JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

VIETNAM RAILWAYS (VR)

STUDY FOR THE FORMULATION OF HIGH SPEED RAILWAY PROJECTS ON HANOI – VINH AND HO CHI MINH – NHA TRANG SECTION

FINAL REPORT

TECHNICAL REPORT 2

DEMAND FORECAST AND TRANSPORTATION COST

June 2013

ALMEC CORPORATION
JAPAN INTERNATIONAL CONSULTANTS FOR TRANSPORTATION CO., LTD.
ORIENTAL CONSULTANTS CO., LTD.
NIPPON KOEI CO., LTD.
JAPAN TRANSPORTATION CONSULTANTS, INC.

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USD 1 = JPY 78 = VND 21,000

(Based on rate on November 2011)

PREFACE

In response to the request from the Government of the Socialist Republic of Vietnam, the Government of Japan decided to conduct the Study for the Formulation of High Speed Railway Projects on Hanoi – Vinh and Ho Chi Minh – Nha Trang Section and entrusted the program to the Japan International cooperation Agency (JICA).

JICA dispatched a team to Vietnam between April 2011 and June 2013, which was headed by Mr. IWATA Shizuo of ALMEC Corporation and consisted of ALMEC Corporation, Japan International Consultants for Transportation Co., Ltd., Oriental Consultants Co., Ltd., Nippon Koei Co., Ltd. and Japan Transportation Consultants, Inc.

In the cooperation with the Vietnamese Counterpart Team including the Ministry of Transport and Vietnam Railways, the JICA Study Team conducted the study which includes traffic demand analysis, natural and socio-economic conditions, alignment planning, consideration of various options including the upgrading of existing railway, technical standards for high speed railway, implementation schedule and institutions, and human resource development. It also held a series of discussions with the relevant officials of the Government of Vietnam. Upon returning to Japan, the Team duly finalized the study and delivered this report in June 2013.

Reflecting on the history of railway development in Japan, it is noted that Japan has indeed a great deal of experience in the planning, construction, operation, etc., and it is deemed that such experiences will greatly contribute to the railway development in Vietnam. JICA is willing to provide further cooperation to Vietnam to achieve sustainable development of railway sector and to enhance friendly relationship between the two countries.

It is hoped that this report will contribute to the sustainable development of transport system in Vietnam and to the enhancement of friendly relations between the two countries.

Finally, I wish to express my sincere appreciation to the officials of the Government of Vietnam for their close cooperation.

June 2013

Kazuki Miura
Director, Economic Infrastructure Department
Japan International Cooperation Agency

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ABBREVIATIONS

ADB	Asian Development Bank
AGR	Average Growth Rate
BOT	Build-Operate-Transfer
CFEZ	Central Focal Economic Zone
FDI	Foreign Direct Investment
FEZ	Focal Economic Zone
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
GSO	General Statistics Office
HCMC	Ho Chi Minh City
HSR	High Speed Railway
ICAO	International Civil Aviation Organization
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
LCC	Low Cost Carriers
MPI	Ministry of Planning and Investment
NCPFP	National Committee for Population and Family Planning
NFEZ	Northern Focal Economic Zone
NH	National Highway
NSHSR	North – South High Speed Railway
O & M	Operation And Maintenance
OD	Origin-Destination
SED	Socio-Economic Development
SEDP	Socio-Economic Development Plan
SFEZ	Southern Focal Economic Zone
TEU	Twenty foot Equivalent Units
UNFPA	United Nations Population Fund
URGD	Urban Rural Growth Difference
USD	United States Dollar
VAT	Value Added Tax
VITRANSS2	The Comprehensive Study On The Sustainable Development Of Transport System In Vietnam
VND	Vietnamese Dong
VOC	Vehicle Operation Cost
VOT	Value of Time
VR	Vietnam Railways

1 OUTLINE

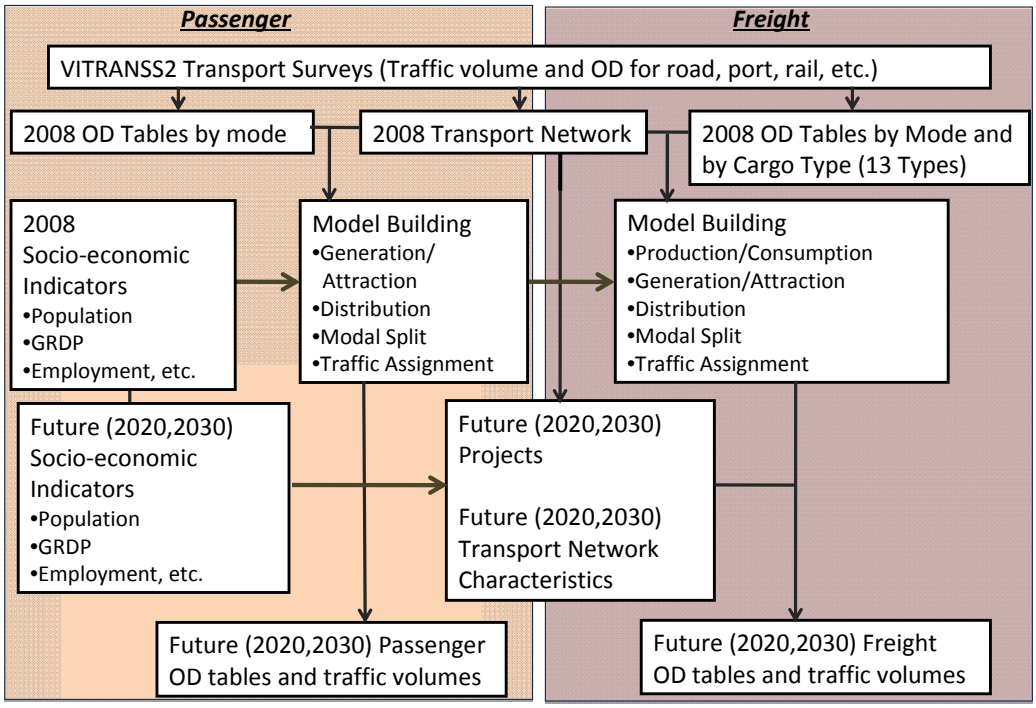
1.1 Demand Forecast in VITRANSS2

1.1 In VITRANSS2, the demand forecast model targeting domestic inter-provincial traffic demand in the whole Vietnam was developed for passenger and freight transport. The traffic model utilized for this study is based on this VITRANSS2 model.

1.2 Figure 1.1.1 presents the outline of the demand forecast methodology adopted in VITRANSS 2.The demand forecast is divided into two parts, namely, passenger and freight. The starting point of both is the creation of current origin-destination (OD) tables based on the transportation and traffic surveys and other relevant data collected from various government agencies. While passenger OD tables are prepared by mode (i.e. car, bus, existing railway, high speed railway and air), freight OD tables are further broken down by cargo type (13 types such as rice, wood, steel, etc.).

1.3 Using these OD tables and socio-economic indicators of the study area, forecast models were constructed. Both for passenger and freight, the conventional four-step modeling was adopted, i.e., generation/attraction, distribution, modal split and assignment. For freight, however, production and/or consumption should be determined by traffic zone for all 13 cargoes prior to stepping into the four-step modeling process, because this is the root cause of freight traffic.

1.4 Once models were built, future conditions in terms of socio-economic indicators and proposed projects were inputted to the models. The models output the simulation results for the target years.



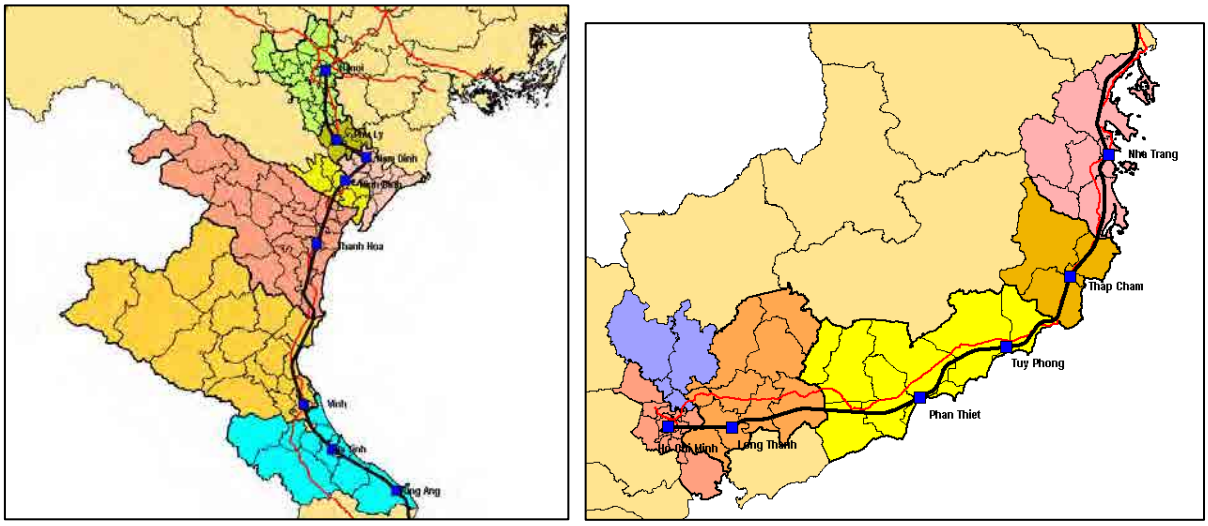
Source: VITRANSS 2(2010, JICA)

Figure 1.1.1 Outline of Demand Forecast Methodology

1.2 Update of Demand Forecast Model

1.5 Passenger traffic demand model was newly updated for the analysis on the priority sections of HSR in Vietnam. The main characteristics of the updates are as follows;

(i) Modification of Zoning: The zone unites were updated for conducting the analysis more in detail. Provincial boundaries applied for VITRANSS2 model were too large to analyse the traffic between stations and access traffic to railway stations. Therefore, in this study, district boundaries were applied in the provinces along North-South railway line (from Hanoi to Ha Tinh in the north and from HCMC to Nha Trang in the south).



Source: JICA Study Team

Figure 1.2.1 New Zones for Target Area

(ii) Socio-economic Indicators: Socio-economic Indicators, which are basic input of the demand forecast, were updated based on the latest data and socio-economic plans of national and local governments in Vietnam.

(iii) Base year OD Data: Base year inter-provincial traffic data was updated based on the traffic survey conducted in October 2011 and traffic data obtained from related agencies.

(iv) Network and Parameters: The network and parameters were also updated based on the latest available data including transport passengers interview data conducted in October 2011.

(iv) Future OD Forecast Model: While the same model with VITRANSS2 was applied for the analysis, coefficients of traffic demand forecast model was re-estimated based on the latest socio-economic indicators and traffic data. For modal split model, the distinct model was developed for each of three types of OD pairs, namely within North area, within South area and the other OD pairs utilizing the stated preferences of modal choice obtained by interview survey.

1.6 The updated traffic demand forecast model is explained in detail in Chapter 4.

2 TRAFFIC AND PASSENGER INTERVIEW SURVEYS

2.1 Objective and Scope of the Surveys

2.1 To obtain the data for updating the current traffic situation and understand the characteristics of passenger travel and passenger travel preference, supplemental traffic and passenger interview surveys were conducted. This appendix presents the basic outputs of the surveys. The scope of the surveys is shown in Table 2.1.1 below.

Table 2.1.1 Scope of Traffic and Passenger Interview Surveys

No.	Item	Contents
1.	Traffic Count/ Origin-Destination (OD) Interview (Date: 11 November, 2011)	1) Traffic Count • Survey location: 20 points (Hanoi-Binh, HCMC-Nha Trang sections and surrounding area) • Duration: 24 hours (6 AM-6 AM) 2) OD Interview Survey • Survey location: 20 points (same as in traffic count survey) • Duration: 13 hours (6 AM-7 PM)
2.	Bus Transport Survey	1) Data Collection (routes, fare, etc.) • Survey location: Hanoi (4 terminals), Ninh Binh, Thanh Hoa, Vinh, Da Nang, Nha Trang, Phant Thiet. Bien Hoa, Ho Chi Minh (2 terminals) 2) Passenger Interview Survey • No. of samples: Hanoi (4 terminals)(200 each), Ninh Binh (100), Thanh Hoa (100), Binh (100), Da Nang (100), Nha Trang (100), Phan Thiet (100), Bien Hoa (100), HCMC (2 terminals) (200 each)
3.	Railway Transport Survey	1) Data Collection (no. of passengers, fare, etc.) 2) Passenger Interview Survey • No. of samples: 200 samples each in Hanoi, Thanh Hoa, Vinh, Da Nang, Hue, Nha Trang, Phan Thiet, HCMC
4.	Air Transport Survey	1) Data Collection (no. of flights, no. of air passengers, cargo transport demand) 2) Passenger Interview Survey • No. of samples: 200 samples each in Hanoi, Da Nang, Hue, Nha Trang, HCMC

Source: JICA Study Team

2.2 Traffic Survey

1) Traffic Count

2.2 The traffic count survey was conducted on 11 November 2011 at 20 survey points along the North-South corridor. The summary of the results of the traffic count survey are shown in Table 2.2.1.

Table 2.2.1 Summary of Traffic Count Survey Results

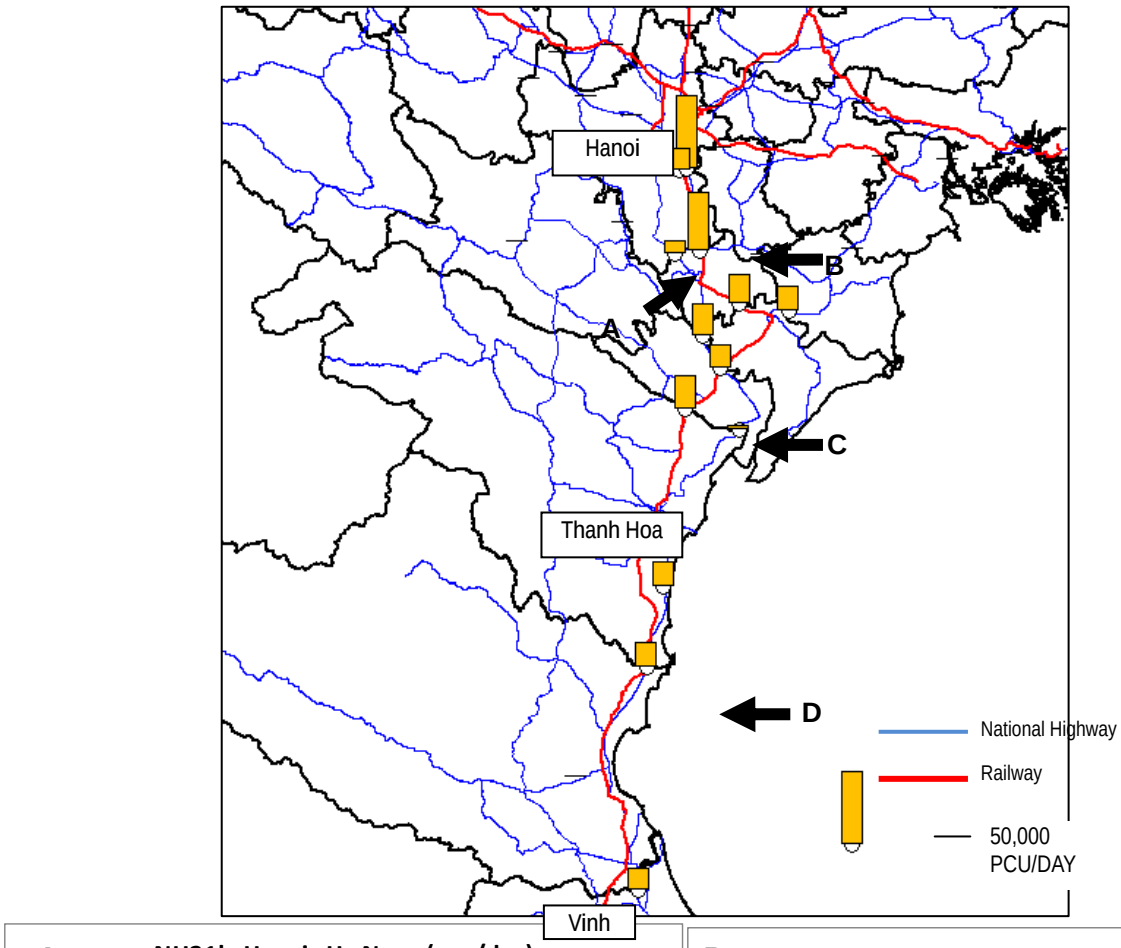
Location		Traffic Volume (Vehicle/day)					Traffic Volume (PCU/day)
		Car	Bus	Truck	MC	BC	Total [1)]
1	Hanoi - Ha Hay (previous) (NH1)	1,888	416	2,149	21,140	1,913	14,834
2	Hanoi - Ha Hay (previous) (Exp)	12,583	4,948	8,316	14,042	63	49,962
3	Hanoi - Ha Nam (NH21b)	1,063	258	1,740	10,737	989	9,378
4	Hanoi - Ha Nam (NH1)	9,062	3,616	7,882	9,409	717	40,701
5	Hanoi - Ninh Binh and Nam Dinh (NH21)	3,161	3,095	3,842	5,194	484	22,110
6	Hanoi - Ninh Binh and Nam Dinh (NH1)	4,527	2,100	2,884	10,980	575	20,339
7	Thai Binh - Nam Dinh (NH10)	2,828	1,519	3,503	6,168	620	17,295
8	Nam Dinh - Ninh Binh (NH10)	2,525	1,497	2,864	7,496	867	15,763
9	Ninh Binh - Thanh Hoa (NH1)	2,979	1,711	5,641	7,094	1,095	23,597
10	Ninh Binh - Thanh Hoa (NH10)	77	37	463	3,716	1,461	2,588
11	Thanh Hoa (NH1)	1,621	1,390	3,935	7,015	1,092	17,147
12	Thanh Hoa - Nghe An	1,564	1,372	4,367	3,350	133	16,930
13	Nghe An - Ha Tinh (NH1/NH18)	2,929	1,017	2,380	12,685	2,232	15,450
14	Phu Yen - Khanh Hoa (NH1)	344	665	2,114	2,639	496	8,133
15	Khanh Hoa - Ninh Thuan (NH1)	600	960	2,625	6,928	471	11,688
16	Nhinh Thuan - Binh Thuan (NH1)	603	857	2,295	2,515	31	9,241
17	Binh Thuan (NH1)	1,182	1,767	3,328	6,900	1,556	16,145
18	Binh Thuan - Dong Nai (NH1)	1,437	1,736	3,605	4,785	79	16,233
19	Dong Nai - HCMC (NH1)	18,203	11,081	43,640	26,581	27	162,983
20	Dong Nai - VR-VT (NH51)	4,523	2,222	6,340	40,520	725	38,157

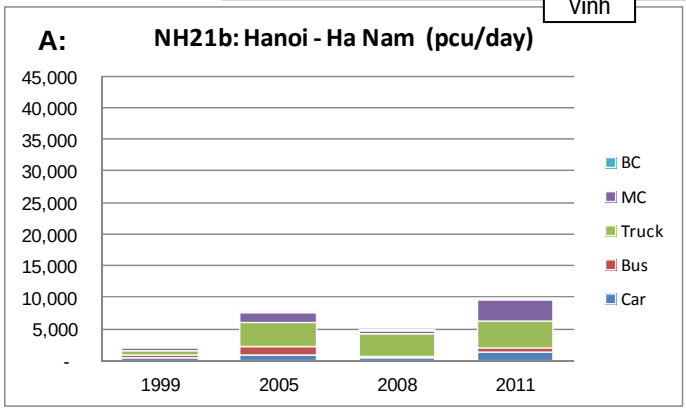
Source: JICA Study Team

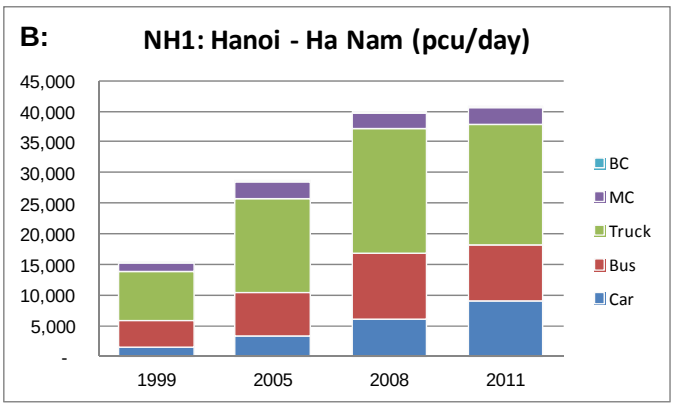
Note: PCU Factor Assumption: Car =1, Bus = 2.5, Truck = 2.5, MC = 0.3, BC = 0.1

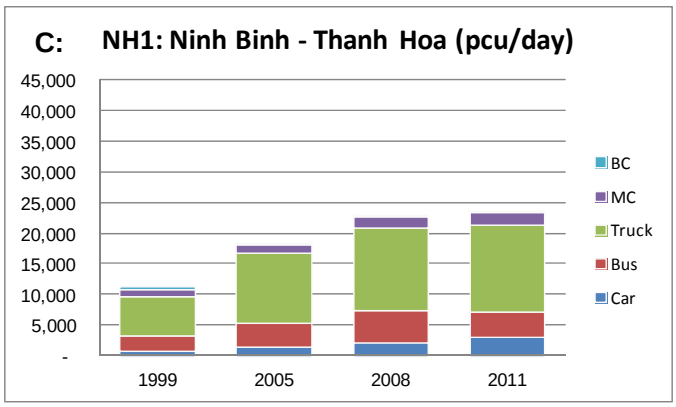
2.3 The results of the traffic count surveys for the north and south are illustrated in Figure 2.2.1 and Figure 2.2.2, respectively, which are compared with data from previous years (1999, 2005 and 2008). While traffic volume between 1999 and 2008 substantially increased in most of survey points, the same has not changed much since then excluding the traffic around urban area in the south (Dong Nai-HCMC), which has increased significantly. In all survey points, the truck is the dominant vehicle type, followed by the bus and passenger car.

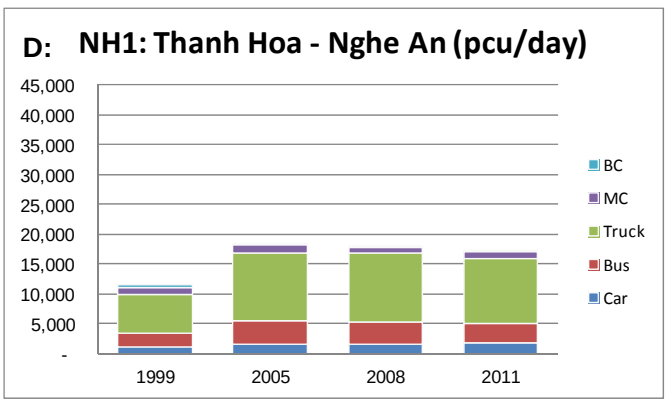
2.4 Figure 2.2.3 compares the traffic volumes along the North-South corridor by major road sections in the north and the south.





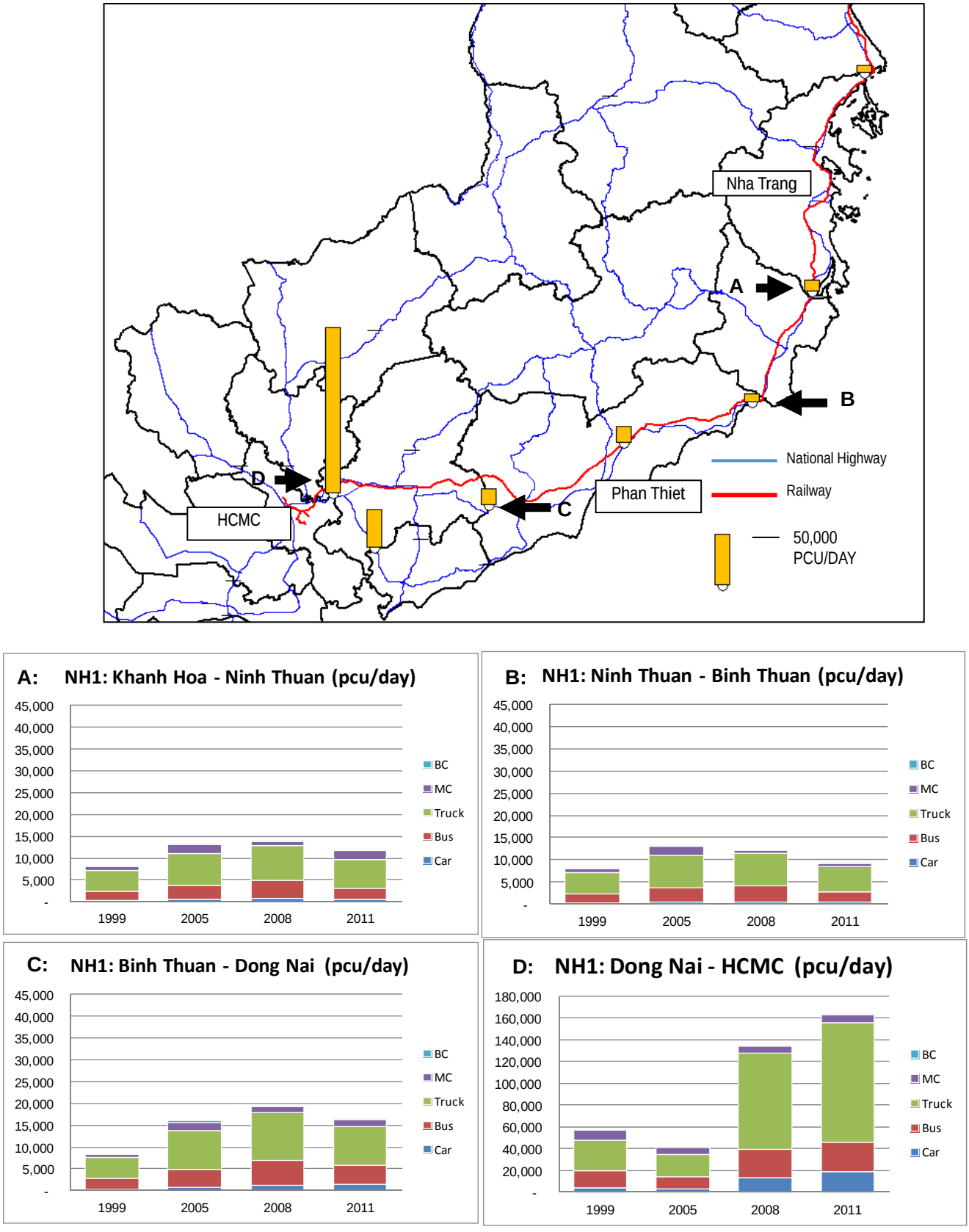






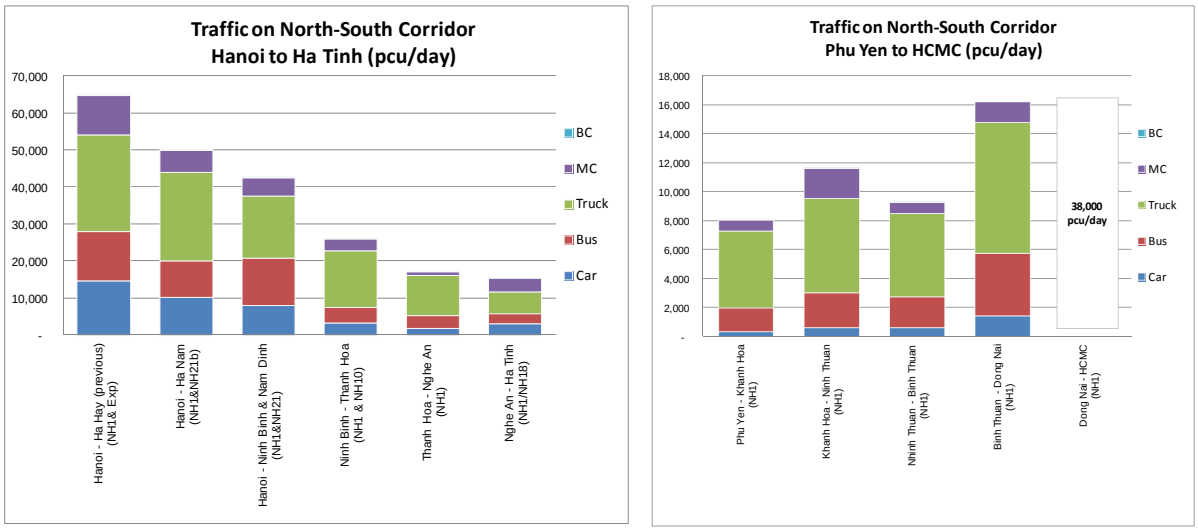
Source: JICA Study Team

Figure 2.2.1 Results of Traffic Count Survey in the North



Source: JICA Study Team

Figure 2.2.2 Results of Traffic Count Survey in the South



Source: JICA Study Team

Figure 2.2.3 Comparison of Traffic along the North-South Corridor (in the north and the south)

2) Traffic Volume of Other Transport Modes

2.5 Besides the traffic count survey, data collection for other transport modes was conducted to update information on the current traffic situation. These are summarized in the following sections.

