised, for instance, formation level width, short sleeper, small rail section, small curvature, signaling systems, based on the total revise of the railway standard.

(2) Poor State of Rolling Stock

- Lack of investment; Deteriorated rolling stocks decrease attractiveness of the railway transportation.
- Delay of adoption of newer and effective technology; VR workers can't show enough productivity under the stained or old technology standard.
- Lack of sensitiveness to the customer; The better accommodation, for instance, passenger-seat, bed-length, clean window, air-condition, etc. such consideration to the passenger shall be performed much more and improved passenger cars shall be installed, for instance.

(3) Shortage of railway network

There is no clue of railway network in the productive Mekong Delta region.

(4) Delay of using railway system as a mass transportation in big cities

HCM City and Hanoi's traffic congestion are coming very serious. Fundamentally, railway system is the most fit to the mass transportation in big cities. VR's existing railway network should be available for this problem occurring now.

(5) Low productivity of employees and low level of working spirit

VR workers' productivity is comparatively in low level. The productivity shall be improved at the same time with the improvement of hardware (facilities, equipment, rolling stocks) and software (working manuals, standards, institutional systems, group activities).

The work volume and peculiarity changes very much when the states of the art is introduced. For instance, the watch-men are posted now at the sites of

important structures such as tunnels, or long bridges. These watches shall be rationed to the checking by intervals or the automatic check by inspection tools according to the checking characteristic after those structures are improved or newly constructed.

(6) Low level of Marketing

The following issues are easily felt;

- Passenger cars are generally full with the passengers.
- Necessary tickets cannot be bought sometimes.
- The railway information is not easy to have for the passengers (train delay, train cancel, ticket reservation, etc.).
- From above,
  1) More real time information shall be delivered
  2) Train windows shall be kept clean
  3) More trains shall be driven
  4) Much easier ticket buy shall be realized