(1) Railway Transport

2.6 Data on railway passenger and freight traffic volume are shown in Table 2.2.2 and Table 2.2.3. The change in traffic demand of railway passengers over the past three years has been very limited (gradually decreasing from 48,660 passengers/ day in 2008 to 46,733 passengers/ day in 2010). In contrast, cargo traffic demand in 2010 has significantly dropped by about 25% to 30,269 tons/ day from 42,091 tons/ day in 2008.

Table 2.2.2 Railway Passenger Traffic Volume (2008-2010)

Route	2008	2009	2010
	passenger/day (%)	passenger/day (%)	passenger/day (%)
Hanoi–Saigon	16,487 (33.9)	16,108 (33.5)	17,173 (36.7)
Hanoi–Haiphong	8,805 (18.1)	8,771 (18.2)	8,461 (18.1)
Gia Lam–Dong Dang	7,338 (15.1)	7,228 (15.0)	6,621 (14.2)
Yen Bien–Quang Trieu	6,488 (13.3)	6,513 (13.5)	5,988 (12.8)
Dong Anh–Lao Cai	9,274 (19.1)	9,275 (19.3)	8,399 (18.0)
Pho Trang–Ha Long	268 (0.5)	252 (0.5)	91 (0.2)
Total	48,660 (100.0)	48,147 (100.0)	46,733 (100.0)

Source: Vietnam Railways

Table 2.2.3 Railway Freight Traffic Volume (2008-2010)

Route	2008	2009	2010
	ton/day (%)	ton/day (%)	ton/day (%)
Hanoi–Saigon	8,941 (21.3)	8,237 (20.6)	5,947 (19.7)
Hanoi–Haiphong	5,506 (12.0)	5,073 (12.7)	3,701 (12.2)
Gia Lam–Dong Dang	8,934 (21.2)	8,892 (22.2)	5,292 (17.5)
Yen Bien–Quang Trieu	4,974 (11.8)	4,899 (12.2)	4,703 (15.5)
Dong Anh–Lao Cai	9,475 (22.5)	8,435 (21.0)	7,124 (23.5)
Pho Trang–Ha Long	2,431 (5.8)	2.499 (6.2)	1,502 (5.0)
Van Dien–Bac Hong	2,280 (5.4)	2,048 (5.1)	2,000 (6.6)
Total	42,091 (100.0)	40,083 (100.0)	30,269 (100.0)

Source: Vietnam Railways

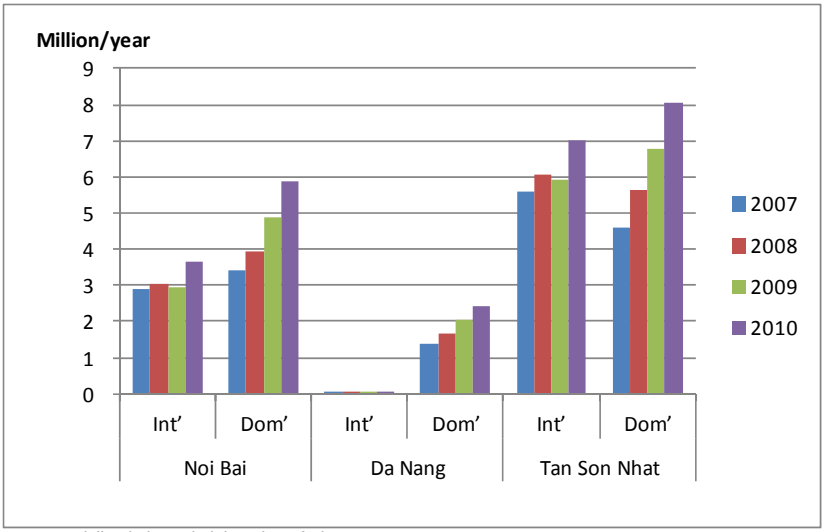
(2) Air Transport

2.7 Data on air traffic volume at the major airports in Vietnam over the last four years are shown in Table 2.2.4 and Figure 2.2.4. Domestic air traffic demand increased significantly, with an annual growth rate of 20.1%, from 9.4 million passengers in 2007 to 16.3 million in 2010. While not as high as domestic demand, international traffic volume has been growing by 8.0% per year (from 8.5 million to 10.7 million passengers) during the same period. This growth would be attributable to the rapid increase of income levels of people, which promotes more travel, and more frequent transport services (i.e., increase in the number of flights).

Table 2.2.4 Traffic Volume at Major Airports in Vietnam

		No. of Passengers (000/year)				2010/2007	Annual Growth Rate ('07-'10)
		2007	2008	2009	2010		
Noi Bai	International	2,900	3,040	2,951	3,659	1.26	8.1
	Domestic	3,405	3,947	4,880	5,858	1.72	19.8
Da Nang	International	27	37	17	46	1.70	19.3
	Domestic	1,408	1,680	2,068	2,438	1.73	20.1
Tan Son Nhat	International	5,599	6,061	5,939	7,021	1.25	7.8
	Domestic	4,604	5,658	6,787	8,028	1.74	20.4
Total	International	8,525	9,138	8,907	10,726	1.26	8.0
	Domestic	9,416	11,285	13,734	16,325	1.73	20.1

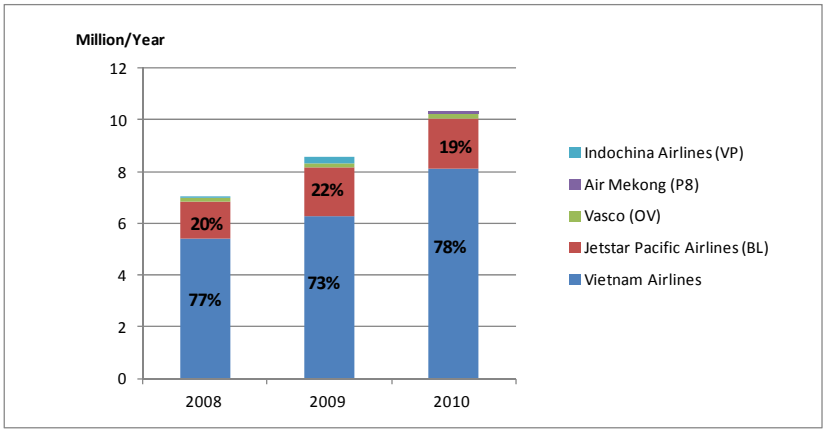
Source: Civil Aviation Administration of Vietnam



Source: Civil Aviation Administration of Vietnam

Figure 2.2.4 Traffic Volume at Major Airports in Vietnam

2.8 The number of annual domestic air passenger by operating company is shown in Figure 2.2.5 below. Both Vietnam Airlines and the low cost carriers (i.e., Jet Star Pacific, VASCO, Air Mekong, and Indochina Airlines) have been increasing their passenger volumes over the last three years.



Source: Civil Aviation Administration of Vietnam

Figure 2.2.5 No. of Annual Domestic Air Passenger by Operating Company

2.9 Table 2.2.5 shows the frequency of flights in 2010. The busiest route is the Hanoi-HCMC section, with 224 flights for each way per week. This is followed by HCMC-Danang (106 flights) and Hanoi-Danang (60 flights).

Table 2.2.5 Frequency of Flights by Routes (2010)

Route		Airline	Frequency (Flight/week/way)
Hanoi – Buon Me Thuot	HAN-BMV	Vietnam Airlines	7
		Air Mekong	7
Hanoi – Nha Trang	HAN-CXR	Vietnam Airlines	21
Hanoi – Danang	HAN-DAD	Vietnam Airlines	60
Hanoi – Dien Bien	HAN-DIN	Vietnam Airlines	14
Hanoi – Da Lat	HAN-DLI	Vietnam Airlines	7
		Air Mekong	7
Hanoi – Hue	HAN-HUI	Vietnam Airlines	28
Hanoi - Pleiku	HAN-PXU	Vietnam Airlines	7
		Air Mekong	7
Hanoi – HCM	HAN-SGN	Vietnam Airlines	130
		Pacific Airlines	70
		Air Mekong	24
Hanoi – Tuy Hoa	HAN-TBB	Vietnam Airlines	7
Hanoi – Quy Nhon	HAN-UIH	Vietnam Airlines	5
Hanoi – Can Tho	HAN-VCA	Vietnam Airlines	14
Hanoi – Chu Lai	HAN-VCL	Vietnam Airlines	4
Hanoi – Dong Hoi	HAN-VDH	Vietnam Airlines	5
Hanoi – Vinh	HAN-VII	Vietnam Airlines	14
HCM – Buon Ma Thuot	SGN-BMV	Vietnam Airlines	23
HCM – Nha Trang	SGN-CXR	Vietnam Airlines	28
HCM – Danang	SGN-DAD	Vietnam Airlines	78
		Pacific Airlines	28
HCM – Da Lat	SGN-DLI	Vietnam Airlines	28
HCM – Hai Phong	SGN-HPH	Vietnam Airlines	26
		Pacific Airlines	14
HCM – Hue	SGN-HUI	Vietnam Airlines	28
		Pacific Airlines	7
HCM – Phu Quoc	SGN-PQC	Vietnam Airlines	49
		Air Mekong	11
HCM – Pleiku	SGN-PXU	Vietnam Airlines	19
		Air Mekong	14
HCM – Quy Nhon	SGN-UIH	Vietnam Airlines	14
		Air Mekong	7
HCM – Dong Hoi	SGN-VDH	Vietnam Airlines	4
HCM - Vinh	SGN-VII	Vietnam Airlines	21
		Pacific Airlines	14

Route		Airline	Frequency (Flight/week/way)
HCM – Rach Gia	SGN-VKG	Vietnam Airlines	7
Danang – Buon Me Thuot	DAD-BMV	Vietnam Airlines	7
Danang – Nha Trang	DAD-CXR	Vietnam Airlines	21
Danang – Da Lat	DAD-DLI	Vietnam Airlines	7
Danang – Hai Phong	DAD-HPH	Vietnam Airlines	7
Danang – Pleiku	DAD-PXU	Vietnam Airlines	7
HCM – Con Dao	SGN-VCS	VASCO	28
		Air Mekong	5
HCM – Ca Mau	SGN-CAH	VASCO	11
HCM – Chu Lai	SGN-VCL	VASCO	10
HCM – Tuy Hoa	SGN-TBB	VASCO	10
Con Dao – Can Tho	VCS-VCA	VASCO	4
Buon Me Thuot - Vinh	BMV-VII	Air Mekong	3
Pleiku - Vinh	PXU-VII	Air Mekong	3

Source: Civil Aviation Administration of Vietnam

(3) Coastal Shipping

2.10 Data on cargo handling volume at the ports was also collected through the internet (as this was not part of the traffic surveys conducted for this study). Table 2.2.6 shows the changes in traffic demand from 2007 to 2010. The total volume of domestic and international container cargo handled in Vietnam increased by an average of 10.7% per year, from 4.3 million TEU in 2007 to 6.4 million TEU in 2010. While absolute total volume has been fluctuating very sharply during this period (especially between 2009 and 2010), domestic container cargo traffic has been increasing quite steadily by 5.4% yearly in all regions.

Table 2.2.6 Summary of the Cargo Throughput of Ports in Vietnam (2007-2010)

Region	Item		2007	2008	2009	2010	2010/2007	Annual Growth Rate 2007-2010
Northern Region	Cargo throughput (x 1,000 million tons)	Import	11,827	14,195	17,127	16,611	1.40	8.9
		Export	23,483	20,831	29,129	24,330	1.04	0.9
		Domestic	11,567	21,327	17,497	14,806	1.28	6.4
		Total	46,877	56,353	63,753	55,747	1.19	4.4
	Container (TEU)		1,075,658	1,380,202	1,762,627	1,936,826	1.80	15.8
Central Region	Cargo throughput (x 1,000 million tons)	Import	1,540	1,649	1,184	1,681	1.09	2.2
		Export	6,037	5,993	6,677	7,938	1.31	7.1
		Domestic	7,522	7,393	7,472	7,141	0.95	-1.3
		Total	15,099	15,035	15,333	16,760	1.11	2.6
	Container (TEU)		128,954	154,594	132,229	202,983	1.57	12.0
Southern Region	Cargo throughput (x 1,000 million tons)	Import	36,662	34,372	28,826	40,012	1.09	2.2
		Export	22,581	29,024	45,286	21,095	0.93	-1.7
		Domestic	12,770	12,388	19,301	17,392	1.36	8.0
		Total	72,013	75,784	93,413	78,500	1.09	2.2
	Container (TEU)		3,082,728	3,429,270	3,494,246	4,290,088	1.39	8.6
TOTAL	Cargo throughput (x 1,000 million tons)	Import	50,029	50,216	47,137	58,304	1.17	3.9
		Export	52,101	55,848	81,092	53,364	1.02	0.6
		Domestic	31,859	41,108	44,270	39,339	1.23	5.4
		Total	133,989	147,172	172,499	151,007	1.13	3.0
	Container (TEU)		4,287,340	4,964,066	5,389,102	6,429,897	1.50	10.7

Source: http://www.vpa.org.vn/vn/information/info_static2010.htm Note : TEU – twenty-foot equivalent units.

2.3 Terminal Interview Surveys

1) Objective and Scope

2.11 Terminal interview surveys mainly aim to collect data necessary for demand forecast analysis. They are useful tools for measuring and forecasting traffic demand along existing and new transport routes. For the HSR study, the terminal interview surveys included the following three categories of questions:

(i) Personal information;

(ii) Travel information; and

(iii) Transport mode preference.

2.12 The surveys covered a total of 4,461 passengers of bus, railway and air transport who were interviewed in November 2011. The results of the surveys are discussed in the following sections.

2) Profile of Samples

2.13 Survey locations, number of samples, and the profile of samples for the interview surveys are shown in the following tables.

2.14 The surveys covered 13 bus terminals, 8 railway stations, and 5 airports (see Table 2.3.1). The total 4,461 interview respondents included 1,914 bus passengers, 1,563 railway passengers, and 984 airline passengers (see Table 2.3.2).

Table 2.3.1 Terminal Interview Survey Locations

Mode	Location
Bus Terminal (13)	Hanoi (Giap Bat, My Dinh, Nuoc Ngam, Yen Nghia), Ninh Binh, Thanh Hoa, Vinh (Nge An), Da Nang, Nha Trang, Phan Thiet (Binh Thuan), Bien Hoa (Dong Nai), HCMC (East Terminal, West Terminal)
Railway Station (8)	Hanoi, Thanh Hoa, Vinh, Danang, Hue, Nha Trang, Phan Thiet, HCMC
Airport (5)	Airports in Hanoi (Noi Bai), Danang, Hue, Nha Trang (Cam Ranh) and HCMC

Source: JICA Study Team

Table 2.3.2 Number of Samples

Province	Bus Passenger	Railway Passenger	Air Passenger	Total
Hanoi	822	184	199	1,205
Ninh Binh	105	0	0	105
Thanh Hoa	82	201	0	283
Vinh	100	204	0	304
Hue	0	199	200	399
Danang	98	195	198	491
Nha Trang	100	200	201	501
Phan Thiet	104	185	0	289
Bien Hoa	104	0	0	104
HCMC	399	195	186	780
Total	1,914	1,563	984	4,461

Source: JICA Study Team

2.15 A little more than half of the respondents are male (see Table 2.3.3), giving a male to female ration of 1.2:1. The overall sample is generally young, with an average age of 36.2 years old (see Table 2.3.4). Bus passengers tend to be a bit younger than railway and air passengers.

Table 2.3.3 Sex of Interviewees

Sex	Male	Female	Total
No.	2,433	2,028	4,461
%	54.5	45.5	100

Source: JICA Study Team

Table 2.3.4 Average Age of Interviewees

Bus Passenger	Railway Passenger	Air Passenger	All
35.0	35.9	38.8	36.2

Source: JICA Study Team

2.16 Many of the respondents are professional/ technical workers, skilled workers, students or business owners (see Table 2.3.5). A very small number are jobless. Almost a third belongs to the middle-income group, earning between VND 2-8 million/month (see Table 2.3.6). Average income is VND 4 million/month. Transport affordability is reflected in the mode preference, with bus and railway passengers averaging incomes of around VND 3 million, less than half that of the air passengers. Meanwhile, air passengers have the most access to other vehicles (i.e., private and company cars, motorcycles) than bus and railway passengers (see Table 2.3.7). Nevertheless, a great majority of all passengers (ranging from 82-95%) have access to motorcycles, regardless of their preferred mode of transport during the interviews.

Table 2.3.5 Occupations of Interviewees

	Bus Passenger	Railway Passenger	Air Passenger	Total	% Share
Manager	112	35	97	244	5.5
Professional / technical	250	326	267	843	18.9
Farmer / fisherman	175	123	14	312	7.0
Military / police	66	62	50	178	4.0
Skilled worker (e.g. machinist, tailor, tour guide, artist)	289	230	109	628	14.1
Unskilled worker	166	53	9	228	5.1
Small-scale vendor	163	96	56	315	7.1
Own business	162	192	222	576	12.9
Student	273	281	58	612	13.7
Housewife	78	46	21	145	3.2
No job	35	14	5	54	1.2
Retired	105	100	73	278	6.2
Other	36	4	3	43	1.0
Unknown	4	1	0	5	0.1
Total	1,914	1,563	984	4,461	100

Source: JICA Study Team

Table 2.3.6 Income Level of Interviewees

	Bus Passenger	Railway Passenger	Air Passenger	Total	% Share
No income	370	280	88	738	16.5
< 0.5 M VND/mo	27	25	4	56	1.3
0.5~1 M VND/mo	94	43	3	140	3.1
1~1.5 M VND/mo	84	85	21	190	4.3
1.5~2M VND/ mo	198	135	13	346	7.8
2~4M VND/ mo	583	489	141	1,213	27.2
4~8M VND/mo	467	447	440	1,354	30.4
8~12M VND/mo	73	49	182	304	6.8
12~16M VND/mo	9	2	33	44	1.0
16~20M VND/mo	3	1	27	31	0.7
20~24M VND/mo	1	0	12	13	0.3
>24M VND/mo	2	5	20	27	0.6
Unknown	3	2	0	5	0.1
Total	1,914	1,563	984	4,461	100
Average Income (Mil. VND)	3.1	3.3	6.6	4.0	
Average Income (USD)	149.3	157.0	313.8	188.3	

Source: JICA Study Team

Table 2.3.7 Access to Vehicles

Access to Vehicle	Bus Passenger	Railway Passenger	Air Passenger
Private Car	3.0%	5.4%	24.6%
Company Car	3.3%	1.5%	15.1%
Motorcycle	81.9%	83.2%	95.3%

Source: JICA Study Team

2.17 The average respondent takes about 8 inter-provincial trips a year (see Table 2.3.8). Air passengers go to the provinces more frequently than the others, though railway passengers have the least number. More passengers were either going on private travel or going home at the time of the interviews (see Table 2.3.9). The other bus and railway passengers were going to school or work while the air passengers were mainly on business trips.

Table 2.3.8 No. of Inter-Provincial Travel

	Bus Passenger	Railway Passenger	Air Passenger	Total
Average inter-provincial travel times/ year	9.0	5.3	12.3	8.4

Source: JICA Study Team

Table 2.3.9 Travel Purpose

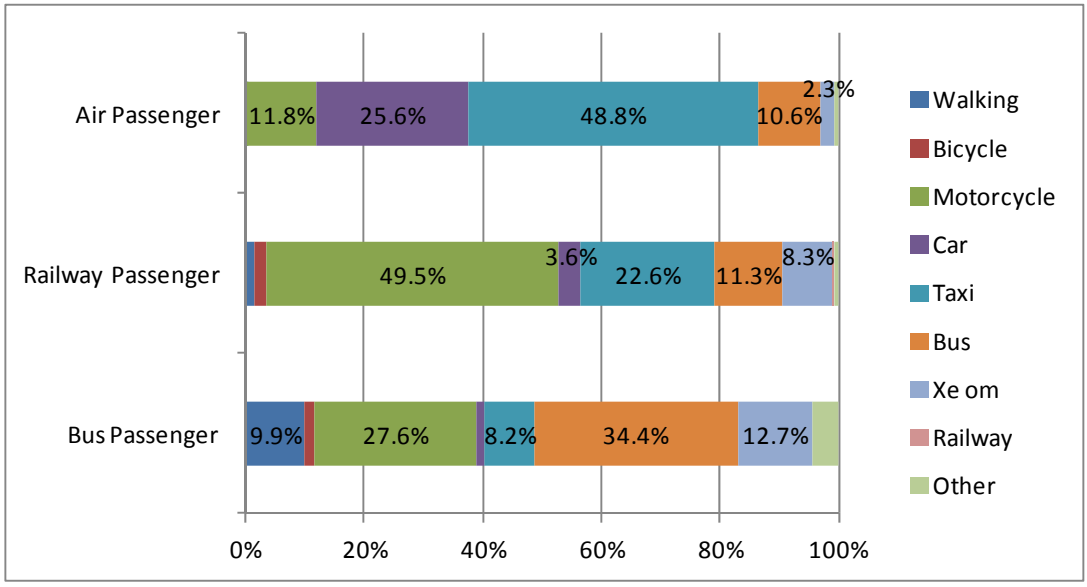
	Bus Passenger	Railway Passenger	Air Passenger	Total
To Work	7.7	5.6	-	12.6
To school	4.6	7.4	-	17.0
At Work/Business	17.6	18.7	33.2	16.4
Private	23.5	30.7	56.2	20.8
To home	29.6	25.5	-	21.7
Others	17.0	12.0	10.6	11.5
Total	100	100	100.0	100

Source: JICA Study Team

3) Access Travel

2.18 Survey information regarding access travel is shown in the following tables and figures by type of passenger.

2.19 How the passengers access the terminals varies by travel mode. For bus passengers, the bus is also their main access mode while for railway and air passengers, the motorcycle and taxi are the main access modes, respectively (see Figure 2.3.1).



Source: JICA Study Team
Note: No. of samples: 1,914 bus passengers; 1,563 railway passengers; 984 air passengers

Figure 2.3.1 Access Mode to Terminals

2.20 Regarding the fare to access the terminals, the bus is the cheapest while railway is almost twice as much as the bus (see Table 2.3.10). The cost of air transport is much higher than the two other modes.

Table 2.3.10 Average Fare to Terminals

	Bus Passenger	Railway Passenger	Air Passenger
Average Fare (VND)	15,353	29,163	127,737

Source: JICA Study Team

2.21 Table 2.3.11 shows the average access time to the terminals. Average access times for the bus, railway and air transport passengers are 27 minutes, 32 minutes and 50 minutes, respectively. For railway passengers, though, their average access time from one railway terminal to another is 266 minutes (which actually skews the overall figures to a higher average time).

Table 2.3.11 Average Access Time to Terminal (minutes)

Access Mode	Bus Passenger	Railway Passenger	Air Passenger	All
Walking	10.7	9.0	7.5	10.5
Bicycle	19.1	25.3	-	22.2
Motorcycle	18.0	26.8	33.5	24.0
Car	21.8	29.9	58.1	50.5
Taxi	23.1	26.8	46.8	35.9
Bus	41.2	68.2	58.8	48.3
Xe om	18.5	21.7	60.9	22.0
Railway	-	265.7	-	265.7
Other	43.3	62.5	73.6	47.4
All	26.9	32.2	49.8	33.8

Source: JICA Study Team

4) Main Travel Mode

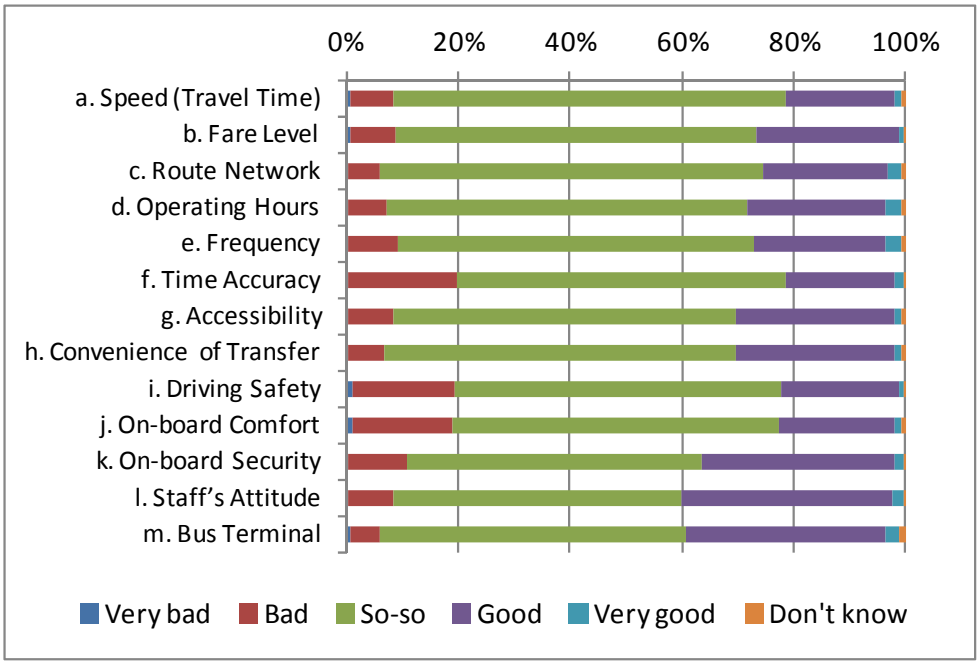
2.22 Table 2.3.12 shows the average waiting time at the terminals. Railway waiting time is as much as 47 minutes and more than twice as much as bus passenger. Air passengers, however, wait the longest (average of 52 minutes) for their transport.

Table 2.3.12 Waiting Time at Terminal (minutes)

	Bus Passenger	Railway Passenger	Air Passenger
Average waiting time	19.7	46.9	51.9

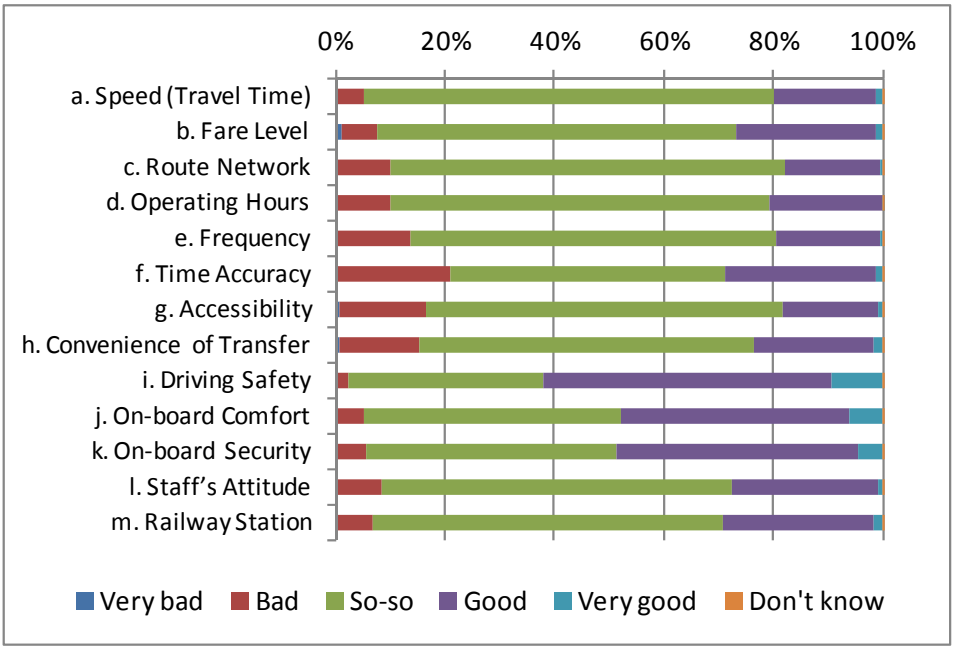
Source: JICA Study Team
Note: Data is only for passengers leaving from the terminals. Number of samples: 806 bus passengers, 514 railway passengers, 334 air passengers

2.23 Figure 2.3.2 to Figure 2.3.5 show the evaluation of each travel mode by passengers of each mode according to travel time, fare, route network, operating hours, frequency, time accuracy, accessibility, convenience of transfer, driving safety, on-board comfort, on-board security, staff's attitude, and terminal condition. Air travel is consistently ranked higher than both railway and bus travel in all these aspects. Bus travel is evaluated higher than railway travel in most aspects except time accuracy, driving safety, on-board comfort, and on-board security. Overall, the difference in the evaluation of modes is most obvious as to driving safety, on-board comfort, on-board security.



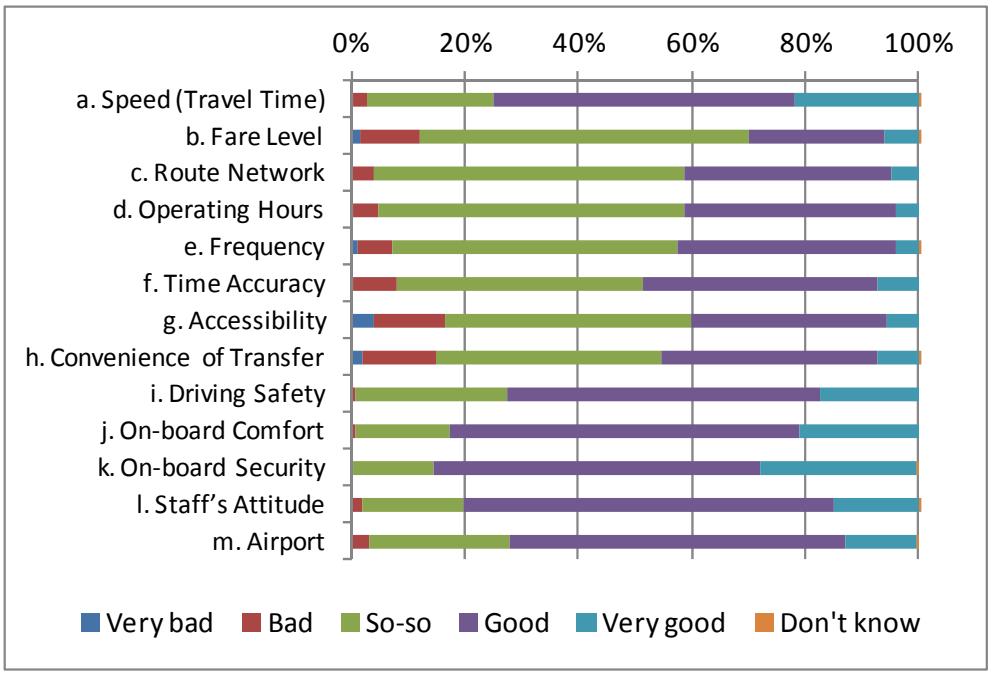
Source: JICA Study Team
Note: No. of Samples: 1,889-1,909

Figure 2.3.2 Evaluation of Bus Travel



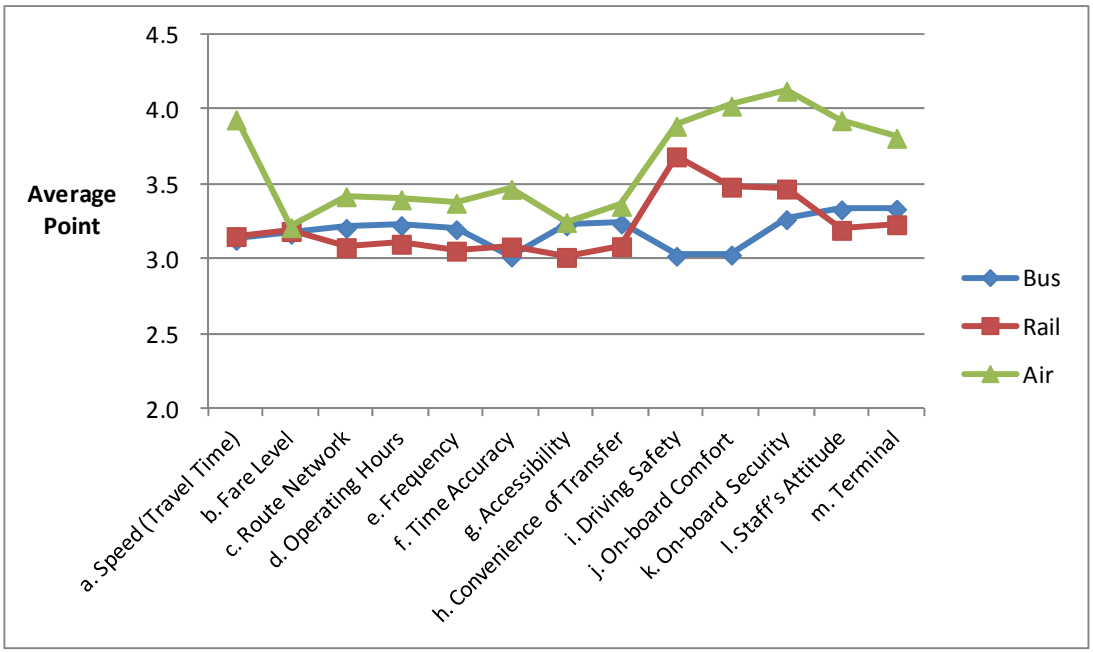
Source: JICA Study Team
Note: No. of Samples: 1,560-1,562

Figure 2.3.3 Evaluation of Railway Travel



Source: JICA Study Team
Note: No. of Samples: 981-984

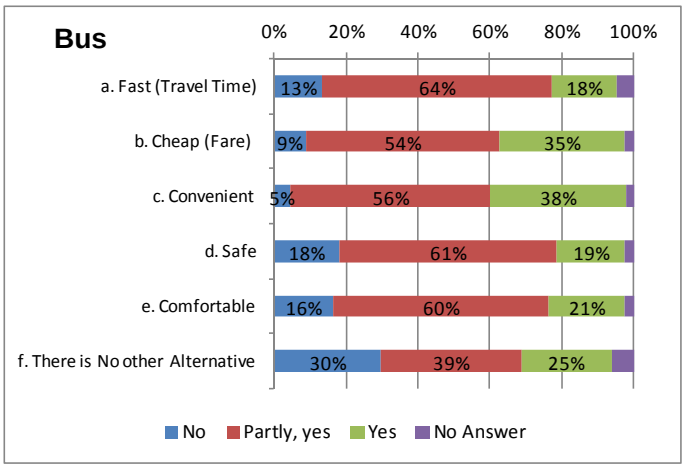
Figure 2.3.4 Evaluation of Air Travel



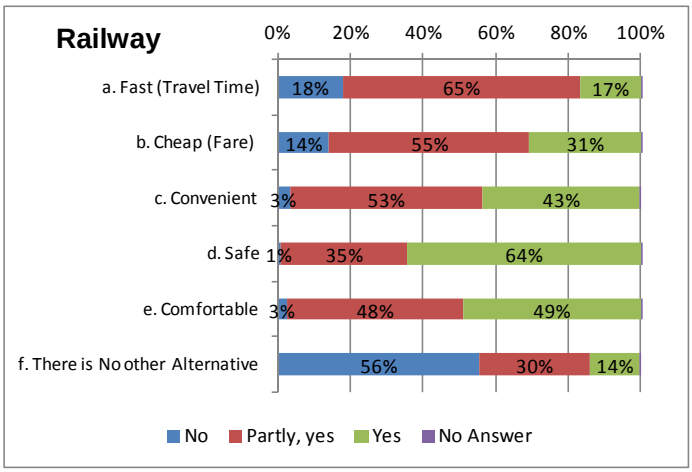
Source: JICA Study Team
Note: Average point is calculated by converting evaluations as follows: Very Bad = 1 point, Bad =2 points, So-so = 3 points, Good = 4 points, Very good = 5 points.

Figure 2.3.5 Comparative Evaluation of All Travel Modes

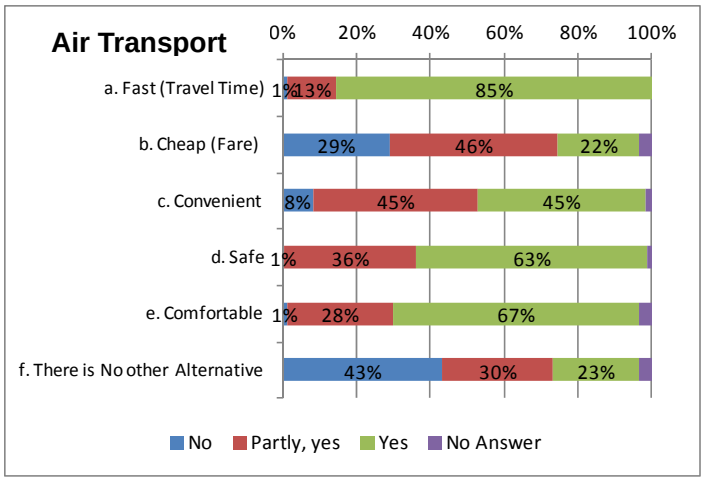
2.24 The reasons for selecting a particular travel mode are shown in Figure 2.3.6. Except for “Fast (Travel Time)”, railway and air passengers cited similar reasons for selecting railway and air travel, respectively. For them, safety, comfort and convenience are their main reasons for choosing these modes. For air passengers, fast travel time is the primary reason for travelling by plane. In the case of bus passengers, the bus is their preferred mode of travel mainly because of convenience and the cheap fare.



Note: No. of Samples: 1,914



Note: No. of Samples: 1,563



Note: No. of Samples: 984

Source: JICA Study Team

Figure 2.3.6 Reasons to Select Transport Mode

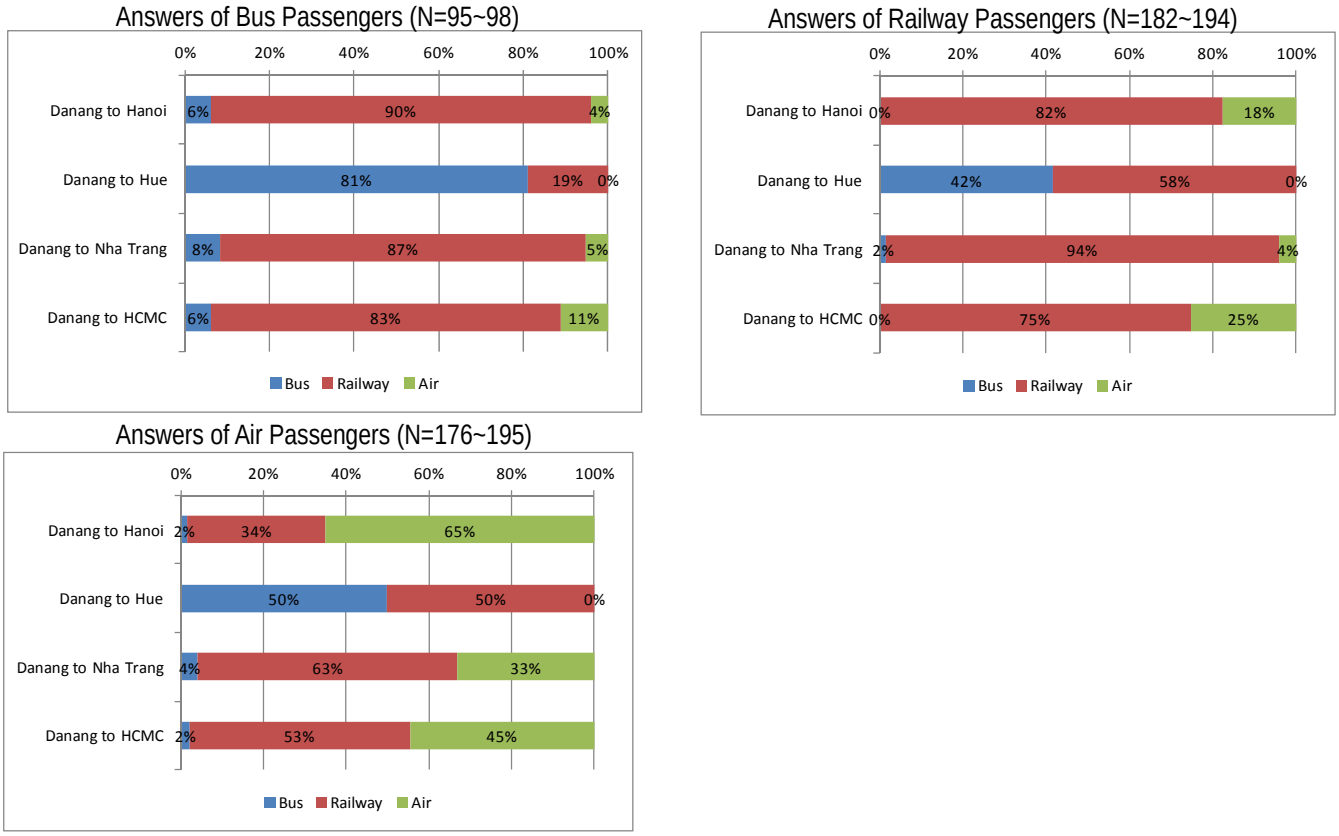
5) Current Mode Choice and Willingness-to-Pay

2.25 The interviewees were asked to select their preferred public transport mode for specific routes under the current situation. The survey results for Hanoi, Danang and HCMC are shown in Figures 2.3.7 to 2.3.9.

2.26 For travel between Hanoi and HCMC, besides air transport, the preference for railway is also significant for railway and bus users (39% and 63% for bus and railway passengers, respectively, in Hanoi and 23% and 25%, respectively, in HCMC). The bus is preferred only for short distance trips and considered not applicable for long-distance travel such as the Hanoi-HCMC section.

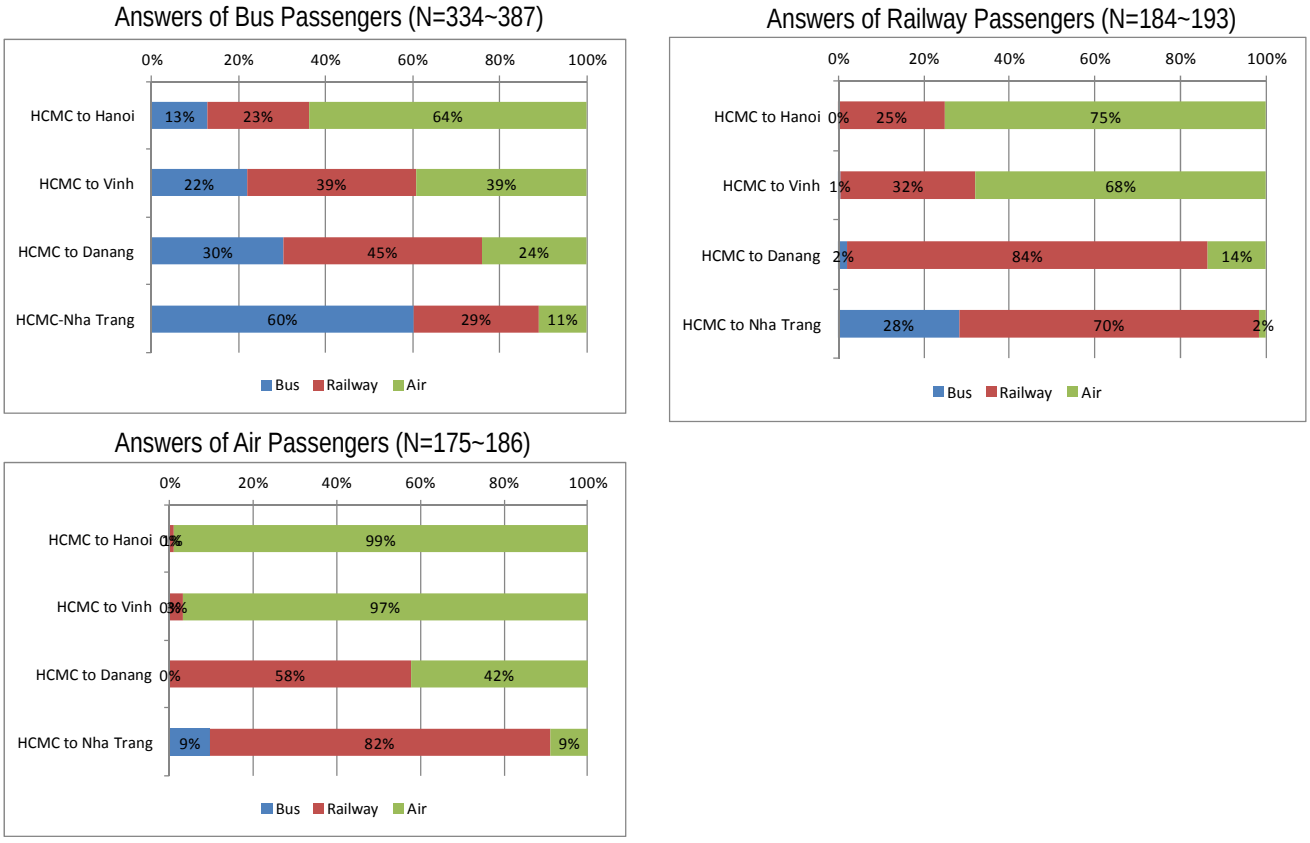
Source: JICA Study Team

Figure 2.3.7 Current Mode Choice for Selected Routes (Answers of Passengers in Hanoi



Source: JICA Study Team

Figure 2.3.8 Current Mode Choice for Selected Routes (Answers of Passengers in Danang)



Source: JICA Study Team

Figure 2.3.9 Current Mode Choice for Selected Routes (Answers of Passengers in HCMC)

2.27 The willingness-to-pay was surveyed by asking the passengers up to how much fare they are willing to pay for shortening their travel time by 30 minutes, 1 hour, 2 hours and 3 hours. The results are shown in Table 2.3.13. Air passengers signified the highest payable amount for faster travel service while bus passengers gave the lowest.

Table 2.3.13 Willingness to Pay (Average Amount Per Hour)

	VND/hour	USD/hour
Air	38,450	1.83
Bus	7,344	0.35
Railway	28,336	1.35

Source: JICA Study Team

6) Mode Choice under Assumed Conditions

2.28 By giving the expected future travel conditions in terms of travel time and fare level, the mode choice for specific routes was asked of the interviewees. For Fare A, the fare level of HSR is assumed to be half of airfare, for Fare B, the same as airfare, and for Fare C, the airfare assumed to be 1.5 times higher than the current level.

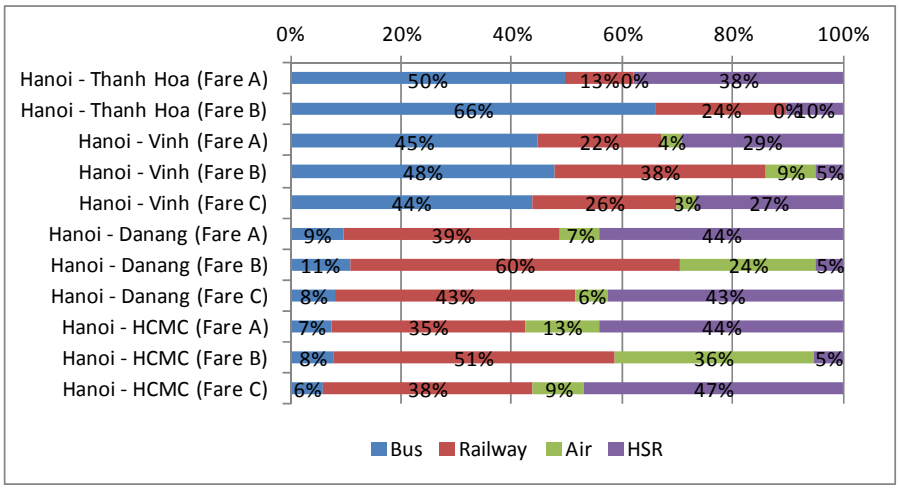
Table 2.3.14 Assumed Travel Conditions in the Future (Hanoi)

Route	Distance (km)		Bus	Railway	Air	HSR
Hanoi to Thanh Hoa	150	Total Travel Time (portion for waiting and access)	2 h 20 (30 min)	1 h 50 (30 min)	N/A	1 h 0 (30 min)
		Fare A (000VND)	60	60	N/A	130
		Fare B (000VND)	60	60	N/A	250
Hanoi to Vinh	280	Total Travel Time (portion for waiting and access)	4 h 0 (30 min)	3 h 0 (30 min)	2 h 30 (2h)	1 h 30 (30 min)
		Fare A (000VND)	120	120	470	240
		Fare B (000VND)	120	120	470	470
		Fare C (000VND)	120	120	710	240
Hanoi to Danang	700	Total Travel Time (portion for waiting and access)	9 h 20 (30 min)	6 h 50 (30 min)	3 h 00 (2h)	2 h 50 (30 min)
		Fare A (000VND)	300	300	1,180	590
		Fare B (000VND)	300	300	1,180	1,180
		Fare C (000VND)	300	300	1,770	590
Hanoi to HCMC	1570	Total Travel Time (portion for waiting and access)	20 h 10 (30 min)	14 h 50 (30 min)	4 h 20 (2h20)	5 h 40 (30 min)
		Fare A (000VND)	680	680	2,650	1,330
		Fare B (000VND)	680	680	2,650	2,650
		Fare C (000VND)	680	680	3,980	1,330

Source: JICA Study Team

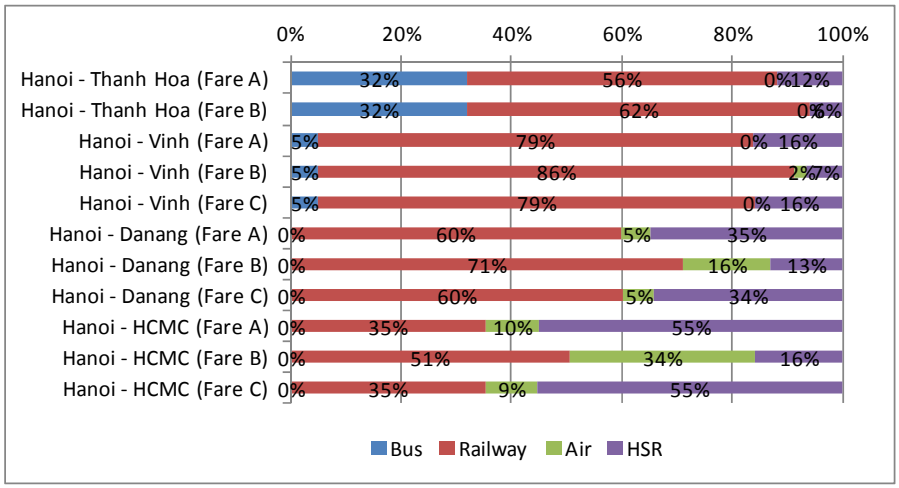
Notes: 1) Assumption for Fare A is made based on the current fare level for travel between Hanoi and HCMC. 2) Travel time is assumed based on the assumption of speed of each travel mode as follows: bus: 80km/h, railway: 110km/h, air: current level, HSR: 300km/h

2.29 The mode choices of passengers in Hanoi are shown in Figure 2.3.10 to Figure 2.3.12. Each transport user has biased preferences on the modes which they currently use. In the case of “Fare A” and “Fare C”, HSR is strongly preferred for the long routes of Hanoi-Danang and Hanoi-HCMC instead of air transport. If fare level is “Fare B”, air transport is preferred for the Hanoi-HCMC route while for the Hanoi-Danang route, HSR still competes with air transport.



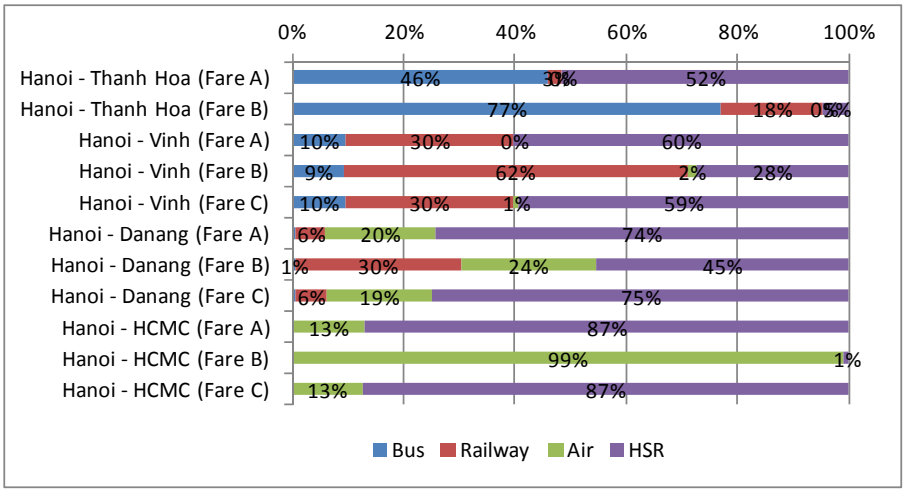
Source: JICA Study Team
Note: No. of Samples: 812~819

Figure 2.3.10 Mode Choice of Bus Passengers (Hanoi)



Source: JICA Study Team
Note: No. of Samples: 184

Figure 2.3.11 Mode Choice of Railway Passengers (Hanoi)



Source: JICA Study Team
Note: No. of Samples: 196~199

Figure 2.3.12 Mode Choice of Air Passengers (Hanoi)

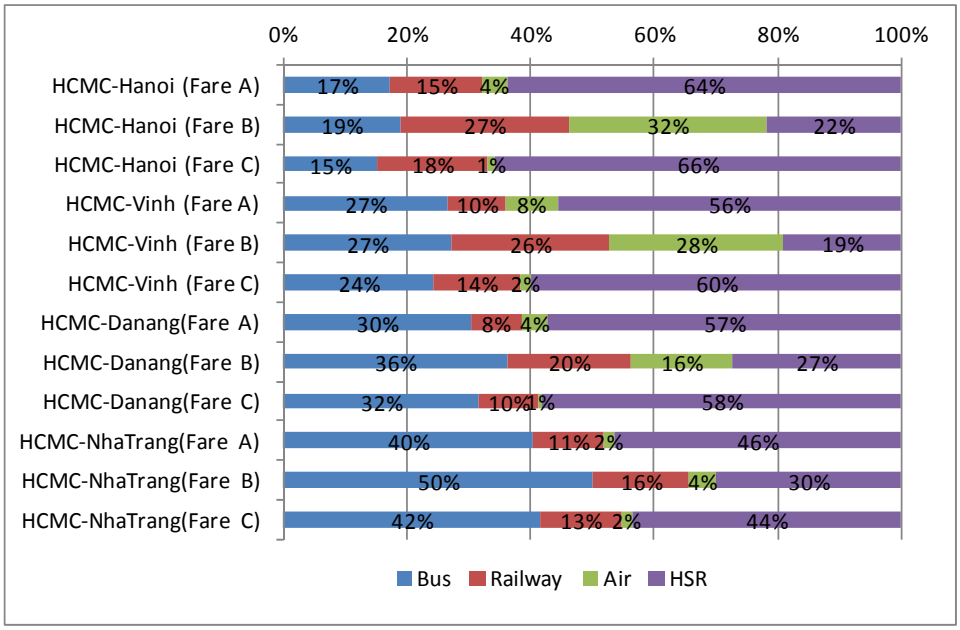
2.30 As with the survey results in Hanoi, the mode choices of passengers in HCMC are also shown in Figure 2.3.13 to Figure 2.3.15 (The assumed conditions for interview are shown in Table 2.3.15). The results are quite similar with those in Hanoi. Air transport is dominant in case of Fare B for the Hanoi-HCMC route, while in the case of Fare A and Fare C, HSR is very competitive to air transport on the same route.

Table 2.3.15 Assumed Travel Conditions in the Future (HCMC)

Route		Distance (km)		Bus	Railway	Air	HSR
HCMC	Hanoi	1570	Total Travel Time (portion for waiting and access)	20 h 10 (30 min)	14 h 50 (30 min)	4 h 20 (2h20)	5 h 40 (30 min)
			Fare A (000VND)	680	680	2,650	1,330
			Fare B (000VND)	680	680	2,650	2,650
			Fare C (000VND)	680	680	3,980	1,330
HCMC	Vinh	1290	Total Travel Time (portion for waiting and access)	16 h 40 (30 min)	12 h 10 (30 min)	3 h 40 (2h)	4 H 50 (30 min)
			Fare A (000VND)	560	560	2,180	1,090
			Fare B (000VND)	560	560	2,180	2,180
			Fare C (000VND)	560	560	3,270	1,090
HCMC	Danang	870	Total Travel Time (portion for waiting and access)	11 h 20 (30 min)	8 h 20 (30 min)	3 h 0 (1h 55)	3 h 20 (30 min)
			Fare A (000VND)	380	380	1,470	740
			Fare B (000VND)	380	380	1,470	1,470
			Fare C (000VND)	380	380	2,210	740
HCMC	NhaTrang	370	Total Travel Time (portion for waiting and access)	5 h 10 (30 min)	3 h 50 (30 min)	2 h 50 (2h 25)	1 H 40 (30 min)
			Fare A (000VND)	160	160	630	320
			Fare B (000VND)	160	160	630	630
			Fare C (000VND)	160	160	950	320

Source: JICA Study Team

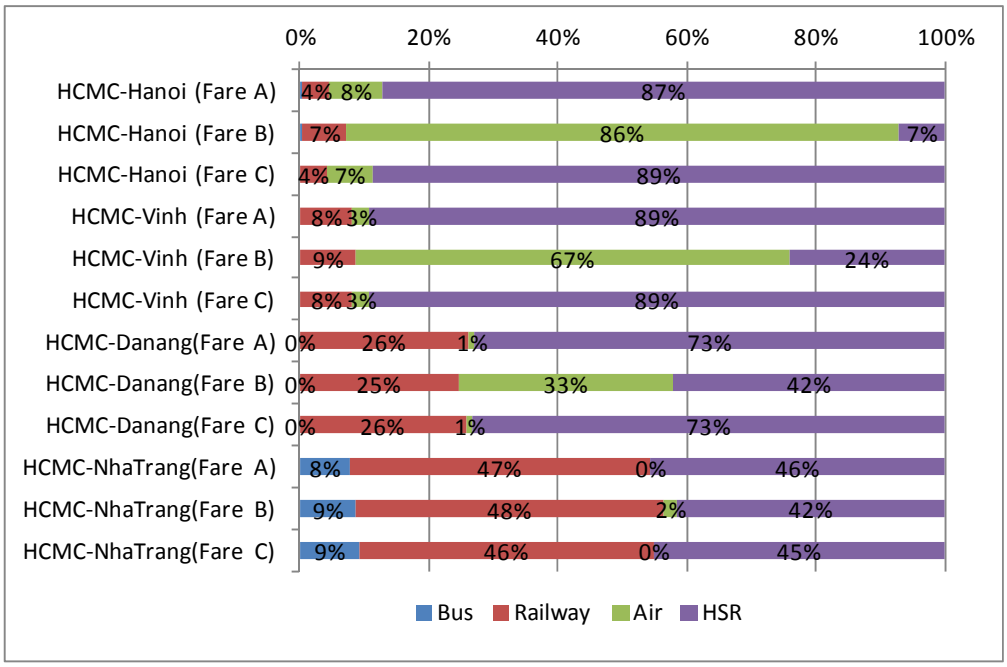
Notes: 1) Assumption for fare A is made based on current fare level for travel between Hanoi and HCMC. 2) Travel time is assumed based on the assumption of speed of each travel mode as follows: bus: 80km/h, railway: 110km/h, air: current level, HSR: 300km/h



Source: JICA Study Team

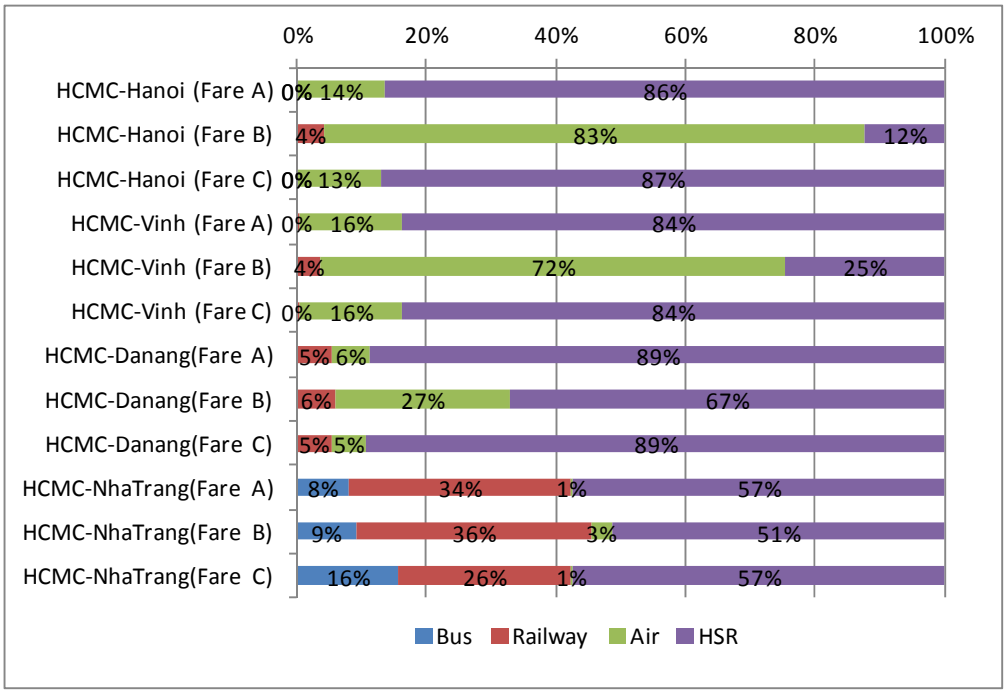
Note: No. of Samples: 397~399

Figure 2.3.13 Mode Choice of Bus Passengers (HCMC)



Source: JICA Study Team
Note: No. of Samples: 194~195

Figure 2.3.14 Mode Choice of Railway Passengers (HCMC)

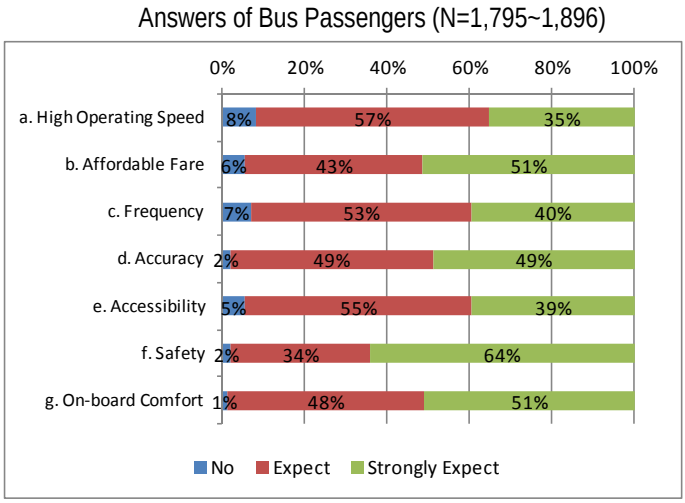


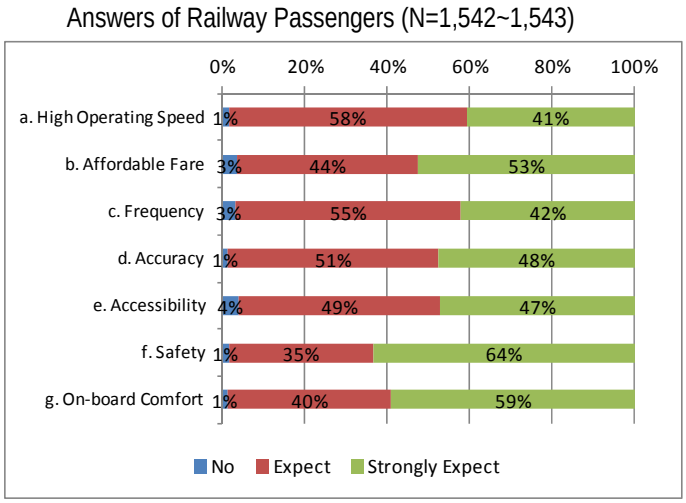
Source: JICA Study Team
Note: No. of Samples: 185~186

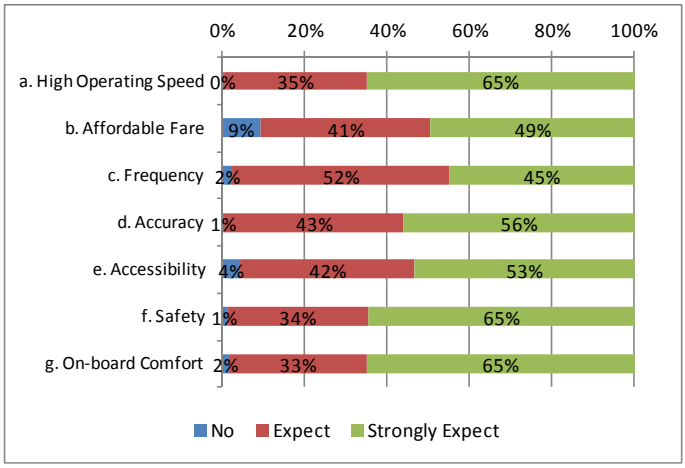
Figure 2.3.15 Mode Choice of Air Passengers (HCMC)

2.31 The expected factors for HSR operation are shown in Table 2.3.16. Safety is the most important concern among other issues, followed by on-board comfort and affordable fare. In addition, for air passengers, high operating speed is also considered a main factor expected from HSR operation.

Table 2.3.16 Expected Factors for HSR Operation







3 SOCIO-ECONOMIC FRAMEWORK

3.1 National and Regional Development Orientations

1) National Development Orientations

3.1 The latest National Socio-Economic Development Plan (2010-2015) is currently being formulated based on the Communist Party National Congress XI held in August 2008. The specific goals targeted can be summarized in the draft SEDP can be summarized as follows:

(a) Promote rapid economic development, sustainable innovation associated with improvement of growth model and economic restructure towards higher quality, efficiency and competitiveness;

(b) Ensure social welfare and social security, improve spiritual and material life of the people;

(c) Enhance external affairs, and improve the efficiency of international integration;

(d) Protect the independence, sovereignty, unity, territorial integrity and social order and safety; and

(e) Create the foundation of Vietnam by 2020 to become an industrialized and modernized country.

3.2 Given this direction, specific major tasks and measures are identified as elaborated in Table 3.1.1.

Table 3.1.1 Major Tasks and Measures in National SEDP, 2010-2015

Topic	Tasks and Measures
1. Concentrate on inflation control, macro-economic stability, ensured major balance of the economy.	• Ensure harmonious combination between monetary policy and fiscal policy to control inflation. • Ensure growth of payment capacity and increase annual credit. • Strengthen State management to regulate interest rates, control exchange rates, and regulate price for commodities. • Boost export and reduce trade deficits. • Attract ODA and FDI in parallel with control and encourage flow of investment and people from foreign countries.
2. Prioritize resources for implementation of economy restructuring, growth model renovation toward efficiency, and competitiveness improvement.	• Ensure consistency of growth model renovation policy. • Enhance efficiency, productivity, quality and competitiveness of the economy. • Give priority to sectors and projects with far-reaching effects and provide conditions for economic restructuring. • Decrease public funding and mobilize other sources for capital investment. • Restructure foreign/private sector investment policy to attract more investors. • Elaborate a plan for consolidation of state-owned enterprises (SOEs) operating inefficiently and at a loss and ensure transparency of operation by monitoring and publication of business gains. • Accelerate restructuring of private sector such as commercial banks, and financial and credit institutions.
3. Solving difficulties and creating conditions for enterprises to develop production, business and market expansion	• Implement tight fiscal and currency policies to control inflation. • Promote business development to Increase commodity and service supply sources. • Boost public-private partnership and other forms of investments such as BOT, BT, BTO, etc. • Improve access to capital.

Topic	Tasks and Measures
	• Boost trade promotion activities to expand markets and increase exports • Promote use of locally made products. • Develop services to support young businesses. • Focus on the development of key manufacturing industries and support industries.
4. Continue improving social security and welfare, focusing on solving urgent social issues	• Promote social development and improve social welfare and security for sustainable development. • Reduce poverty rate to 2%. • Create additional 1.6 million jobs annually. • Improve healthcare services and primary healthcare. • Develop education and training for improvement of human resources especially in remote areas.
5. Promote development of science and technology and enhance environment protection and improvement	• Continue to improve the science and technology management policies, institutions and organizational structure. • Promote technological renovation and strengthen research activities. • Develop scientific and technological application systems and centers. • Decentralize environmental management responsibilities with regard to inspection and violation sanctions • Encourage all economic sectors to adopt waste management technologies. • Implement environment programs and projects effectively, especially water and sanitation.
6. Improve effectiveness and efficiency of state management and strengthen anti-corruption	• Implement administrative reform focusing on institutional and administrative procedures. • Amend the Land Law for acquisition of land for public purposes. • Continue renewal of the organizational structure and operation of the State Apparatus. • Improve the quality of sectoral and regional plans and plan management • Implement comprehensive measures to prevent corruption such as making transparent the State Apparatus' operation, prompt handling of violations, etc.
7. Strengthen national defense and security and improve the efficiency of foreign affairs	• Implement effective measures to promote synergy and protect the State sovereignty and national security. • Implement national programs on crime prevention. • Strengthen close coordination between the State Foreign Affairs and foreign diplomats. • Enhance external communication and information and promote national identify and image.

Source: National SEDP, 2010-2015.

2) Regional Development Orientations

3.3 Three focal economic zones, the North (NFEZ), the Central (CFEZ) and the South (SFEZ) are the most advanced zones in terms of social and economic development. Development direction of these areas is directed in the SEDP to economic concentration of industrial and export processing zones and high-tech industrial zones. In addition, main objectives of socio-economic development of the NFEZ, CFEZ and SFEZ, based on the Prime Minister Decision No.145, 146 and 148/2004/QD-TTg dated August 13rd 2004, are described below.

Development Direction of NFEZ

3.4 The NFEZ includes 8 provinces and cities; Hanoi City, Hai Phong City, Quang Ninh Province, Hai Duong Province, Hung Yen Province, Ha Tay Province, Vinh Phuc Province, and Bac Ninh Province. The major goal of the NFEZ is to become the locomotive of the process of industrialization and modernization of the whole country, supporting to other areas in developing process. NFEZ is a national hub of international cooperation and FDI attraction. Key development objectives are as follows:

(a) Attain an annual average GDP growth rate of 1.3 times the average national GDP growth rate in the 2006-2010 period and 1.25 times in the 2011-2020 period. To raise the region's contribution to the national GDP from 21% in 2005 to around 23-24% by 2010 and 28-29% by 2020.

(b) Raise the annual average per-capita export value from USD 447 in 2005 to USD 1,200 by 2010 and USD 9,200 by 2020.

(c) Raise the region's contribution to the national budget revenues from 23% in 2005 to 26% by 2010 and 29% by 2020.

(d) Speed up technological renewal at an average rate of 20-25% year, to take the lead in the modernization process, to reach the advanced technology rate of around 45%. To raise the percentage of trained laborers to around 55% by 2010.

(e) Reduce the percentage of poor households to 1.5% by 2010 and under 0.5 % by 2020, to reduce the unemployment rate to around 6.5% by 2010, and to continue controlling it at the permitted safety rate of 4%. To ensure that by 2010, 100% of urban population have access to tap water; around 90-95% of rural population use clean water; 100% of rural households have sanitary latrines; people can easily travel, enjoy good healthcare, go to school and raise their educational level.

(f) Reduce the natural population growth rate to 1% by 2010 and under 0.8% by 2010. To control the average population growth (including mechanical migration impacts) at a rate not exceeding 1.5%. To ensure social discipline, order and safety, to maintain security and national defense; to ensure environmental sustainability in both urban and rural areas in the region.

Development Direction of CFEZ

3.5 The CFEZ includes 5 provinces and cities; Danang City, Thua Thien Hue Province, Quang Nam Province, Quang Ngai Province, and Binh Dinh Province. The major goal of the CFEZ is to utilize the region’s potentials, geographical position and comparative advantages and develop the region into a growth center and engine for the development of Central Vietnam and the Central Highlands. Key development objectives are as follows:

(a) Attain an annual GDP growth rates of 1.2 times and 1.25 times the national average GDP growth rate in the 2006-2010 and 2011-2020 periods respectively. To increase the region's contribution to the national GDP from the current 5% to around 5.5% by 2010 and 6.5% by 2020.

(b) Increase the average per-capita annual export value from USD 149 in 2005 to USD 375 by 2010 and USD 2,530 by 2020.

(c) Raise the percentage of the region's contribution to the national budget revenues from 4.6% in 2005 to 6% by 2010 and 7% by 2020.

(d) Speed up the technological renewal at an average rate of 20% year in the modernization process, and to gradually raise the percentage of trained laborers to around 50% by 2010.

(e) Strive for the urbanization rate of 40% by 2010 in the Central Vietnam key economic region. To reduce the unemployment rate to 5% and continue controlling it below the permitted safety rate of 4% by 2020, striving to create more than 60-70 thousand jobs a year.

(f) Reduce the percentage of poor households from 15.5 % in 2005 to under 8.8% by 2010 and around 2% by 2020.

(g) Ensure the political security, social order and sustainable environment in urban and rural areas.

Development Direction of SFEZ

3.6 The SFEZ includes 7 provinces and cities; Ho Chi Minh City, Dong Nai Province, Ba Ria – Vung Tau Province, Binh Duong Province, Tay Ninh Province, Binh Phuoc Province and Long An Province. The major goal of the SFEZ is to develop the region into a dynamic economic development region playing a decisive role in the national economic growth which takes the lead in national industrialization and modernization, taking the lead in the international economic integration. Key development objectives are as follows:

(a) Attain an annual average GDP growth rate in the 2006-2010 period shall be around 1.2 times and in the 2011-2020 period, around 1.1 times the national annual growth rate. To raise the region's contributions to the national GDP from 36% at present to 40-41% by 2010 and 43-44% by 2020.

(b) Increase the per-capita annual average export value from USD 1,493 in 2005 to USD 3,620 by 2010 and USD 22,310 by 2020.

(c) Raise the region's contributions to the whole country's budget revenues from 33.9% in 2005 to 38.7% by 2010 and 40.5% by 2020.

(d) Speed up technological renovation, striving to reach the average rate of 20-25%/year during the modernization process and gradually increase the proportion of trained laborers to over 50% by 2010.

(e) Form high-quality production and social service centers of international and Southeast Asian levels, thus meeting the demands of the whole southern region and foreigners.

(f) Strive to reduce the poor household rate to below 4% by 2010 and below 1% by 2020 and the unemployment rate to about 4% by 2020.

(g) Stabilize the region's population at about 15-16 million by 2020. To ensure social

disciplines, order and safety, firmly maintain security and national defense as well as environmental sustainability in both urban and rural areas.

Development Indicators

3.7 The development indicators for the NFEZ, CFEZ, and SFEZ are worked out as follows:

Table 3.1.2 Main Economic Targets of 3 FEZs up to 2010 and Vision up to 2020

FEZ	Aspect	2005	2006 - 2010	2011 - 2020
Northern	GDP growth (times)	-	1.30 times of national AGR	1.25 times of national AGR
	GDP share to national total (%)	21	23 – 24	28 – 29
	Average export per capita (USD)	447	1,200	9,200
	Poor household rate (%)	-	1.5	Under 0.5
Central	GDP growth (times)	-	1.20 times of national AGR	1.25 times of national AGR
	GDP share to national total (%)	5	5.5	6.5
	Average export per capita (USD)	149	375	2,530
	Poor household rate (%)	15.5	8.8	2.0
Southern	GDP growth (times)	-	1.20 times of national AGR	1.10 times of national AGR
	GDP share to national total (%)	36	40 – 41	43 – 44
	Average export per capita (USD)	1,493	3,620	22,310
	Poor household rate (%)	-	Under 4.0	Under 1.0

Source: Prime Minister Decision No. 145, 146, 148/ 2004/ QD-TTg dated April 13rd, 2004.

3.2 Forecast of Population

1) Methodology

3.8 For the purpose of conducting the traffic demand analysis of the North-South Railway development, the future population was estimated at three levels, i.e. national, provincial, and district (for 11 provinces within priority sections) level, for total and urban population.

3.9 The General Statistic Office under the Ministry of Planning and Investment in coordination with the United Nations Population Fund (UNFPA) estimated the population from 2009 to 2049 based on the Population and Housing Census was conducted in 2009 (hereinafter referred as the "Census 2009"). The Census 2009 was conducted from April 2009, in all provinces of Vietnam, in both urban and rural areas. This GSO estimate is the latest official population estimate of Vietnam, and is available at provincial level for the total population, and for the national level for the urban population.

3.10 Hence, other methodologies were applied to breakdown this official estimation. For the provincial urban population, using the national urban population calculated by GSO as a control total, the National Committee for Population and Family Planning (NCPFP) forecast (population forecast used in VITRANSS2) was used to work out the urban population by province by adjusting this to 2009 actual statistics.

3.11 For the district breakdown, since SEDPs are available for major cities, the targets in the SEDPs were referred, however considering the total balance within the province. For the remaining districts, estimations were made in light of past trends.

2) Background and Basic Assumptions of GSO Forecast

3.12 The accuracy of the Census 2009 is high in international standards, that is, according to the UNFPA, while the net errors of some countries' census are: India: 7.8%, Bangladesh: 3.0%, Australia: 1.6%, United States: 4%, South Korea: 1.5%, Indonesia: 3.3%, Malaysia: 4.4%, Japan: 0.4% in urban areas and 0.7% in rural areas, Pakistan: 4.4%, that of Vietnam Census 2009 is only -0.3% (undercount)[1]. This proves that the Census 2009 is a very reliable basis for the population projection in the study.

3.13 The projection brings out 4 variants of population change, based on 4 scenarios of fertility, one scenario of mortality, and one scenario of migration, as follows:

(a) **Mortality:** While development countries have fully-constituted registration systems for both birth and death, this is not the case in Vietnam yet. Therefore, several assumptions are needed to estimate the actual mortality. In Census 2009, mortality data were collected from 15% sample enumeration areas. In the results of the Census 2009, life expectation at births of males was 70.2, while that of females was 75.6. For future projection of mortality, the first stage (2009-2014) was assumed to be the same as that of 2009. The life expectation at birth of the next stage was calculated based on the value of the life expectancy of the previous stage and

[1] The value of overcounting and undercounting were evaluated by the Post-Enumeration Survey in 60 enumeration areas. The samples were designed and enumeration areas were selected randomly in order to represent for the whole country and for every 6 regions. The Central Population and Housing Census Steering Committee organized survey teams which directly visit the selected enumeration areas to interview each resident. The results of the interview would be matched with the census questionnaires in order to find cases of overcount or undercount.

quinquennial gain in life expectancy at birth suggested by the United Nations[2].

(b) **Migration:** In the GSO population projection, it was assumed that the net international migration is none. For internal migration, it was assumed that the migration model by age in the 15% sample survey of the Census 2009 would continue during the whole projection period.

(c) **Fertility:** The fertility rate has 4 variants, i.e. medium variant (assuming that fertility variation observed in the past would continue until it reaches 1.85 births/ women, and fertility will remain constant at that rate until the end of the projection period), high variant (formed from medium fertility variant with the total fertility rate at each 5-year period higher than those at the medium fertility, variant by 0.30 births/ women), low variant (formed from medium fertility variant with the total fertility rate at each 5-year period lower than those at the medium fertility, variant by 0.30 births/ women), and constant variant (assumed that fertility models, observed from the results of the 15% samples of the Census 2009, remains unchanged during the projection period). GSO selected the medium variant was selected to estimate the future population.

3.14 **Urbanization:** The Urban Rural Growth Difference (URGD) model is the most common projection method to project the population urbanization level. This method assumes that urbanization matches with the logistic curve. At the beginning, the level and speed of urbanization is low, after that it will increase. Urbanization speed increases continuosly until it reaches the proportion of urban population at 50%. After reaching this level, although the proportion of urban population continues to increase, its speed will decrease until the speed gets 0 when urbanization is asymptotic to the highest level. The logistic curve to match the proportion of urban population is presented in the following formula. Note that this model was used to estimate the national urban population only (there are no official estimates for urban population at the provincial level).

$$100\frac{U_t}{T_t} = \frac{100e^{dt}}{1+e^{dt}}$$

$$d = \log_e \frac{U^t}{R^t}$$

$\frac{U_t}{T}$ Proportion of urban population at time point t (urbanization rate)

d Difference of growth in urban population and rural population

[2] In 2004, the United Nations adjusted models for mortality improvement and quinquennial gain in life expectancy at birth.

3) Total Population

3.15 The population of Vietnam according to the Census 2009 is 85.8 million, and by the end of the projection period (2049), the population will be 108.7 million. (see Table 3.2.1)

Table 3.2.1 Projected Population and Average Annual Growth Rate

	Population (000')	Growth Rate (%)
2009	85,847	-
2014	90,654	1.09
2019	95,354	1.01
2024	99,466	0.84
2029	102,678	0.64
2034	105,092	0.46
2039	106,887	0.34
2044	108,102	0.23
2049	108,707	0.11

Source: General Statistics Office, MPI

3.16 The estimated population shows that Vietnam's population will be aged considerably. The median age increased speedily from 27.9 years in 2009 to 40.5 years in 2049. The proportion of the population under 15 will shrink, and the decrease in 40 years of the report period is nearly 7% (from 24.5% in 2009 to 17.6% in 2049). (see Figure 3.2.1)

Source: General Statistics Office, MPI

Figure 3.2.1 Vietnam Population Pyramid, 2009 and 2049

Table 3.2.2 Population Structure

	2009	2049
Total population (million)	85.8	108.7
Under 15 years old (%)	24.5	17.6
15 – 64 years old (%)	69.1	64.4
65 years old and above (%)	6.4	18.0
Median age (years)	27.9	40.5

Source: General Statistics Office, MPI

3.17 The population growth of regions after 2009 decreases until the end of the projection period. In 2029-2034, the national average growth rate is 0.46%, Central Highlands Region is highest at 0.90%, followed by Southeast Region at 0.71%, and the Mekong River Delta Region being lowest at 0.30%.

Table 3.2.3 Projected Population by Region

	2009	2014	2019	2024	2029	2034
Red River Delta	19,584.3	20,589.8	21,553.9	22,343.1	22,909.6	23,325.1
Northern Midlands and Mountains	11,054.0	11,629.9	12,225.5	12,744.3	13,159.0	13,492.9
North and South Central Coast	18,835.2	19,357.0	20,080.8	20,797.8	21,360.9	21,740.2
Central Highlands	5,115.1	5,542.0	5,956.1	6,359.4	6,722.2	7,030.4
Southeast	14,067.4	15,792.7	17,159.6	18,289.7	19,164.4	19,853.2
Mekong River Delta	17,191.5	17,742.9	18,377.7	18,931.9	19,361.9	19,650.0
Total	85,847.0	90,654.4	95,353.5	99,466.2	102,677.9	105,091.8

Source: General Statistics Office, MPI

Table 3.2.4 Projected Population Growth by Region

	99-09	09-14	14-19	19-24	24-29	29-34
Red River Delta	0.93	1.00	0.92	0.72	0.50	0.36
Northern Midlands and Mountains	0.97	1.02	1.00	0.83	0.64	0.50
North and South Central Coast	0.41	0.55	0.73	0.70	0.53	0.35
Central Highlands	2.31	1.60	1.44	1.31	1.11	0.90
Southeast	3.26	2.31	1.66	1.28	0.93	0.71
Mekong River Delta	0.64	0.63	0.70	0.59	0.45	0.30
Total	1.18	1.09	1.01	0.84	0.64	0.46

Source: General Statistics Office, MPI

3.18 Since the projection years to be used in the study are 2020 and 2030, the estimations done by the GSO were used by assuming growth at the same pace between the estimated years.

3.19 For the district breakdown in 11 provinces along the HSR alignment (i.e. Hanoi, Ha Nam, Nam Dinh, Ninh Binh, Thanh Hoa, Nghe An, Khanh Hoa, Ninh Thuan, Binh Thuan, Dong Nai, HCMC) and 2 provinces adjacent to these provinces (i.e. Ha Tinh, Binh Duong), past trends, overall development directions, city SEDP targets were used (however due consideration was given to the overall balance within the province). The population calculated by GSO was used as a control total for each province to conform to the population framework defined by province.

4) Urban Population

3.20 Urban population of Vietnam increased from 25.4 million people in 2009 to 63.9 million people in 2049. Therefore, after 40 years, the urban population of Vietnam is projected to increase by 38.5 million people, on average increase by 962,000 people per

year, reaching the urban population rate of 58.8% in 2049.

Table 3.2.5 Projected Urbanization Rate

	Urbanization Rate (%)	Growth Rate of Urban Population (%)
2009	29.6	3.42
2014	32.9	3.90
2019	36.4	3.00
2024	40.0	2.73
2029	43.7	2.41
2034	47.4	2.13
2039	51.3	1.88
2044	55.1	1.66
2049	58.8	1.43

Source: General Statistics Office, MPI

3.21 The GSO has not officially estimated the urbanization rate by province. Therefore, using the national urban population calculated by GSO as a control total, the National Committee for Population and Family Planning (NCPFP) forecast (population forecast used in VITRANSS2) was used to work out the urban population by province by adjusting this to 2009 actual statistics.

3.22 For the district breakdown in 11 provinces along the HSR alignment (i.e. Hanoi, Ha Nam, Nam Dinh, Ninh Binh, Thanh Hoa, Nghe An, Khanh Hoa, Ninh Thuan, Binh Thuan, Dong Nai, HCMC) and 2 provinces adjacent to these provinces (i.e. Ha Tinh, Binh Duong), past trends, overall development directions, city SEDP targets were used (however due consideration was given to the overall balance within the province). In addition, population density, population growth, land use, and future spatial structure plans of the province were considered in order to estimate the urbanization rate.

5) Summary of Results

3.23 The results of population projections are summarized as follows.

Table 3.2.6 Population and Urbanization Projection by Province

Region	Province	2005		2009		2020		2030		AGR for Pop. (%)		
		Pop.	Urban (%)	Pop.	Urban (%)	Pop.	Urban (%)	Pop.	Urban (%)	05 - 09	09 - 20	20 - 30
Red River Delita	Hanoi	5,943	38.5	6,452	41.0	7,569	55.5	8,200	61.6	2.1	1.5	0.8
	Vinh Phuc	1,157	14.4	1,000	22.4	1,103	28.7	1,175	38.2	-3.6	0.9	0.6
	Bac Ninh	991	16.2	1,025	23.5	1,155	27.6	1,242	40.7	0.8	1.1	0.7
	Ha Tay	-	-	-	-	-	-	-	-	-	-	-
	Quang Ninh	1,096	48.4	1,145	51.9	1,285	52.7	1,368	55.4	1.1	1.1	0.6
	Hai Duong	1,686	15.8	1,705	19.0	1,816	26.9	1,886	32.6	0.3	0.6	0.4
	Hai Phong	1,773	40.8	1,837	46.1	2,055	56.9	2,172	64.2	0.9	1.0	0.6
	Hung Yen	1,111	11.0	1,128	12.1	1,221	22.7	1,285	36.3	0.4	0.7	0.5
	Thai Binh	1,791	7.5	1,782	9.7	1,823	13.2	1,853	20.3	-0.1	0.2	0.2
	Ha Nam	791	8.0	784	9.5	813	16.9	837	30.8	-0.2	0.3	0.3
	Nam Dinh	1,851	15.3	1,828	17.6	1,933	21.5	2,013	28.0	-0.3	0.5	0.4
	Ninh Binh	894	15.6	899	17.9	936	30.4	962	40.7	0.2	0.4	0.3
	Sub total	19,084	25.6	19,584	29.3	21,709	39.3	22,992	47.1	0.6	0.9	0.6
Northern midlands and mountain areas	Ha Giang	682	11.4	725	11.6	847	13.2	944	13.8	1.5	1.4	1.1
	Cao Bang	505	14.7	507	16.9	553	19.0	586	22.6	0.1	0.8	0.6
	Bac Kan	288	15.3	294	16.1	323	19.6	342	23.3	0.5	0.9	0.6
	Tuyen Quang	712	11.2	725	13.0	789	17.6	830	20.8	0.4	0.8	0.5
	Lao Cai	581	20.6	615	21.0	720	22.9	803	27.4	1.4	1.4	1.1
	Yen Bai	720	19.7	740	18.8	818	22.1	872	24.9	0.7	0.9	0.6
	Thai Nguyen	1,099	24.0	1,123	25.6	1,246	27.2	1,320	28.8	0.6	1.0	0.6
	Lang Son	724	18.9	733	19.2	799	21.6	841	26.0	0.3	0.8	0.5
	Bac Giang	1,537	9.0	1,554	9.4	1,665	10.7	1,740	12.2	0.3	0.6	0.4
	Phu Tho	1,297	15.1	1,316	15.8	1,415	17.9	1,479	20.4	0.4	0.7	0.4
	Dien Bien	439	16.1	490	15.0	571	16.3	641	17.3	2.8	1.4	1.2
	Lai Chau	357	13.1	371	14.2	438	15.1	494	15.6	1.0	1.5	1.2
	Son La	1,015	12.7	1,076	13.8	1,280	15.9	1,421	17.2	1.5	1.6	1.0
	Hoa Binh	844	15.4	785	15.0	864	14.4	910	16.0	-1.8	0.9	0.5
	Sub total	10,799	15.3	11,054	15.9	12,327	17.8	13,225	20.0	0.6	1.0	0.7
North Central and Central coastal areas	Thanh Hoa	3,436	9.9	3,401	10.4	3,521	11.4	3,647	13.5	-0.3	0.3	0.4
	Nghe An	2,896	11.5	2,912	12.9	3,181	14.5	3,389	18.1	0.1	0.8	0.6
	Ha Tinh	1,248	12.4	1,227	14.9	1,266	16.9	1,320	23.5	-0.4	0.3	0.4
	Quang Binh	830	13.9	845	15.0	904	16.3	955	21.4	0.4	0.6	0.6
	Quang Tri	590	25.8	598	27.4	643	39.0	694	45.7	0.3	0.7	0.8
	Thua Thien - Hue	1,073	33.2	1,087	36.0	1,180	38.3	1,265	42.9	0.3	0.7	0.7
	Da Nang	806	83.8	887	86.9	1,079	88.7	1,203	92.3	2.4	1.8	1.1
	Quang Nam	1,407	17.0	1,422	18.6	1,495	28.3	1,568	37.8	0.3	0.5	0.5
	Quang Ngai	1,210	14.3	1,217	14.6	1,268	24.8	1,324	33.8	0.1	0.4	0.4
	Binh Dinh	1,478	26.1	1,487	27.7	1,580	39.1	1,671	49.7	0.1	0.6	0.6
	Phu Yen	838	20.5	862	21.8	926	31.2	981	42.5	0.7	0.6	0.6
	Khanh Hoa	1,115	38.4	1,158	39.9	1,284	58.3	1,378	73.7	0.9	0.9	0.7
	Ninh Thuan	548	30.4	565	36.1	619	53.3	669	64.2	0.8	0.8	0.8
	Binh Thuan	1,133	35.5	1,167	39.3	1,277	42.5	1,372	55.3	0.7	0.8	0.7

Region	Province	2005		2009		2020		2030		AGR for Pop. (%)		
		Pop.	Urban (%)	Pop.	Urban (%)	Pop.	Urban (%)	Pop.	Urban (%)	05 - 09	09 - 20	20 - 30
	Sub total	18,609	22.0	18,835	24.0	20,222	30.4	21,436	37.7	0.3	0.6	0.6
Central Highlands	Kon Tum	386	33.0	430	33.5	545	57.3	647	71.3	2.7	2.2	1.7
	Gia Lai	1,175	27.2	1,274	28.6	1,509	42.2	1,698	52.4	2.1	1.5	1.2
	Dak Lak	1,659	22.1	1,734	24.0	1,997	32.9	2,221	40.4	1.1	1.3	1.1
	Dak Nong	424	14.6	489	14.7	598	19.8	682	26.7	3.7	1.8	1.3
	Lam Dong	1,126	38.2	1,188	37.8	1,385	54.7	1,535	70.3	1.4	1.4	1.0
	Sub total	4,768	27.4	5,115	28.2	6,035	41.2	6,783	51.7	1.8	1.5	1.2
South East	Binh Phuoc	800	16.2	874	16.5	1,003	17.9	1,082	19.2	2.2	1.3	0.8
	Tay Ninh	1,038	14.9	1,067	15.6	1,175	20.5	1,241	35.2	0.7	0.9	0.5
	Binh Duong	1,109	30.1	1,482	29.9	2,214	40.8	2,646	49.4	7.5	3.7	1.8
	Dong Nai	2,264	32.0	2,486	33.2	3,018	42.6	3,356	59.6	2.4	1.8	1.1
	Ba Ria – Vung Tau	939	46.4	997	49.9	1,151	55.8	1,252	78.6	1.5	1.3	0.8
	Ho Chi Minh	6,231	82.6	7,163	83.3	8,818	84.0	9,723	85.7	3.5	1.9	1.0
	Sub total	12,381	55.9	14,068	57.2	17,379	61.3	19,300	68.8	3.2	1.9	1.1
Mekong River Delta	Long An	1,393	17.0	1,436	17.4	1,553	24.5	1,634	33.6	0.8	0.7	0.5
	Tien Giang	1,650	13.5	1,672	13.7	1,762	20.5	1,822	26.0	0.3	0.5	0.3
	Ben Tre	1,273	9.3	1,256	9.9	1,294	14.0	1,329	20.6	-0.3	0.3	0.3
	Tra Vinh	990	14.3	1,003	15.3	1,067	24.9	1,112	34.6	0.3	0.6	0.4
	Vinh Long	1,020	14.9	1,025	15.3	1,077	21.4	1,112	27.6	0.1	0.5	0.3
	Dong Thap	1,640	16.0	1,667	17.8	1,771	23.0	1,846	26.6	0.4	0.6	0.4
	An Giang	2,118	25.4	2,143	28.4	2,303	41.6	2,405	52.9	0.3	0.7	0.4
	Kien Giang	1,620	24.8	1,688	27.0	1,847	32.6	1,964	38.0	1.0	0.8	0.6
	Can Tho	1,149	49.9	1,188	65.9	1,372	72.5	1,529	82.5	0.8	1.3	1.1
	Hau Giang	752	15.6	757	19.6	821	26.1	863	38.0	0.2	0.7	0.5
	Soc Trang	1,259	18.8	1,293	19.4	1,380	25.9	1,446	32.1	0.7	0.6	0.5
	Bac Lieu	813	25.6	857	26.1	935	40.6	985	54.1	1.3	0.8	0.5
	Ca Mau	1,183	19.7	1,207	20.4	1,304	24.8	1,372	29.4	0.5	0.7	0.5
	Sub total	16,859	20.4	17,191	22.8	18,487	30.6	19,419	38.6	0.5	0.7	0.5
Vietnam Total		82,499	27.0	85,847	29.6	96,159	37.1	103,155	44.4	1.0	1.0	0.7

Source: JICA Study Team.

3.3 Forecast of Economic Growth

1) Methodology

3.24 For the purpose of conducting the traffic demand analysis of the North-South Railway development, the future GRDP was estimated for two levels, i.e. national and provincial. Basically the estimates were made based on future development orientations and past trends. For each level, the total GRDP was estimated first, then the GRDP structure was estimated and applied to calculate the GRDP value per sector (primary, secondary, tertiary).

2) National Economic Growth

3.25 The national GDP of Vietnam in 2010 is 551,609 VND billion, and according to the estimates of the Ministry of Planning and Investment done in 2008, the overall national economic growth was estimated to be an annual 7.5% in 2010-2015 period, and 8.5% in 2015-2020 period.

3.26 However, according to the latest draft of the National Socio-Economic Development Plan (2010-2015) currently being formulated based on the Communist Party National Congress XI held in August 2008, the overall national economic growth in 2010-2015 period has been reestimated to be an annual 6.5-7.0%, with a target to achieve an annual 7.0% growth.

3.27 Although Vietnam's economy has grown greatly due to heavy investment, given the recent trends of global economic crisis, increase in price of petroleum, and a general trend of gradual decrease in economic growth in a fast-growing nation, the revised SEDP scenario is more realistic for the traffic demand forecast. Therefore, the overall economic growth has been estimated as Table 3.3.1 and Table 3.3.2.

Table 3.3.1 Projected National GRDP Growth Rates

			Actual			Estimated	
			00 - 05	05 - 10	00 - 10	10 - 20	20 - 30
Existing Estimates	National	SED Strategy (2011-2020)	7.5 %	7.0 %	7.3 %	7.0 - 8.0 %	-
		SED Plan (2011-2015) [1)]				6.5 - 7.0 %	-
	Third Party	World Bank [2)]				6.3 - 6.7 %	-
		International Monetary Fund [3)]				7.5 %	-
		Asian Development Bank [4)]				5.8 - 6.3 %	-
		VITRANSS2				6.5 %	5.5 %
Scenarios	High Growth Scenario					7.0 %	6.5 %
	Medium Growth Scenario					6.5 %	6.0 %
	Low Growth Scenario					6.0 %	5.5 %

Source:
1) Estimated growth for 2011-2015.
2) East Asia and Pacific Economic Update 2011, WB. Estimated growth for 2011-2012.
3) World Economic Outlook, 2011, IMF. Estimated growth for 2011-2015.
4) Asia Economic Monitor, 2011, ADB. Estimated growth for 2011-2012.

Table 3.3.2 Projected National GRDP Growth

	GRDP (1994 price, VND billion)				AGR (%)		
	2005	2010	2020	2030	05 - 10	10 - 20	20 - 30
Primary	76,888	90,613	120,165	155,573	3.3	2.9	2.6
Secondary	157,867	231,336	479,728	897,793	7.9	7.6	6.5
Tertiary	158,276	229,660	435,553	800,959	7.7	6.6	6.3
Total	393,031	551,609	1,035,446	1,854,326	7.0	6.5	6.0

Source: MPI and Study Team.

3) Provincial Economic Growth

3.28 For the provincial breakdown, overall GRDP growth was set based on regional and provincial SEDP targets[3] and in light of past trends. These estimated figures were then readjusted based on the regional totals and overall balance within the region. The future economic structure of the province was estimated by considering 3 types of development patterns, judged based on the changes observed between 2000, 2005, and 2010. The assumed development patterns are as follows (see Table 3.3.3 and 3.3.4) :

(a) Transition from industry to service (Type A): Industry will be the leading development sector till 2020, gradually shifting towards a service-lead industry by 2030.

- Continuous industrialization has been undergoing in the province
- Development is likely to occur on a more mild pace compared to the past
- Growth in the service sector is high and industries such as tourism is growing

(b) Intensive industrialization and rapid growth (Type B): Industrialization will continue till 2030.

- The province is still at the incunabula of industrialization
- Rapid economic development is expected in the near future
- Major investment by the Central Government (oil refiniery plants, nuclear power plants, etc.) or large scale industrial zones are in place (or in plan)

(c) Hybrid development (Type C): Although the AFA[4] sector will grow at a much milder pace, the ratio of the AFA sector in the overall economic development within the province will still remain conspicuous, and simultaneously industry and service sector will continue to grow further.

- The AFA sector has been the major economic growth engine in the province, and is likely to remain so in the near future as well
- Located close to consumers in large cities and serves as the food basket to the region
- Provinces which are expected to expand their administrative boundaries to take in the rural areas in the fringe areas as a part of the new administrative area
- There is potential for further growth in industry and services sector as well

[3] Direct reflection of SEDP targets results in overestimation of economic growth, and it was also the case that some SEDP targets had large gaps between the current achievements. The Study Team took this into consideration when readjusting and balancing estimations.

[4] AFA = agriculture, forestry, aquaculture

Table 3.3.3 Projected GRDP Growth and Structure by Province

Region	Province	Growth of Total GRDP (%)			Structure (%)									Growth Type
					2010			2020			2030			
		00-10	10-20	20-30	1	2	3	1	2	3	1	2	3	
Red River Delta	Ha Noi	6.8	7.0	6.7	5	41	53	4	43	54	3	40	58	A
	Vinh Phuc	11.8	7.0	5.7	11	57	32	5	65	31	2	68	30	B
	Bac Ninh	11.0	7.5	6.7	12	54	34	5	60	35	3	65	33	B
	Ha Tay	-	-	-	-	-	-	-	-	-	-	-	-	-
	Quang Ninh	8.4	7.4	7.1	5	52	43	3	55	42	2	58	40	B
	Hai Duong	6.7	5.7	5.3	15	54	32	12	55	33	10	58	32	C
	Hai Phong	7.0	6.0	5.7	7	39	53	5	45	50	4	48	49	B
	Hung Yen	8.8	7.8	7.5	20	46	35	12	53	35	7	57	36	B
	Thai Binh	6.6	5.7	5.3	31	35	34	23	45	32	18	50	32	C
	Ha Nam	7.7	6.7	6.4	18	56	25	11	65	24	7	70	23	B
	Nam Dinh	5.4	4.5	4.2	22	40	38	16	45	39	12	50	38	B
	Ninh Binh	11.8	7.0	6.7	15	56	29	6	60	34	3	65	33	B
	Subtotal	7.5	6.7	6.3	11	45	44	7	49	44	4	50	45	-
Northern midlands and mountain areas	Ha Giang	8.4	7.4	7.1	29	27	44	20	35	45	12	40	48	B
	Cao Bang	7.8	6.8	6.5	21	22	57	12	25	63	7	30	63	B
	Bac Kan	9.1	8.1	7.8	35	22	43	23	25	52	15	30	55	C
	Tuyen Quang	9.0	8.0	7.7	25	31	44	16	38	46	10	43	47	B
	Lao Cai	9.0	8.0	7.6	25	37	38	18	46	36	13	50	37	B
	Yen Bai	7.5	6.6	6.2	24	41	35	17	45	38	12	50	38	B
	Thai Nguyen	6.5	5.5	5.2	19	45	36	13	50	37	9	55	36	B
	Lang Son	7.0	6.0	5.7	28	23	49	19	30	51	14	35	51	B
	Bac Giang	5.5	4.6	4.2	31	34	35	25	40	35	20	45	35	C
	Phu Tho	6.5	5.5	5.2	19	46	35	15	50	35	12	55	33	B
	Dien Bien	6.8	5.8	5.5	25	26	49	18	35	47	13	40	47	B
	Lai Chau	7.7	6.7	6.4	30	37	33	20	45	35	14	50	36	C
	Son La	10.7	9.0	8.6	28	28	44	18	45	37	12	50	38	B
	Hoa Binh	9.9	7.0	6.7	18	61	21	10	65	25	6	65	29	B
	Subtotal	7.6	6.6	6.4	24	37	39	17	43	40	12	48	41	-
North Central and Central coastal areas	Thanh Hoa	6.6	5.7	5.3	18	47	35	12	55	33	8	60	32	B
	Nghe An	6.5	5.5	5.2	24	37	39	17	45	38	12	50	38	B
	Ha Tinh	6.4	5.4	5.1	22	36	42	15	40	45	10	45	45	B
	Quang Binh	6.0	5.1	4.7	19	38	43	14	45	41	10	50	40	B
	Quang Tri	6.2	5.2	4.9	24	40	36	17	50	33	12	55	33	B
	Thua Thien - Hue	6.8	5.9	5.5	11	44	46	7	50	43	5	55	40	B
	Da Nang	7.4	7.5	7.2	3	38	59	2	30	69	1	24	75	A
	Quang Nam	8.2	7.2	6.8	16	43	41	10	45	45	6	50	44	B
	Quang Ngai	10.6	8.0	5.7	17	54	28	9	65	26	5	70	25	B
	Binh Dinh	6.5	5.5	5.2	32	29	39	25	35	40	20	40	40	C
	Phu Yen	8.0	7.0	6.7	18	38	44	13	45	42	9	50	41	B
	Khanh Hoa	7.0	6.0	5.7	12	40	48	8	50	42	5	55	40	B
	Ninh Thuan	5.9	4.9	4.6	34	27	39	28	35	37	24	40	36	B
	Binh Thuan	10.1	8.0	5.7	23	38	39	15	45	40	10	50	40	B
	Subtotal	7.2	6.3	5.7	19	40	41	12	46	41	8	50	42	-
Central Highland	Kon Tum	9.6	8.6	8.3	32	29	39	24	40	36	18	45	37	C
	Gia Lai	9.5	8.5	8.2	34	36	31	25	45	30	18	50	32	C

Region	Province	Growth of Total GRDP (%)			Structure (%)									Growth Type
					2010			2020			2030			
		00-10	10-20	20-30	1	2	3	1	2	3	1	2	3	
s	Dak Lak	7.8	6.8	6.5	46	18	36	30	30	40	20	40	40	C
	Dak Nong	10.1	7.0	6.7	47	32	20	30	50	20	20	60	20	B
	Lam Dong	10.1	7.0	6.7	47	27	26	35	35	30	25	45	30	C
	Subtotal	9.1	7.3	7.1	43	26	30	30	37	33	21	46	33	-
South East	Binh Phuoc	13.4	10.0	8.6	44	26	30	35	35	30	30	40	30	C
	Tay Ninh	10.7	8.0	5.2	24	29	47	15	35	50	10	40	50	B
	Binh Duong	11.2	9.0	7.7	5	60	35	2	65	33	1	70	29	B
	Dong Nai	9.2	7.0	6.7	9	65	26	5	70	25	3	75	23	B
	Ba Ria - Vung Tau	0.9	4.0	3.7	7	76	17	8	70	22	8	65	27	B
	Ho Chi Minh	6.6	6.0	5.2	1	43	55	1	45	54	1	40	59	A
	Subtotal	6.3	6.3	5.6	5	51	44	4	52	44	3	51	46	-
Mekong River Delta	Long An	7.1	6.1	5.8	28	42	30	20	45	35	15	45	40	A
	Tien Giang	6.8	5.8	5.5	32	27	41	24	35	41	18	40	42	C
	Ben Tre	6.6	5.6	5.2	40	21	39	30	25	45	23	30	47	C
	Tra Vinh	8.8	7.8	7.5	41	21	38	28	30	42	20	40	40	C
	Vinh Long	6.7	5.7	5.4	34	26	40	28	30	42	25	35	40	C
	Dong Thap	9.2	8.0	6.7	37	27	36	25	35	40	18	40	42	C
	An Giang	6.2	5.2	4.9	23	18	59	17	20	63	13	25	62	B
	Kien Giang	8.3	7.0	5.7	36	33	32	28	40	32	23	45	32	C
	Can Tho	10.3	6.5	6.2	9	38	53	5	45	51	2	50	48	B
	Hau Giang	8.2	7.2	6.9	28	39	34	17	45	38	10	50	40	C
	Soc Trang	8.0	7.0	6.7	44	22	33	35	30	35	25	35	40	C
	Bac Lieu	10.4	7.0	6.7	43	25	31	35	30	35	30	35	35	C
	Ca Mau	9.4	6.0	5.7	31	40	29	20	45	35	12	50	38	C
	Subtotal	8.1	6.5	6.0	31	30	39	23	36	41	17	41	42	-
Vietnam Total		7.3	6.5	6.0	16	42	42	12	46	42	8	48	43	-

Source: Regional SEDPs (MPI), Provincial SEDPs (provincial governments) and Study Team.

Table 3.3.4 Projected GRDP by Province

Region	Province	2010				2020				2030			
		1	2	3	Total	1	2	3	Total	1	2	3	Total
Red River Delta	Ha Noi	2,720	20,746	26,625	50,091	3,436	42,210	52,517	98,163	4,665	74,638	107,292	186,595
	Vinh Phuc	929	4,932	2,728	8,589	757	10,941	5,134	16,833	583	19,825	8,746	29,154
	Bac Ninh	753	3,509	2,231	6,492	666	7,994	4,663	13,324	633	16,462	8,231	25,327
	Ha Tay	-	-	-	-	-	-	-	-	-	-	-	-
	Quang Ninh	436	4,735	3,857	9,028	553	10,138	7,742	18,433	730	21,173	14,602	36,506
	Hai Duong	1,303	4,792	2,857	8,951	1,857	8,512	5,107	15,477	2,596	15,055	8,306	25,957
	Hai Phong	1,195	6,440	8,692	16,327	1,456	13,104	14,560	29,121	1,763	24,182	24,434	50,379
	Hung Yen	1,199	2,819	2,124	6,142	1,554	6,861	4,531	12,946	1,853	15,087	9,528	26,468
	Thai Binh	2,352	2,598	2,517	7,467	2,966	5,804	4,127	12,897	3,890	10,805	6,915	21,609
	Ha Nam	653	2,009	897	3,559	745	4,400	1,625	6,769	874	8,742	2,872	12,488
	Nam Dinh	1,550	2,759	2,619	6,927	1,710	4,809	4,168	10,687	1,919	7,996	6,077	15,991
	Ninh Binh	693	2,592	1,371	4,655	600	6,002	3,401	10,004	521	13,554	6,777	20,852
	Subtotal	13,782	57,930	56,518	128,230	16,300	120,777	107,576	244,653	20,027	227,518	203,781	451,326
Northern midlands and mountain areas	Ha Giang	489	443	732	1,665	679	1,189	1,529	3,397	807	2,689	3,227	6,723
	Cao Bang	409	443	1,138	1,991	459	957	2,412	3,829	500	2,143	4,501	7,144
	Bac Kan	294	191	367	852	402	437	909	1,748	522	1,044	1,914	3,480
	Tuyen Quang	699	883	1,225	2,807	968	2,299	2,783	6,049	1,264	5,437	5,943	12,645
	Lao Cai	499	734	752	1,984	765	1,956	1,531	4,252	1,149	4,418	3,269	8,836
	Yen Bai	604	1,010	876	2,490	796	2,106	1,778	4,680	1,024	4,265	3,241	8,530
	Thai Nguyen	806	1,926	1,505	4,238	940	3,614	2,674	7,228	1,076	6,577	4,305	11,959
	Lang Son	842	696	1,506	3,045	1,036	1,635	2,780	5,450	1,325	3,312	4,826	9,462
	Bac Giang	1,233	1,370	1,377	3,980	1,549	2,479	2,169	6,197	1,872	4,212	3,276	9,359
	Phu Tho	934	2,253	1,746	4,932	1,261	4,202	2,942	8,405	1,667	7,641	4,584	13,892
	Dien Bien	337	343	651	1,330	420	816	1,096	2,331	515	1,585	1,862	3,963
	Lai Chau	215	267	243	725	276	621	483	1,380	356	1,273	917	2,546
	Son La	811	816	1,263	2,890	1,118	2,794	2,297	6,209	1,553	6,471	4,918	12,943
	Hoa Binh	630	2,180	759	3,569	699	4,547	1,749	6,995	798	8,643	3,856	13,296
	Subtotal	8,804	13,555	14,139	36,498	11,368	29,651	27,131	68,150	14,428	59,711	50,640	124,779
North Central and Central coastal areas	Thanh Hoa	2,453	6,350	4,708	13,511	2,800	12,835	7,701	23,336	3,128	23,458	12,511	39,097
	Nghe An	2,585	3,999	4,213	10,798	3,132	8,291	7,001	18,425	3,659	15,248	11,588	30,496
	Ha Tinh	1,003	1,610	1,865	4,479	1,137	3,031	3,410	7,577	1,243	5,595	5,595	12,433
	Quang Binh	468	925	1,041	2,435	557	1,790	1,631	3,977	630	3,150	2,520	6,300
	Quang Tri	478	796	713	1,987	559	1,644	1,085	3,287	633	2,902	1,741	5,276
	Thua Thien - Hue	439	1,805	1,900	4,144	510	3,645	3,135	7,290	622	6,842	4,976	12,440
	Da Nang	184	2,691	4,177	7,052	217	4,342	9,914	14,473	259	6,915	21,637	28,811
	Quang Nam	985	2,620	2,475	6,079	1,211	5,448	5,448	12,106	1,403	11,692	10,289	23,384
	Quang Ngai	1,003	3,148	1,653	5,804	1,123	8,107	3,243	12,473	1,300	18,199	6,500	25,998
	Binh Dinh	1,949	1,784	2,405	6,138	2,607	3,649	4,171	10,427	3,436	6,871	6,871	17,179
	Phu Yen	568	1,171	1,367	3,105	792	2,740	2,557	6,089	1,042	5,791	4,749	11,582
	Khanh Hoa	1,012	3,310	3,984	8,306	1,302	8,139	6,836	16,277	1,547	17,017	12,376	30,941
	Ninh Thuan	664	535	751	1,950	930	1,163	1,229	3,322	1,318	2,196	1,977	5,491
	Binh Thuan	1,193	1,933	1,979	5,105	1,646	4,937	4,388	10,971	1,900	9,501	7,600	19,001
	Subtotal	14,984	32,679	33,230	80,893	18,521	69,759	61,748	150,029	22,121	135,377	110,931	268,429
Central Highlands	Kon Tum	523	484	648	1,656	815	1,359	1,223	3,398	1,110	2,775	2,281	6,166
	Gia Lai	1,474	1,569	1,342	4,385	2,250	4,050	2,700	9,000	2,940	8,166	5,226	16,332
	Dak Lak	3,801	1,501	2,955	8,257	4,774	4,774	6,366	15,915	5,951	11,901	11,901	29,754

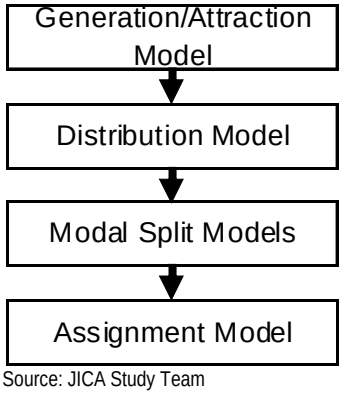
Region	Province	2010				2020				2030			
		1	2	3	Total	1	2	3	Total	1	2	3	Total
	Dak Nong	1,268	869	539	2,676	1,806	3,010	1,204	6,020	2,397	7,190	2,397	11,984
	Lam Dong	3,615	2,037	1,971	7,623	6,002	6,002	5,144	17,148	8,534	15,362	10,241	34,137
	Subtotal	10,680	6,461	7,456	24,597	15,648	19,195	16,638	51,481	20,931	45,394	32,047	98,372
South East	Binh Phuoc	1,707	1,030	1,176	3,913	3,224	3,224	2,764	9,213	5,761	7,681	5,761	19,203
	Tay Ninh	2,074	2,504	4,053	8,631	2,537	5,920	8,457	16,913	2,929	11,718	14,647	29,294
	Binh Duong	532	6,617	3,905	11,054	497	16,163	8,206	24,866	446	34,650	14,405	49,501
	Dong Nai	2,266	15,678	6,239	24,182	2,369	33,173	11,847	47,390	2,252	67,561	20,268	90,081
	Ba Ria - Vung Tau	1,629	18,543	4,214	24,386	3,171	27,749	8,721	39,642	5,001	40,630	16,877	62,507
	Ho Chi Minh	1,109	45,010	57,464	103,583	1,480	83,232	100,248	184,959	1,834	122,277	181,582	305,694
	Subtotal	9,317	89,383	77,049	175,749	13,279	169,460	140,243	322,982	18,223	284,517	253,540	556,280
Mekong River Delta	Long An	2,347	3,551	2,471	8,368	3,019	6,792	5,283	15,094	3,961	11,884	10,564	26,409
	Tien Giang	2,865	2,450	3,721	9,037	3,813	5,561	6,514	15,888	4,877	10,838	11,380	27,095
	Ben Tre	2,579	1,336	2,462	6,376	3,278	2,731	4,916	10,925	4,177	5,448	8,535	18,159
	Tra Vinh	2,187	1,145	2,014	5,347	2,673	2,864	4,010	9,547	3,307	6,614	6,614	16,536
	Vinh Long	1,736	1,325	2,051	5,112	2,490	2,668	3,736	8,894	3,753	5,254	6,004	15,011
	Dong Thap	3,487	2,536	3,318	9,341	5,018	7,025	8,029	20,073	6,868	15,262	16,025	38,155
	An Giang	2,620	2,038	6,702	11,361	3,194	3,757	11,835	18,786	3,917	7,533	18,681	30,131
	Kien Giang	4,357	3,994	3,856	12,206	6,698	9,568	7,654	23,920	9,529	18,644	13,258	41,430
	Can Tho	1,054	4,436	6,247	11,737	1,084	10,840	12,165	24,088	1,079	23,976	22,898	47,953
	Hau Giang	1,144	1,600	1,404	4,149	1,409	3,729	3,149	8,288	1,606	8,029	6,423	16,059
	Soc Trang	3,301	1,664	2,456	7,420	5,091	4,364	5,091	14,546	6,915	9,681	11,064	27,659
	Bac Lieu	2,445	1,439	1,767	5,652	3,876	3,323	3,876	11,076	6,316	7,369	7,369	21,053
	Ca Mau	2,924	3,811	2,800	9,535	3,405	7,662	5,959	17,026	3,539	14,745	11,206	29,490
	Subtotal	33,046	31,327	41,268	105,641	45,048	70,885	82,218	198,151	59,843	145,276	150,020	355,140
Vietnam Total		90,613	231,336	229,660	551,609	120,165	479,728	435,553	1,035,446	155,573	897,793	800,959	1,854,326

Source: Regional SEDPs (MPI), Provincial SEDPs (provincial governments) and Study Team.

4 PASSENGER TRAFFIC DEMAND

4.1 Methodology

4.1 Applied demand forecast models follows the traditional four-step method, namely (i) trip generation/attraction, (ii) trip distribution, (iii) modal split, and (iv) traffic assignment. Although trip generation/attraction model is often used in combination with the trip production model to control the total number of trips generated in a study area, the output of the trip generation/attraction model was used as is in VITRANSS2.

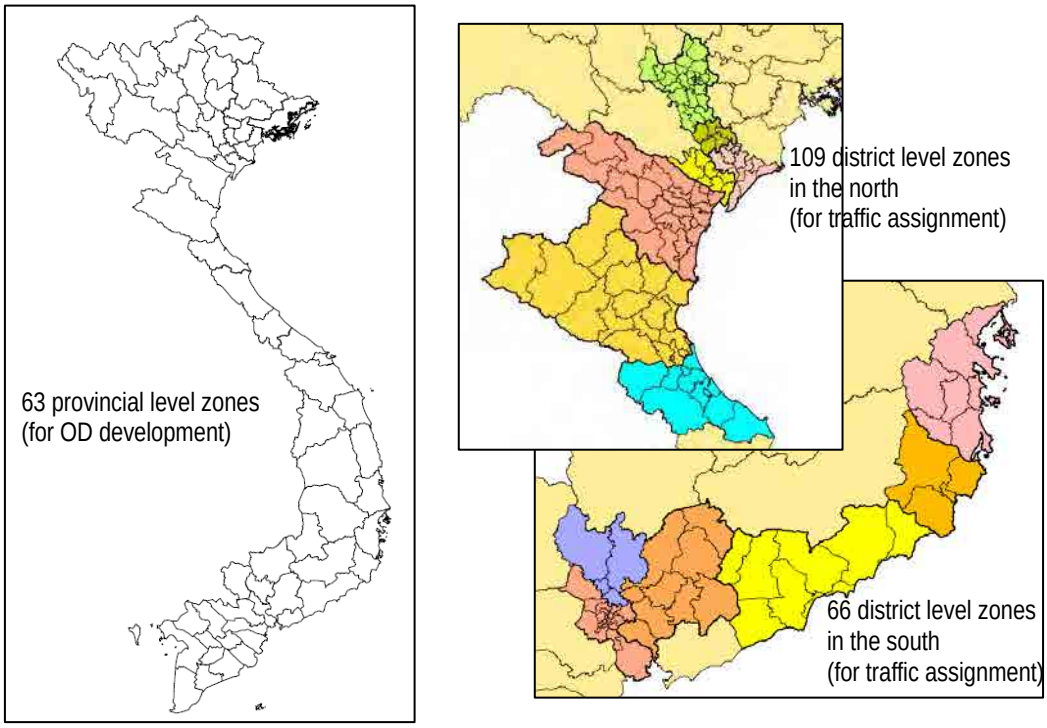


Source: JICA Study Team

Figure 4.1.1 Demand Forecasting Flow

4.2 Zoning

4.2 Applied zones for OD development are provincial administrative boundaries in the whole Vietnam (63 zone), targeting the analysis of traffic flows not only in the project areas but also over the country, especially, on the north-south corridor. On the other hand, district boundaries are applied in the provinces along expected HSR routes (Hanoi-Vinh & HCMC-Nha Trang) and adjacent provinces (Ha Tinh & Binh Duong) for traffic assignment (district level OD is created based on the distribution of urban populations).



Source: JICA Study Team

Figure 4.2.1 Applied Zoning

4.3 Socio-economic Framework

4.3 Current and future socio-economic indicators for the demand forecast were summarized in Table 4.3.1. The basis of the forecast is explained in detail in Chapter 3.

Table 4.3.1 Socio-economic Indicator (2010 and 2030)

Province	Urban population (000)			GRDP (Billion VND, 1994 constant)		
	2010	2030	Annual Growth 2010-2030	2010	2030	Annual Growth 2010-2030
Ha Noi	2,710	5,048	3.2%	50,091	186,595	6.8%
Vinh Phuc	231	449	3.4%	8,589	29,154	6.3%
Bac Ninh	247	505	3.7%	6,492	25,327	7.0%
Hai Duong	327	615	3.2%	8,951	25,957	5.5%
Hai Phong	859	1,395	2.5%	16,327	50,379	5.8%
Hung Yen	140	467	6.2%	6,142	26,468	7.6%
Thai Binh	174	377	4.0%	7,467	21,609	5.5%
Ha Nam	82	258	5.9%	3,559	12,488	6.5%
Nam Dinh	326	563	2.8%	6,927	15,991	4.3%
Ninh Binh	161	391	4.5%	4,655	20,852	7.8%
Ha Giang	106	130	1.1%	1,665	6,723	7.2%
Cao Bang	87	132	2.1%	1,991	7,144	6.6%
Bac Kan	48	80	2.6%	852	3,480	7.3%
Tuyen Quang	95	173	3.0%	2,807	12,645	7.8%
Lao Cai	133	220	2.6%	1,984	8,836	7.8%
Yen Bai	145	217	2.0%	2,490	8,530	6.3%
Thai Nguyen	294	380	1.3%	4,238	11,959	5.3%
Lang Son	141	218	2.2%	3,045	9,462	5.8%
Quang Ninh	603	759	1.2%	9,028	36,506	7.2%
Bac Giang	147	212	1.9%	3,980	9,359	4.4%
Phu Tho	211	302	1.8%	4,932	13,892	5.3%
Dien Bien	76	111	1.9%	1,330	3,963	5.6%
Lai Chau	54	77	1.8%	725	2,546	6.5%
Son La	153	245	2.4%	2,890	12,943	7.8%
Hoa Binh	119	145	1.0%	3,569	13,296	6.8%
Thanh Hoa	358	491	1.6%	13,511	39,097	5.5%
Nghe An	376	613	2.5%	10,798	30,496	5.3%
Ha Tinh	184	311	2.7%	4,479	12,433	5.2%
Quang Binh	129	204	2.3%	2,435	6,300	4.9%
Quang Tri	171	317	3.2%	1,987	5,276	5.0%
Thua Thien - Hue	434	543	1.1%	4,144	12,440	5.7%
Da Nang	805	1,110	1.6%	7,052	28,811	7.3%
Quang Nam	271	592	4.0%	6,079	23,384	7.0%
Quang Ngai	178	448	4.7%	5,804	25,998	7.8%
Binh Dinh	413	831	3.6%	6,138	17,179	5.3%
Phu Yen	203	417	3.7%	3,105	11,582	6.8%
Khanh Hoa	520	1,015	3.4%	8,306	30,941	6.8%
Kon Tum	151	461	5.7%	1,656	6,166	6.8%
Gia Lai	382	889	4.3%	4,385	16,332	6.8%
Dak Lak	431	898	3.7%	8,257	29,754	6.6%
Dak Nong	76	182	4.4%	2,676	11,984	7.8%
Lam Dong	458	1,080	4.4%	7,623	34,137	7.8%
Ninh Thuan	205	430	3.8%	1,950	5,491	5.3%
Binh Thuan	460	759	2.5%	5,105	19,001	6.8%
Binh Phuoc	150	207	1.6%	3,913	19,203	8.3%
Tay Ninh	168	437	4.9%	8,631	29,294	6.3%
Binh Duong	513	1,307	4.8%	11,054	49,501	7.8%
Dong Nai	859	2,001	4.3%	24,182	90,081	6.8%
Ba Ria - Vung Tau	507	985	3.4%	24,386	62,507	4.8%
Ho Chi Minh	6,158	8,333	1.5%	103,583	305,694	5.6%
Long An	255	548	3.9%	8,368	26,409	5.9%
Tien Giang	232	474	3.6%	9,037	27,095	5.6%
Ben Tre	126	274	4.0%	6,376	18,159	5.4%
Tra Vinh	155	385	4.7%	5,347	16,536	5.8%
Vinh Long	158	307	3.4%	5,112	15,011	5.5%
Dong Thap	297	491	2.6%	9,341	38,155	7.3%
An Giang	611	1,272	3.7%	11,361	30,131	5.0%
Kien Giang	458	747	2.5%	12,206	41,430	6.3%
Can Tho	790	1,262	2.4%	11,737	47,953	7.3%
Hau Giang	151	328	4.0%	4,149	16,059	7.0%
Soc Trang	280	463	2.6%	7,420	27,659	6.8%
Bac Lieu	230	533	4.3%	5,652	21,053	6.8%
Ca Mau	259	404	2.3%	9,535	29,490	5.8%
Vietnam	26,224	45,818	2.8%	551,609	1,854,326	6.2%

Source: JICA Study Team

4.4 Update of Base Year OD Data

Present 2010 OD date is developed based on 2008 OD data formulated in VITRANSS2 utilizing following statistics data and survey results;

(i) Roadside traffic count and OD interview data (road side and terminals) (obtained in November 2011)

(ii) 2010 railway station OD data

(iii) 2010 airport passenger demand, flight schedule and aircraft capacity

The difference of base year OD data of VITRANSS2 and this study is shown in Table 4.4.1. Reflecting the transition of traffic demand in the last few years, air traffic demand is increased significantly while railway traffic demand is slightly decreased in the updated data.

Table 4.4.1 Comparison of Base Year OD Data

	Mode	Car	Bus	Railway	Air	Total
VITRANSS2 (2008)	Passenger (thousand/day)	291	645	31	17	985
	Share (%)	29.5	65.5%	3.1%	1.7%	-
Updated Data (2010)	Passenger (thousand/day)	304	675	30	25	1,034
	Share (%)	29.4%	65.3%	2.9%	2.4%	-

Source: VITRANSS2 and JICA Study Team

4.5 Trip Generation/Attraction

4.4 For the trip generation/attraction model, the urban population and GRDP were adopted as explanatory variables in the following regression equations:

Gi or Ai = 1.112 * UPOPi * (GRDPi/Upop) 1.0392

Where, Gi: Generation of Zone *i*
Ai: Attraction of Zone *i*
UPOPi: Urban Population of Zone *i* (unit: 000)
GRDPi: GRDP of Zone *i* (VND billion)

Table 4.5.1 Trip Generation/Attraction Model

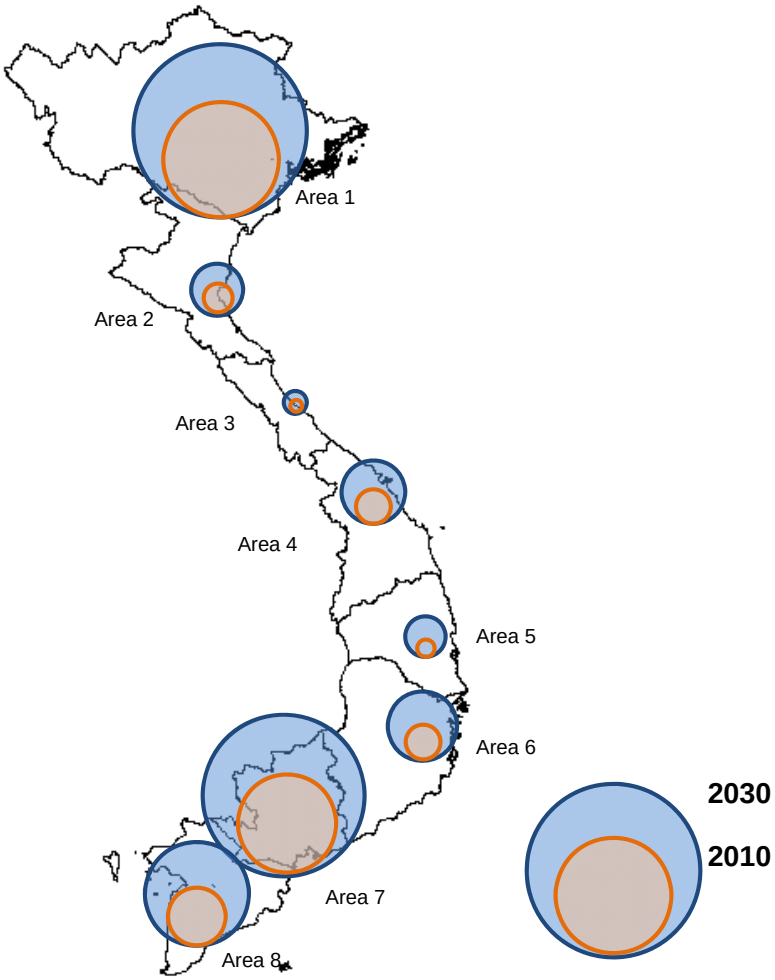
Variable	Generation Model	
	Coefficient	t Value
Constant	1.112	0.17
(GRDP/Urban population)	1.0392	5.11
Multiple correlation coefficient	0.8317	
Number of samples	63	

Source: JICA Study Team

4.5 The difference of actual value to theoretical value was used as adjustment factor similarly to the VITRANSS 2.

4.6 Figure 4.5.1 shows the estimated trip generation/attraction in Vietnam. Area 1 (including Hanoi) in the north and Area 7 (including HCMC) in the south are the biggest generators of traffic demand in Vietnam.

Area	Generation/Attraction (000)	
	2010	2030
1	469	1,003
2	29	100
3	6	15
4	39	132
5	9	49
6	44	169
7	335	879
8	102	381
Total	1,032	2,728



Source: JICA Study Team

Figure 4.5.1 Trip Generation/Attraction per day (2010 & 2030)

4.6 Trip Distribution

4.7 Same with VITRANSS2, symmetric pattern was assumed for both directions. The following equation with a dummy parameter was adopted.

$$T_{ij} = \frac{C \times G_i^a \times A_j^b \times (dum)^d}{GC_{ij}^c}$$

Where,
C: Constant
Tij: No. of trips between Zone i and j
Gi: Average of Trip Generation and Attraction of Zone i
Aj: Average of Trip Generation and Attraction of Zone j
GCij: Generalized Cost between Zone i and j
GCij = (time)*VoT + (cost)
dum: a dummy constant
a, b, c, and d: parameters

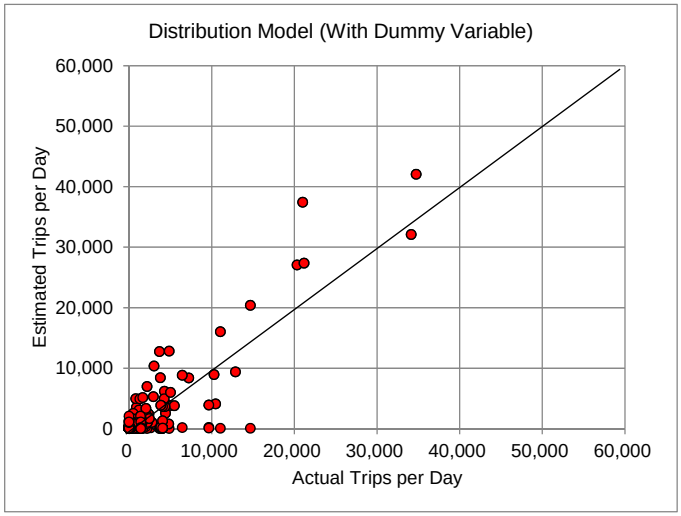
Note: Value of Time (VoT) was determined at VND 387/min and VND1096/min for 2010 and 2030 (2010 value), respectively, as a weighted average of car and bus passengers

Table 4.6.1 Trip Generation/Attraction Model

Variable	Coefficient	t-Value
Constant	1.8244	5.51
Generation	0.4020	18.82
Attraction	0.4020	18.82
Generalized Cost	0.8712	36.31
Dummy	1.6350	36.68
Multiple Correlation Coefficient	0.8318	
Number of Samples	1678	

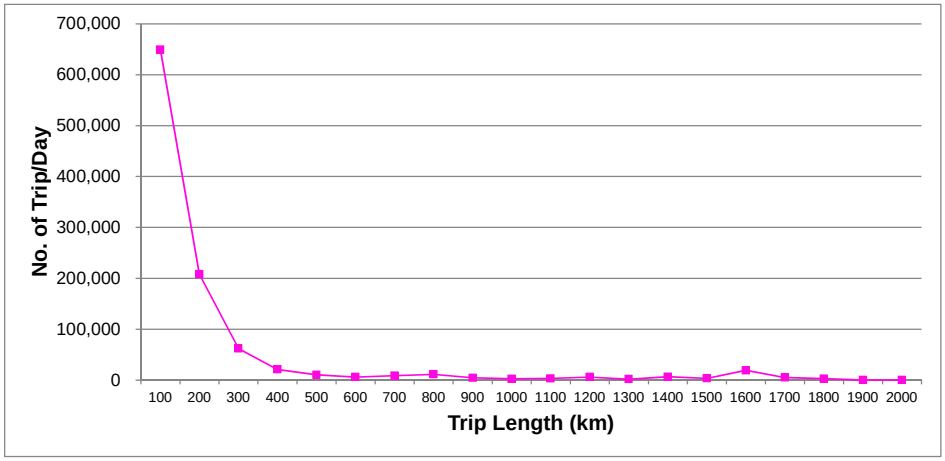
Source: JICA Study Team

4.8 After applying the trip distribution model mentioned above, the Fratar convergence calculation was conducted to adjust the OD values to the trip generation/attraction estimated earlier.



Source: JICA Study Team

Figure 4.6.1 Comparison of Distribution Model Value (With Dummy Variable) and No. of Actual Trips



Source: JICA Study Team

Figure 4.6.2 Trip Distribution Model

4.9 After applying the trip distribution model mentioned above, the Fratar convergence calculation was conducted to adjust the OD values to the trip generation/attraction estimated earlier.

4.10 Trip distribution is summarized in Table 4.6.2, Table 4.6.3 and Figure 4.6.3. Although the OD pairs with short distances tend to have higher traffic volume, the traffic volume

between Area 1 and Area 7 is quite high; over 75,000 passenger/day/both-way for about 1,500 km distance.

Table 4.6.2 Summary of Trip Distribution (2010)

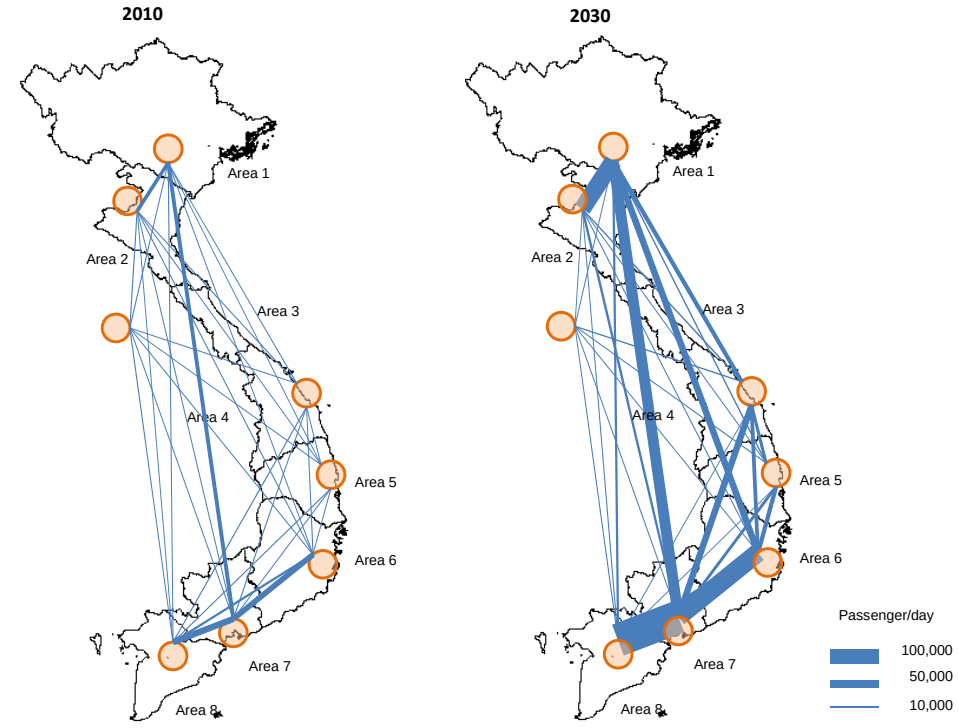
	Area 1 (Hanoi)	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7 (HCMC)	Area8
Area 1	432,634	25,326	1,300	7,698	1,712	8,332	28,023	2,817
Area 2	-	11,120	1,447	1,578	367	1,283	5,904	40
Area 3	-	-	895	5,133	87	184	1,521	308
Area 4	-	-	-	23,583	3,028	2,929	10,052	179
Area 5	-	-	-	-	809	6,095	4,639	159
Area 6	-	-	-	-	-	7,574	39,365	14,526
Area 7	-	-	-	-	-	-	268,595	44,018
Area 8	-	-	-	-	-	-	-	70,526

Source: JICA Study Team

Table 4.6.3 Summary of Trip Distribution (2030)

	Area 1 (Hanoi)	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7 (HCMC)	Area 8
Area 1	847,950	118,338	4,105	37,135	13,078	51,081	73,603	15,218
Area 2	-	19,208	4,502	9,914	1,665	9,575	16,381	330
Area 3	-	-	1,039	7,937	758	2,833	5,964	936
Area 4	-	-	-	55,301	20,235	28,684	48,403	899
Area 5	-	-	-	-	3,697	27,059	26,079	960
Area 6	-	-	-	-	-	32,444	132,928	20,466
Area 7	-	-	-	-	-	-	607,874	238,763
Area 8	-	-	-	-	-	-	-	242,298

Source: JICA Study Team



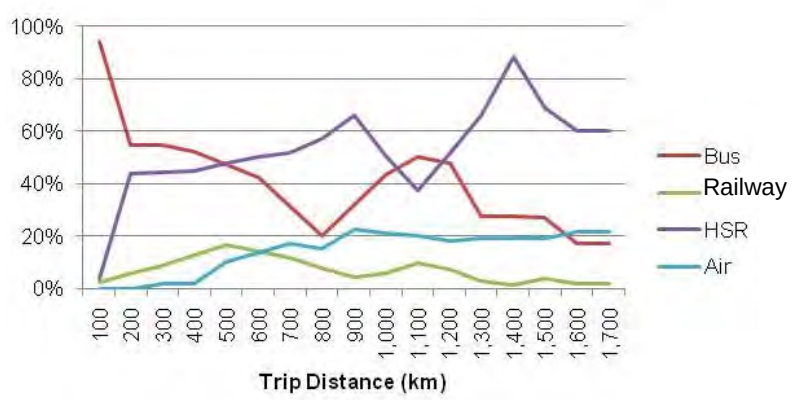
Source: JICA Study Team

Figure 4.6.3 Passenger Trip Distribution (2010 and 2030)

4.7 Modal Split

1) Model

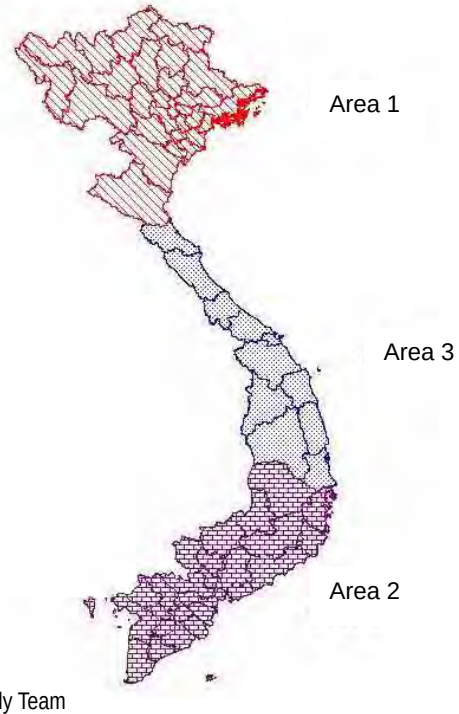
4.11 Although the main purpose of the demand analysis is the forecast of HSR demand, the demand could not be estimated directly from demand model from present condition, since HSR does not exist at present. Therefore, virtual base year passenger OD which is including HSR demand is prepared as the base of modal split model utilizing the data of stated modal choice preference obtained by terminal survey and base year OD data.



Source: JICA Study Team
Note: 1) Based on the data obtained by terminal survey in Hanoi and HCMC, 2) Given HSR fare level is the half of the one of Air

Figure 4.7.1 Modal Share based on Stated Preference

4.12 For the modal split model, following VITRANSS2 model, the aggregate logit model was applied (the model is shown below). Modal choice process is modeled for each of three types of trips: type 1 for intra-movement in the north (Area 1 in Figure 4.7.2), type 2 for intra movement in the south (Area 2 in Figure 4.7.2) and the others.



Source: JICA Study Team

Figure 4.7.2 Distinguished Area for Modal Split Mode

4.13 The utility function by mode is expressed in the following formula:

Car : $V_1 = a \times Time_1 + b \times Cost_1$
Bus : $V_2 = a \times Time_2 + b \times Cost_2 + const_2$
Rail : $V_3 = a \times Time_3 + b \times Cost_3 + const_3 + d_3 \times (GDP/POP)$
HSR : $V_4 = a \times Time_4 + b \times Cost_4 + const_4 + d_4 \times (GDP/POP)$
Air: $V_5 = a \times Time_5 + b \times Cost_5 + const_5 + d_5 \times (GDP/POP)$

4.14 The probability function by mode is expressed in the following formula.

$$Pi = \exp(v_i)/\{ \exp(v_1)+\exp(v_2)+\exp(v_3)+\exp(v_4)+\exp(v_5) \}$$

4.15 GDP/POP factor was added in some of the equations to reflect the preference of rapid transportation mode such as air transportation as economy grows. This is the geometrical means of GDP per capita of origin and destination zones. The network data is utilized in estimating the probability function by mode.

Table 4.7.1 Parameters for the Modal Split Model

Parameter	Coefficient	t-Value
Type 1		
a (Time : min)	-0.003132	-1.60
b_0 (Cost : VND 000)	-0.034587	-9.97
$b=b_0/td$		
d_3 (GDP/POP for Rail)	-0.26627	-2.11
d_4 (GDP/POP for HSR)	0.033803	10.18
d_5 (GDP/POP for Air)	0.037187	25.45
$const_2$ (for Bus)	0.347455	5.11
$const_3$ (for Rail)	0.648785	1.57
$const_4$ (for HSR)	-0.54423	-6.39
$const_5$ (for Air)	-1.48783	-43.93
Type 2		
a (Time : min)	-0.001443	-6.67
b_0 (Cost : VND 000)	-0.003893	-14.26
$b=b_0/td$		
d_3 (GDP/POP for Rail)	-0.12791	-3.84
d_4 (GDP/POP for HSR)	0.002579	3.71
d_5 (GDP/POP for Air)	0.005432	2.29
$const_2$ (for Bus)	0.18298	7.36
$const_3$ (for Rail)	0.081243	0.86
$const_4$ (for HSR)	0.140312	7.64
$const_5$ (for Air)	0.147549	2.60
Type 3		
a (Time : min)	-0.003056	-1.15
b_0 (Cost : VND 000)	-0.029576	-4.58
$b=b_0/td$		
d_3 (GDP/POP for Rail)	-0.00914	-1.19
d_4 (GDP/POP for HSR)	0.019464	3.46
d_5 (GDP/POP for Air)	0.004403	0.24
$const_2$ (for Bus)	0.4784	18.71
$const_3$ (for Rail)	-0.00044	-0.00
$const_4$ (for HSR)	-0.49032	-3.20
$const_5$ (for Air)	-0.5237	-1.25

Source: JICA Study Team
Note: td(time distance decided by per capita GDP ratio)= 1.00 (2010), 2.83 (2030)

4.16 As shown in Table 4.7.1, the increase of time-value (represented as the increase of GDP per-capita) is considered on calculation of the parameter “b”. The increase of the GDP per capita is shown in Table 4.7.2.

Table 4.7.2 Summary of the Increase of GDP per Caipita

		2010	2020	2030
GDP	bil USD, 2010 Constant	106.4	199.8	357.8
	tri VND, 2010 Constant	1,981	3,718	6,659
Population Total (thousand)		86,928	96,159	103,155
GDP per Capita	USD, 2010 Constant	1,224	2,078	3,468
	Thou VND, 2010 Constant	22,788	38,670	64,555
	[Ratio to GDP per Capita in 2010]	[1]	[1.70]	[2.83]

Source: JICA Study Team

2) Assumption on Operating Conditions

4.17 The following parameters are updated for this study.

(i) Load Factor: Because of the difficulty of estimating the future occupancy rate of vehicles, the data obtained by traffic survey conducted in November 2011 was utilized for the future traffic demand.

Table 4.7.3 Load Factor of Car and Bus

	Car	Bus
Average Occupancy (pax/veh)	3.2	20.5
No. of Samples	1,033	1,568

Source: JICA Study Team (Traffic Survey in November 2011)

(ii) Transport Fare and Cost: For selecting travel mode, transportation fare and cost is one of the major factors considered. The fares and costs for car, bus, railway and air transport are set as follows;

(1) Car: Gasoline price per passenger-km is calculated as shown in Table 4.7.4. Besides, the cost for vehicle itself is not taken into account because passengers select travel mode based on perceptible cost in general.

Table 4.7.4 Assumed Gasoline Price for Car

Gasoline Price ($/litter)[1)]	Drive Distance (km/litter)	Gasoline Price per passenger-distance	
		($/km/pax)	(VND/km/pax)
1.06	15.3 (for road; 40 km/h)	0.022	456
	13.2 (for expressway; 80 km/h)	0.025	527

Source: JICA Study Team

Note: 1) Price as of June, 2011

(2) Bus, Railway and Air: For public transportation, the actual fares are investigated and utilized for the input for demand forecast. The fare level is summarized in Table 4.7.5.

Table 4.7.5 Assumed Fare for Public Transporation

Mode	Fare (VND/km/pax)	Note
Bus	525	Based on the fare between Hanoi – HCMC (as of October 2011)
Railway	584	Based on the fare for with air conditioner/soft sheet for Hanoi - Saigon (as of Nov 2011)
Air	1,745	Based on the air fare for regular ticket between Hanoi-HCMC (Vietnam Airline, as of Oct 2011)

Source: JICA Study Team

(3) Cost for Expressway Use: As the fare level for expressway network in Vietnam, 5 US Cent per km (for bus, 12.5 US Cent per km) is assumed considering international practices as shown in the following table.

Table 4.7.6 Expressway Toll (per Passenger-distance)

	Expressway Fare	
	(VND/km/veh)	(VND/km/pax)
Car	1,050	328
Bus	2,625	128

Source: JICA Study Team

(iii) Operation Speed: Average operation speeds for cars and buses are roughly assumed to be 40 km/h and 32 km/h respectively based on the interviews with drivers. As for expressway, the speeds are assumed to be improved to be twice as fast as on national and provincial roads. On the other hand, the actual operation speeds of railway and air transport for travel between Hanoi – HCMC were obtained and utilized for the analysis (60 km/h and 600 km/h respectively). The operating speeds of upgraded existing railway (A2, B1 and B2) were calculated in detail on the process of developing plans. (70 km/h (A2), 110 km/h (B1) and 135 km/h (B2)).

(iv) Access Time: The accessibility is also key factor to be considered model choice. In this study, the access time is calculated from the developed network data while, for waiting time, the obtained data from traffic survey (November 2011) was taken into consideration. Table 4.7.7 shows the result of the survey.

Table 4.7.7 Waiting Time Obtained from Traffic Survey

	Bus Passenger	Railway Passenger	Air Passenger
Waiting Time (min)	19.7	46.9	51.9
No of Samples[1)]	806	514	334

Source: JICA Study Team (Traffic Survey in November, 2011)

Note: 1) Interviewers who leaving transport terminals only because the data of waiting passengers has bias to some extent

Considering the survey result, time at terminal for each travel mode in the future is assumed as shown in the following table. As for railway, it is assumed that the increase of service frequency and operational accuracy will decrease waiting time while regarding to air transport, it is assumed that passengers will arrive airport 60 minute before departure time. As for HSR, the same time at terminal to existing railway is assumed. (See Table 4.7.8)

Table 4.7.8 Assumed Time at Terminal

	Mode			
	Bus	Rail	HSR	Air Transport
Waiting Time (min)	20	20	20	60

Source: JICA Study Team

(v) Summary: Table 4.7.9 summaries the parameters applied to analysis.

Table 4.7.9 Assumed Operating Condition by Mode

Mode			PCU/Veh Ratio	Average Occupancy 1)	Fare/Cost (VND/pax-km)	Travel Speed (km/h)	Time at terminal (waiting time) (min)
Road	Road	Car	1	3.2	527	40	0
		Bus	2.5	20.5	525	32	20
	Expressway	Car	1	3.2	855	80	0
		Bus	2.5	20.5	653	64	20
Railway	Existing Railway		-	-	584	60/70/110 /135 2)	20
	High Speed Railway 3)		-	-	873	280	20
Air Transport			-	-	1,745	600	60

Source: JICA Study Team

Note: 1) Based on traffic survey (2011) (The same condition is assumed for the future), 2) Depending on the level of improvement of existing railway (A1, A2, B1, B2) 3) For base case

3) Basic Output

4.18 The modal share for the base cases under which HSR is operated for Hanoi-HCMC, Hanoi-Vinh, and HCMC-Nha Trang are shown respectively. Daily passenger demand on HSR is 85 thousands and 68 thousands for Hanoi-Vinh and HCMC-Nha Trang sections, respectively, which account for 3.1% and 2.5% of all interprovincial trips. Since cities are located closely to each other in Hanoi-Vinh section, the average trip length of HSR users of Hanoi-Vinh section is as short as 400 km while the one of Nha Trang-HCMC section is 627 km.

Table 4.7.10 Demand Analysis Result by Mode

Year	Assumed HSR Section Under Operation	Unit	Representative Mode of Transport					TOTAL
			Car	Bus	Railway (CR)1)	HSR	Air	
2010 (Base Year)	-	No.of pax/day (000)	304	675	30	-	25	1034
		Modal Share (pax, %)	29.4	65.3	2.9	-	2.4	100.0
		Average Trip Length (km)2)	118	183	407	-	932	188
2030	Hanoi-HCMC	No.of pax/day (000)	733	1558	89	275	74	2728
		Modal Share (pax, %)	26.9	57.1	3.2	10.1	2.7	100.0
		Average Trip Length (km) 2)	191	164	454	667	1250	261
	Hanoi-Vinh	No.of pax/day (000)	787	1647	92	85	116	2728
		Modal Share (pax, %)	28.9	60.4	3.4	3.1	4.3	100.0
		Average Trip Length (km) 2)	220	183	502	400	1238	256
	Nha Trang -HCMC	No.of pax/day (000)	790	1663	92	68	114	2728
		Modal Share (pax, %)	29.0	61.0	3.4	2.5	4.2	100.0
		Average Trip Length (km) 2)	214	178	532	627	1290	258

Source: JICA Study Team

Note: 1) In case service level of railway is A2, 2) Distance from final origin to final destination.

4.8 Traffic Assignment

1) Network

4.19 Transportation network developed for VITRANSS2 was updated to be applicable to district level network analysis. More in detail;

(i) The existing railway network was reviewed and updated by applying the actual locations of railway stations precisely to be useful for district level analysis;

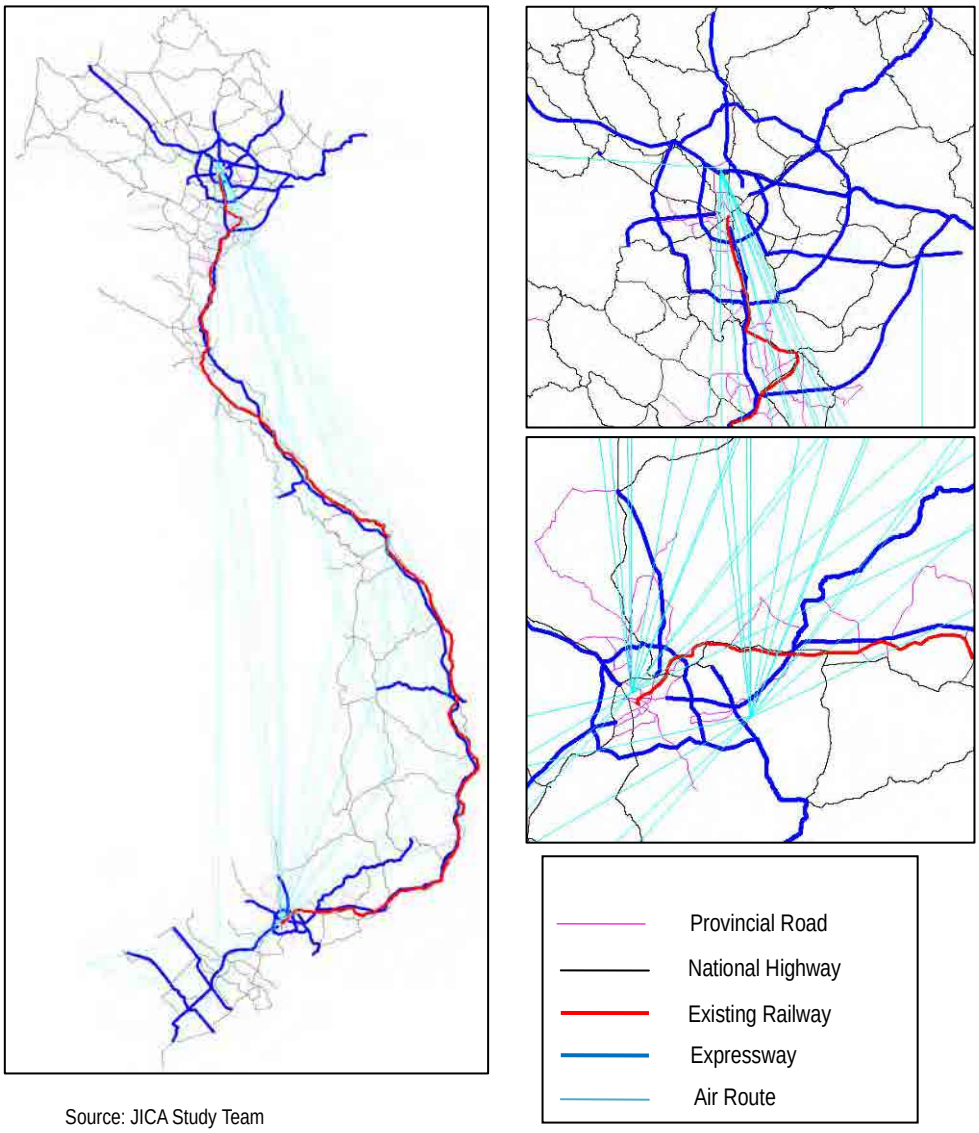
(ii) Expressway network was also reviewed and updated. The alignment and the locations of interchanges were updated based on the alignment study in VITRANSS2. Thus, the network data became applicable to the district level analysis; and

(iii) Provincial road network connecting districts to districts was newly developed in the network data.

4.20 The two types of transport network were developed as follows;

(i) Do Committed Network: This network includes financially committed or under construction projects. As for expressway projects, the following sections are included in addition to existing sections; (i) Cau Gie–Ninh Binh, (ii) Da Nang–Quang Ngai, (iii) HCMC–Long Thanh–Dau Giay, (iv) Long Thanh–Nhon Trach–Ben Luc, (v) Ha Noi–Hai Phong, (vi) Ha Noi–Lao Cai, (vii) Ha Noi–Thai Nguyen and (viii) Ha Long–Mong Cai.

(ii) Do Something Network: In Do Something Network, the following upgrades of network are considered in addition to Do Committed Network; (i) the national expressway network is assumed to be developed excluding sections along Ho Chi Minh Route, namely: Dong Hung – Hoa Lac – Pho Chau, Hong Ling – Huong Son, and Ngoc Hoi – Chon Thanh – Rach Gia; (ii) National Highway No.1 is assumed to be upgraded to 4-6 lanes in between Hanoi and HCMC; and (iii) Since airports in Hanoi and HCMC are considered to be bottlenecks for air traffic in the future, the capacity expansion is considered based on the future plans (new Long Thanh International Airport and the expansion of Noi Bai Airport).



Source: JICA Study Team

Figure 4.8.1 Do Something Network

4.21 The capacity of the VITRANSS2 road network was determined based on the following equation (from relevant highway capacity manual) based on inventory data (HDM Road Inventory) and related future plans. The same methodology is also applied in this study.

$$C = (NL \times C0 \times FCw \times FCsp \times FCmc \times FCsf) \times (100/8.5)$$

Where,
- 100/8.5 : inverse of peak hour ratio, from VITRANSS2.
- C : Capacity (PCUs/day).
- NL : Number of lanes.
- C0 : Base capacity in ideal conditions (PCUs/lane/hr). From HDM Road Inventory. If not available, assumed at 1550 PCUs/lane/hr.
- FCw : Adjustment factor for roadway width (from HDM Road Inventory). If not available, assumed at 1.00 and 1.08 for ordinary road and expressway, respectively.
- FCsp : Adjustment factor for directional split assumed at 0.94

and 1.00 for ordinary road and expressway, respectively.

FCmc : Adjustment factor for motorcycle traffic assumed at 0.783 and 1.00 for ordinary road and expressway, respectively.

FCsf : Adjustment factor for side friction assumed at 0.86 and 1.03 for ordinary road and expressway, respectively.

2) Traffic Assignment

4.22 As for traffic assignment, incremental assignment (distributing traffic by dividing it to 10 times) is applied. As the fare level for expressway network in Vietnam, 5 US Cent per km (for bus, 12.5 US Cent per km) is assumed considering international practices as shown in Table 4.8.1. As for willingness-to-pay for use of expressway, the result of road side survey conducted in the study is applied as shown in Table 4.8.2.

Table 4.8.1 Expressway Toll (per Passenger-distance)

	Expressway Fare	
	(VND/km/veh)	(VND/km/pax)
Car	1,050	328
Bus	2,625	128

Source: JICA Study Team

Table 4.8.2 Willingness to pay for Expressway

	Willingness to pay for Expressway (VND/hr/veh)	
	2011	2030[1)]
Car	37,669	101,216
Bus	56,143	150,853
Truck	55,508	149,147

Source: JICA Study Team

Note: 1) Figures for 2030 are assumed based on estimated increase of per-capita GDP

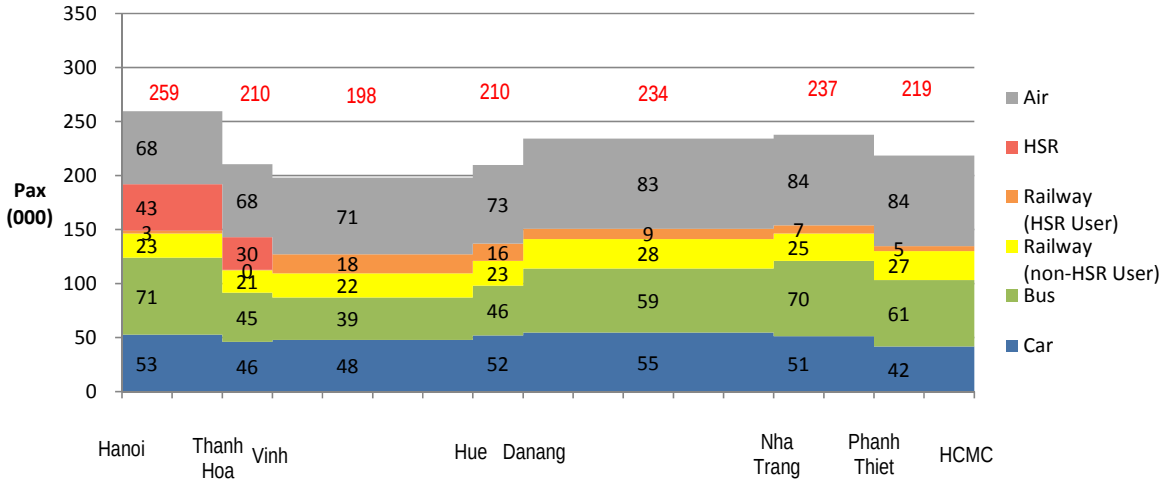
4.23 It should be noted that in case air traffic demand reaches to its capacity, the air traffic demand is fixed at its possible maximum traffic volume and modal split for other transport modes is recalculated excluding the potion for air transport (probability function for Air (P5) is not used in such case). Thus, the excess of traffic to the capacity is distributed to other modes.

4.9 Analysis of HSR Traffic Demand

1) Hanoi-Vinh Section

4.24 Hanoi-Vinh HSR section is approximately 284 km long with 6 stations and the major cities such as Hanoi, Nam Dinh, Ninh Binh and Vinh are located in the section. The estimated HSR passenger demand in case HSR is operated for this section are shown as follows;

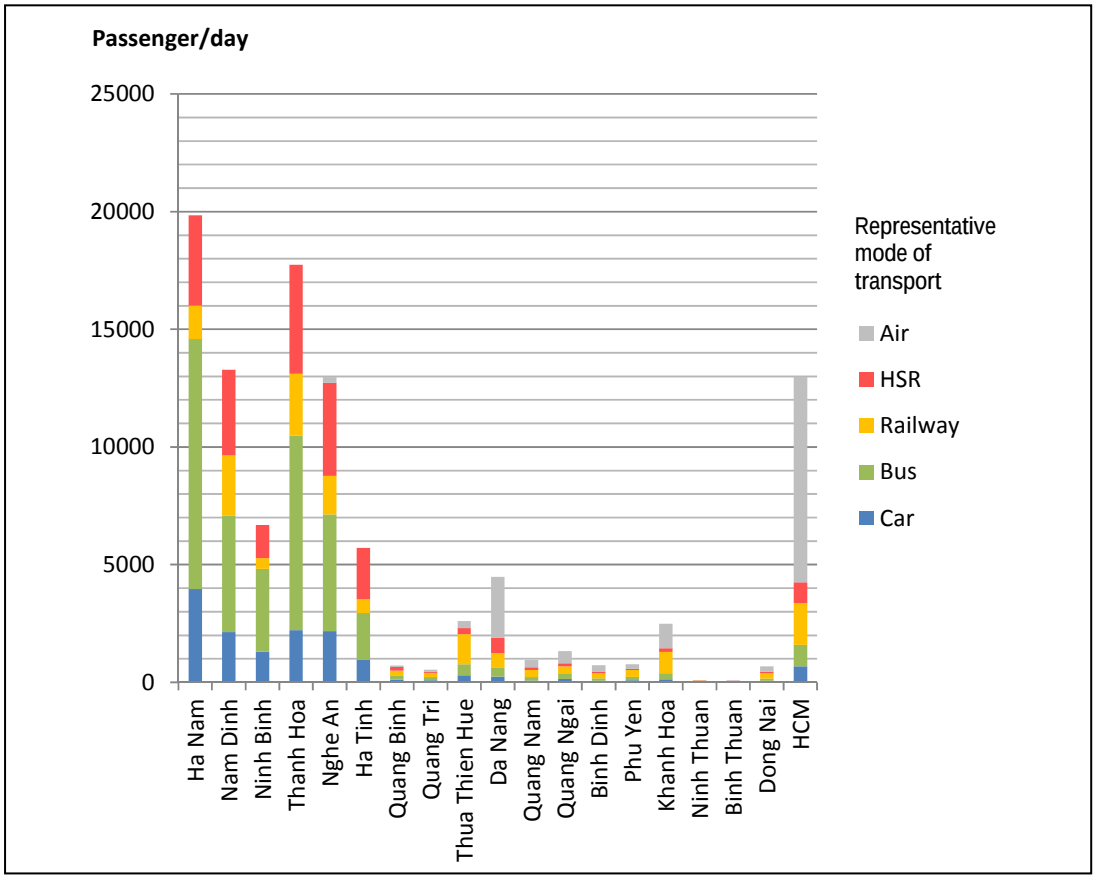
4.25 **Cross Sectional Traffic in the North-South Corridor**: Cross-sectional traffic of North-South corridor (coastal corridor) in 2030, in case Hanoi-Vinh section is under operation, is shown in the following figure. The cross-sectional traffic demand of HSR account for approximately 15% among all modes and 43 thousands and 30 thousands on Ninh Binh/Thanh Hoa and Thanh Hoa/ Vinh borders, respectively. The demand will be generated along the section where HSR exists (Hanoi-Vinh) and North Central Coast area (provinces between Thanh Hoa and Thua Thien Hue).



Source: JICA Study Team

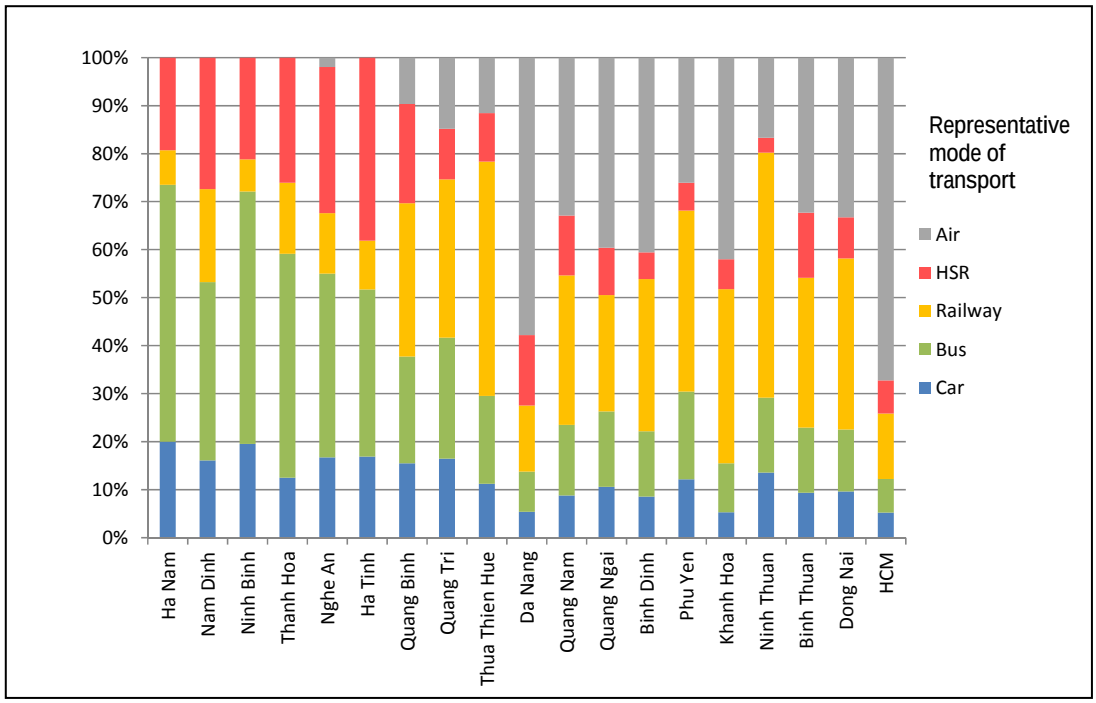
Figure 4.9.1 Cross Sectional Traffic in North-South Corridor (HSR: Hanoi-Vinh is under operation), 2030

4.26 **Traffic Demand from Hanoi:** The modal share from Hanoi, the capital city, to the South, in case Hanoi-Vinh section is under operation in 2030, is shown in Figure 4.9.2 and Figure 4.9.3. The share of HSR for Hanoi – Nam Dinh, Hanoi- Thanh Hoa and Hanoi – Vinh is as high as approximately 30%. Hanoi - Ha Tinh also shows relatively high share of HSR, approximately 35% because of the proximity to Vinh HSR station. On the other hand, the share of HSR for Hanoi–Ha Nam and Hanoi-Ninh Binh is lower, approximately 20% of share, because of relatively high competitiveness of road transport for these OD pairs.



Source: JICA Study Team

Figure 4.9.2 Mode Share for Trips from Hanoi to the South (Hanoi-Vinh is under operation), 2030, No. of passenger



Source: JICA Study Team

Figure 4.9.3 Mode Share for Trips from Hanoi to the South (Hanoi-Vinh is under operation), 2030, percentage

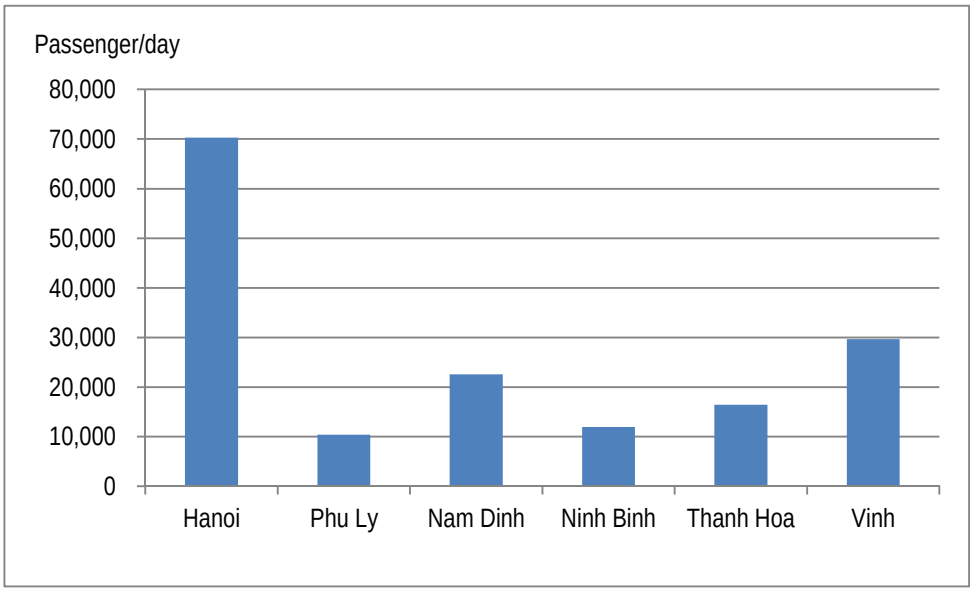
4.27 **Demand between and at Stations:** The HSR passenger demand between stations (station OD table) is shown in Table 4.9.1 for the case in which Hanoi-Vinh section is under operation. Figure 4.9.4 and Figure 4.9.5 & Figure 4.9.6 show the no. of passenger at stations and cross-sectional demands for each section between stations, respectively. Among all stations, the passenger volume at Hanoi station is the most, about 70,000 passengers per day, and, as clearly shown in Figure 4.9.5 & Figure 4.9.6, most HSR passengers are from or to Hanoi, while the passenger demand volume between other provinces are limited.

Table 4.9.1 Daily No. of HSR passengers between Stations (both-direction, Hanoi-Vinh is under operation)

Unit:passenger/day

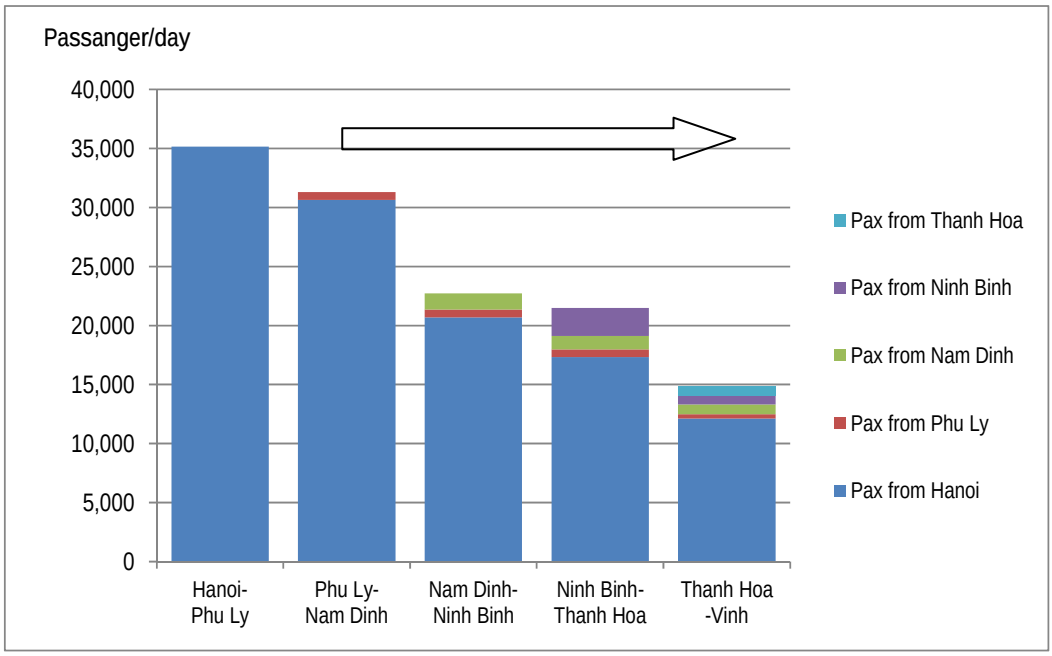
Station		1	2	3	4	5	6
		Hanoi	Phu Ly	Nam Dinh	Ninh Binh	Thanh Hoa	Vinh
1	Hanoi	-	9,027	19,902	6,711	10,421	24,229
2	Phu Ly	-	-	0	86	547	732
3	Nam Dinh	-	-	-	410	659	1,631
4	Ninh Binh	-	-	-	-	3,265	1,469
5	Thanh Hoa	-	-	-	-	-	1,580
6	Vinh	-	-	-	-	-	-

Source: JICA Study Team



Source: JICA Study Team

Figure 4.9.4 No. of Passenger at Stations (HSR: Hanoi-Vinh is under operation)



Source: JICA Study Team

Figure 4.9.5 Daily No. of Passenger between Stations
(Hanoi to Vinh Direction Only)(HSR: Hanoi-Vinh is under operation)

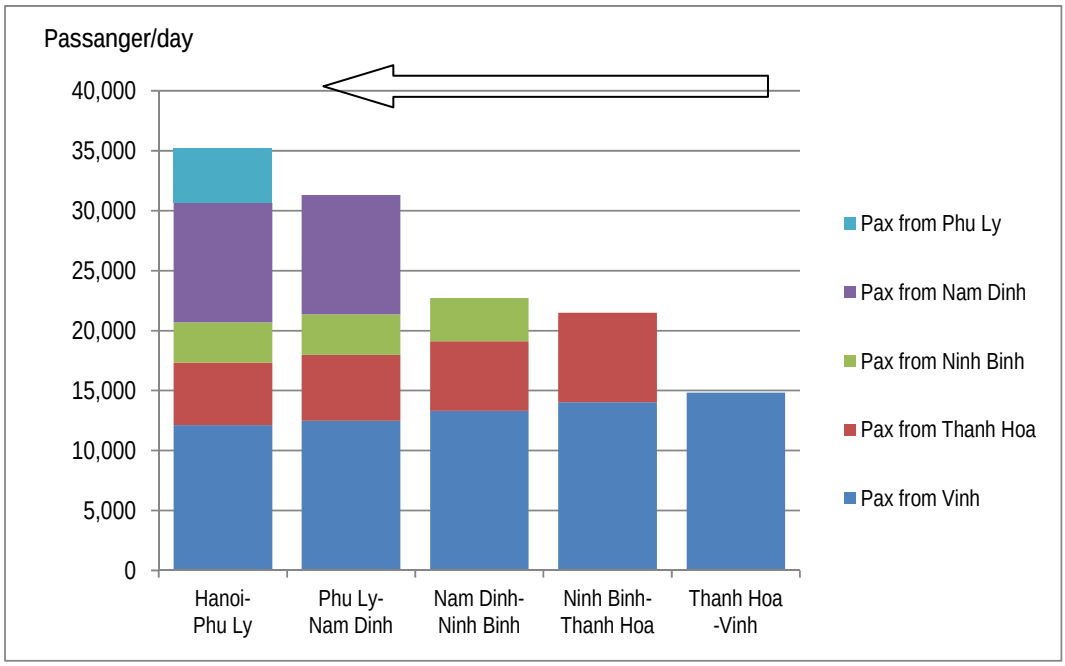
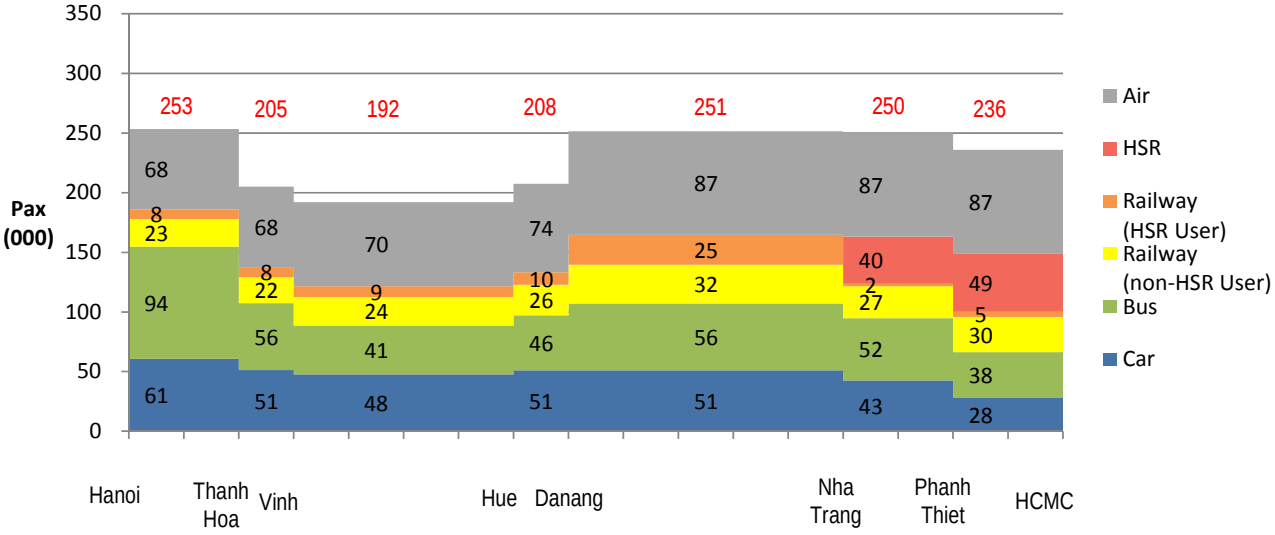


Figure 4.9.6 Daily No. of Passenger between Stations
(Vinh to Hanoi Direction Only)(HSR: Hanoi-Vinh is under operation

2) HCMC-Nha Trang Section

4.28 HCMC-Nha Trang HSR section is approximately 366 km long with 6 stations and the major cities such as HCMC and Nha Trang are located in the section. The estimated HSR passenger demand in case HSR is operated for this section are shown as follows;

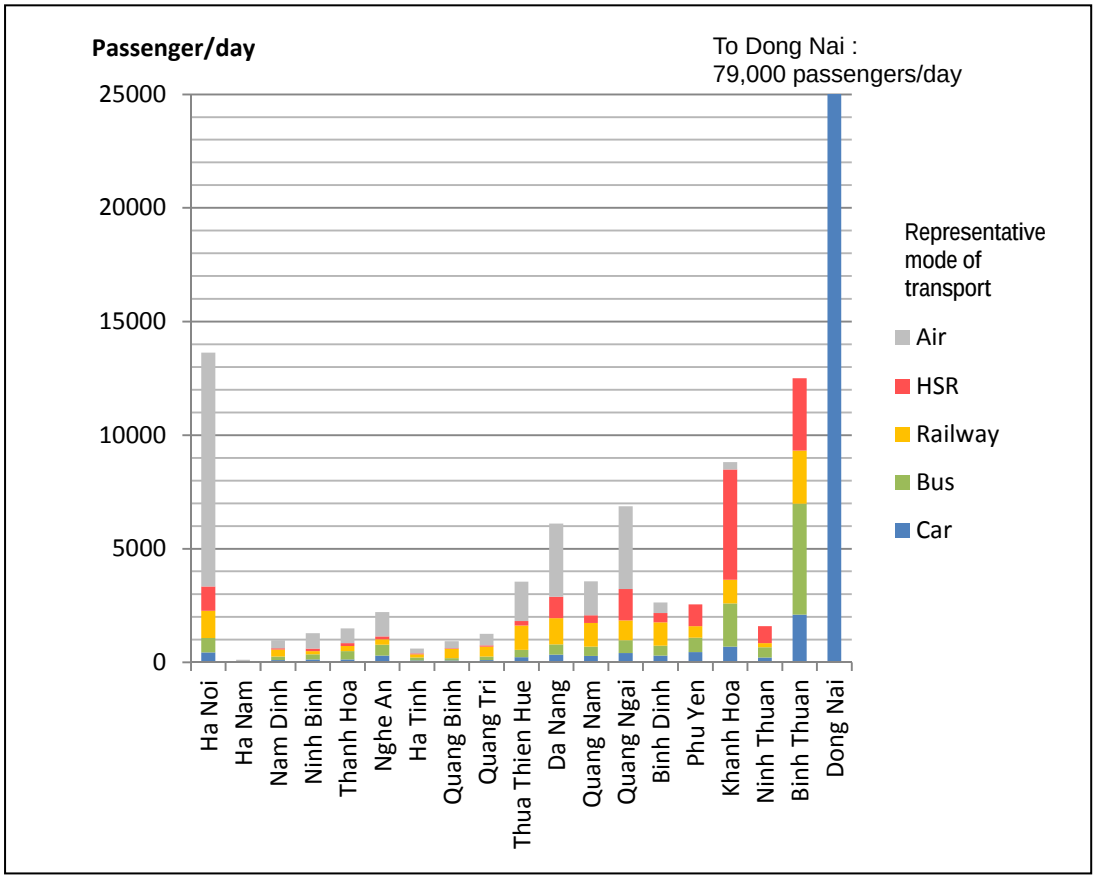
4.29 **Cross Sectional Traffic in the North-South Corridor**: Cross-sectional traffic of North-South corridor (coastal corridor) in 2030, in case HCMC-Nha Trang section is under operation, is shown in the following figure. The cross-sectional traffic demand of HSR account for approximately 20% among all modes and 49 thousands and 40 thousands on Dong Nai/Binh Tuan and Ninh Tuan/ Nghe An borders, respectively. The demand will be generated along the section where HSR exists (HCMC-Nha Trang) and South Central Coastal area (provinces between Danang and Nghe An).



Source: JICA Study Team

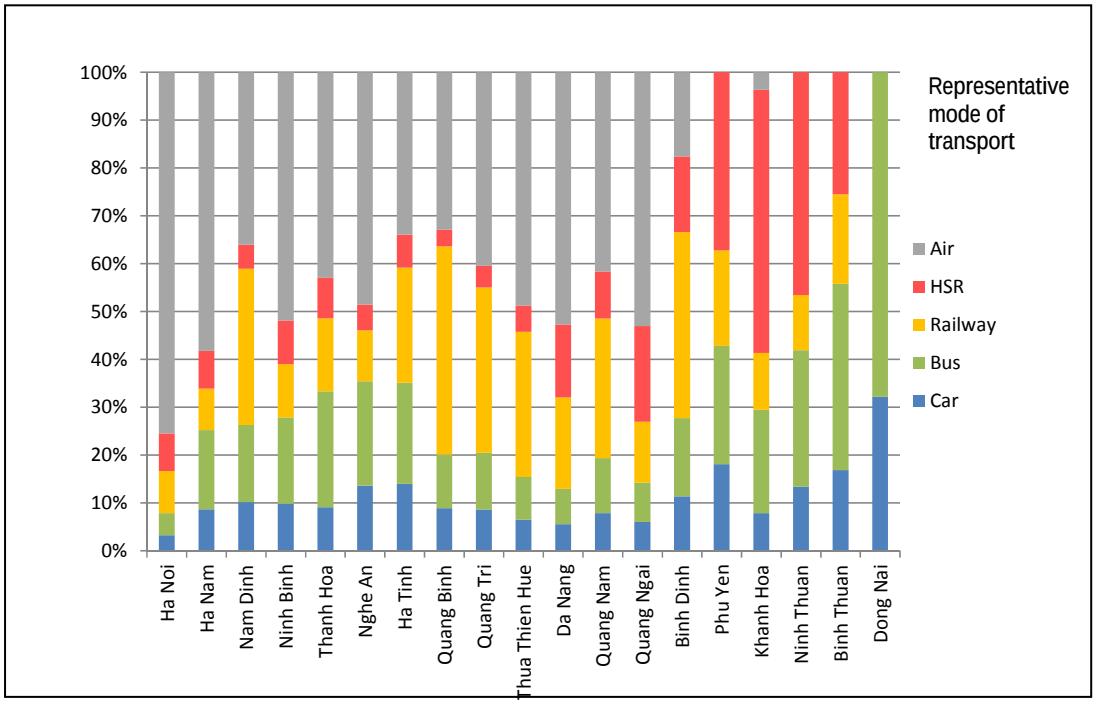
Figure 4.9.7 Cross Sectional Traffic in North-South Corridor (HSR: HCMC-Nha Trang is under operation), 2030

4.30 **Traffic Demand from HCMC:** The modal share from HCMC to the North, in case HCMC-Nha Trang section is under operation in 2030, is shown in Figure 4.9.8 and Figure 4.8.9. The share of HSR for HCMC – Nha Trang is as high as approximately 55%, while the ones for HCMC - Ninh Thuan and HCMC – Binh Thuan are 45% and 25%, respectively.



Source: JICA Study Team

Figure 4.9.8 Mode Share for Trips from HCMC to the North (HCMC-Nha Trang is under operation), 2030, No. of passenger



Source: JICA Study Team

Figure 4.9.9 Mode Share for Trips from HCMC to the North (HCMC-Nha Trang is under operation), 2030, percentage

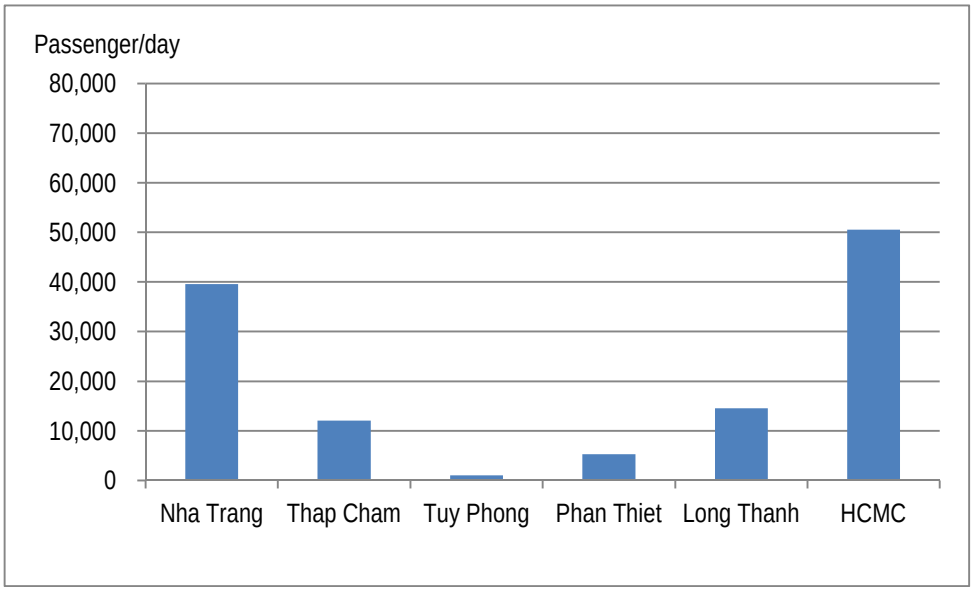
4.31 **Demand between and at Stations:** The HSR passenger demand between stations (station OD table) is shown in Table 4.9.2 for the case in which HCMC-Nha Trang section is under operation. Figure 4.9.10 and Figure 4.9.11 & Figure 4.9.12 show the no. of passenger at stations and cross-sectional demands for each section between stations, respectively. Among all stations, the passenger volume at HCMC station is the most, about 50,000 passengers per day, and, as clearly shown in Figure 4.9.12, most HSR passengers are from or to HCMC, while the passenger demand between other provinces are limited.

Table 4.9.2 Daily No. of HSR passengers between Stations (both-direction, HCMC-Nha Trang is under operation)

Unit:passenger/day

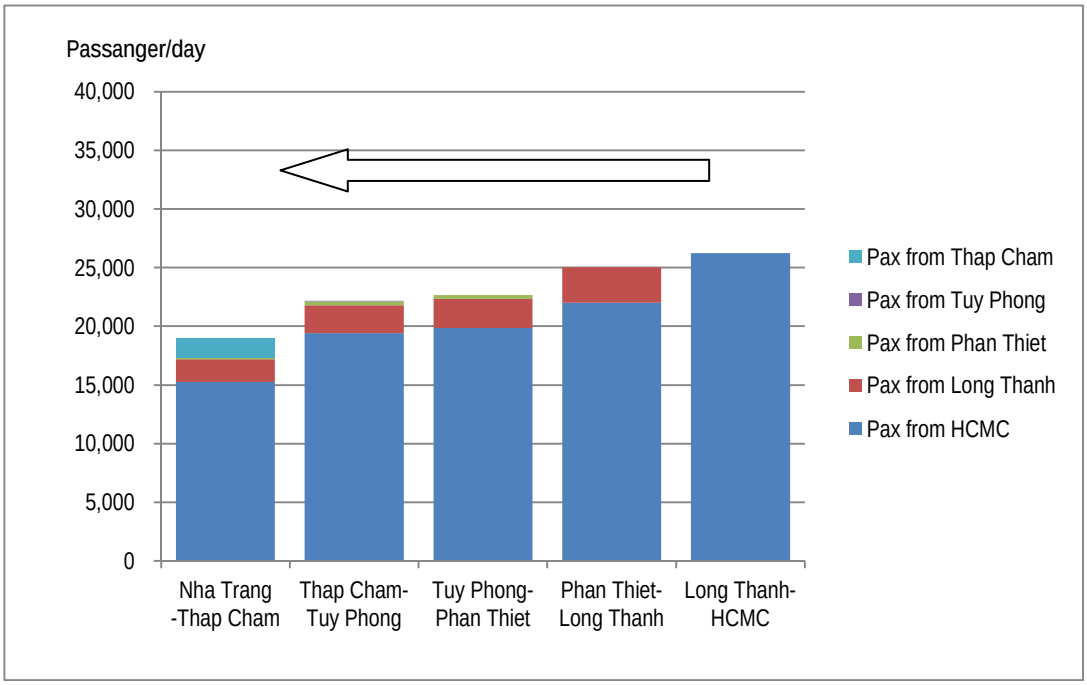
Station		1 Nha Trang	2 Thap Cham	3 Tuy Phong	4 Phan Thiet	5 Long Thanh	6 HCMC
1	Nha Trang	-	3,988	43	221	4,473	30,845
2	Thap Cham	-	-	54	377	731	6,882
3	Tuy Phong	-	-	-	0	182	729
4	Phan Thiet	-	-	-	-	890	3,771
5	Long Thanh	-	-	-	-	-	8,298
6	HCMC	-	-	-	-	-	-

Source: JICA Study Team



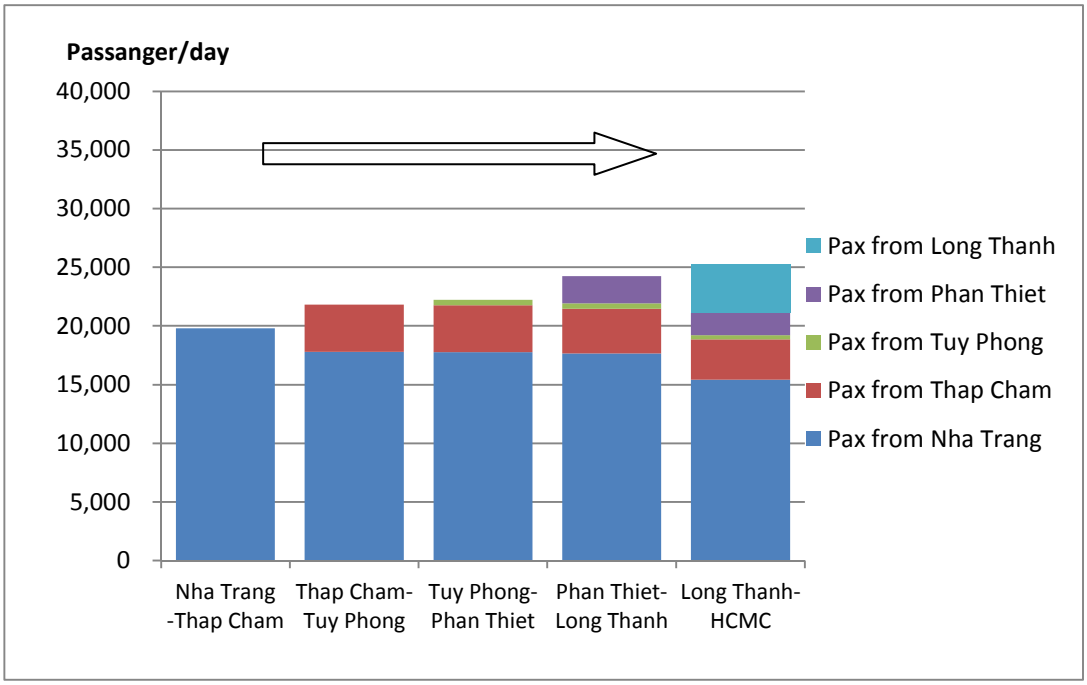
Source: JICA Study Team

Figure 4.9.10 No. of Passenger at Stations (HSR: HCMC-Nha Trang is under operation)



Source: JICA Study Team

Figure 4.9.11 Daily No. of Passenger between Stations (HCMC to Nha Trang Direction Only)(HSR: HCMC-Nha Trang is under operation)



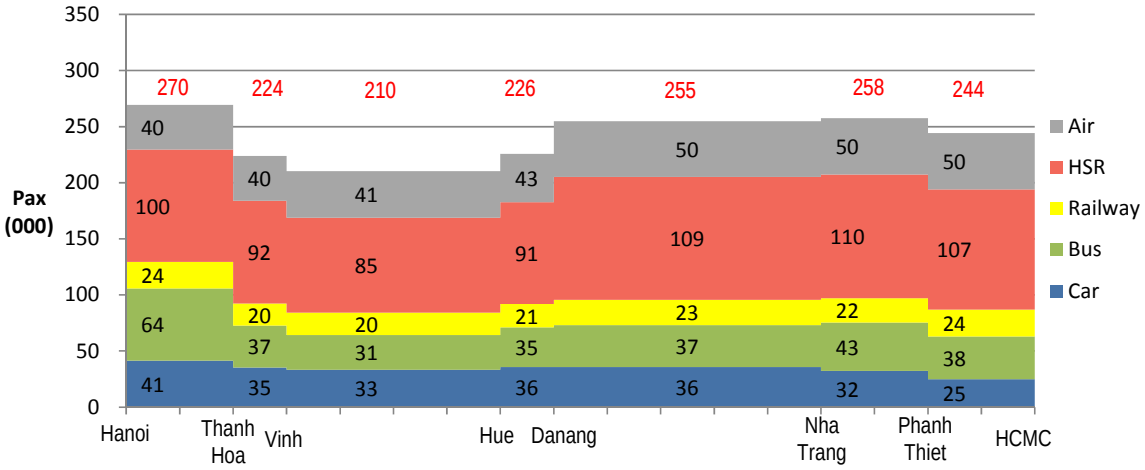
Source: JICA Study Team

Figure 4.9.12 Daily No. of Passenger between Stations (Nha Trang to HCMC Direction Only)(HSR: HCMC-Nha Trang is under operation)

3) The Whole Hanoi-HCMC Section

4.32 The impact of HSR, under the assumption the whole 1,570 km section is developed, was also examined. The estimated HSR passenger for the whole section was shown as follows;

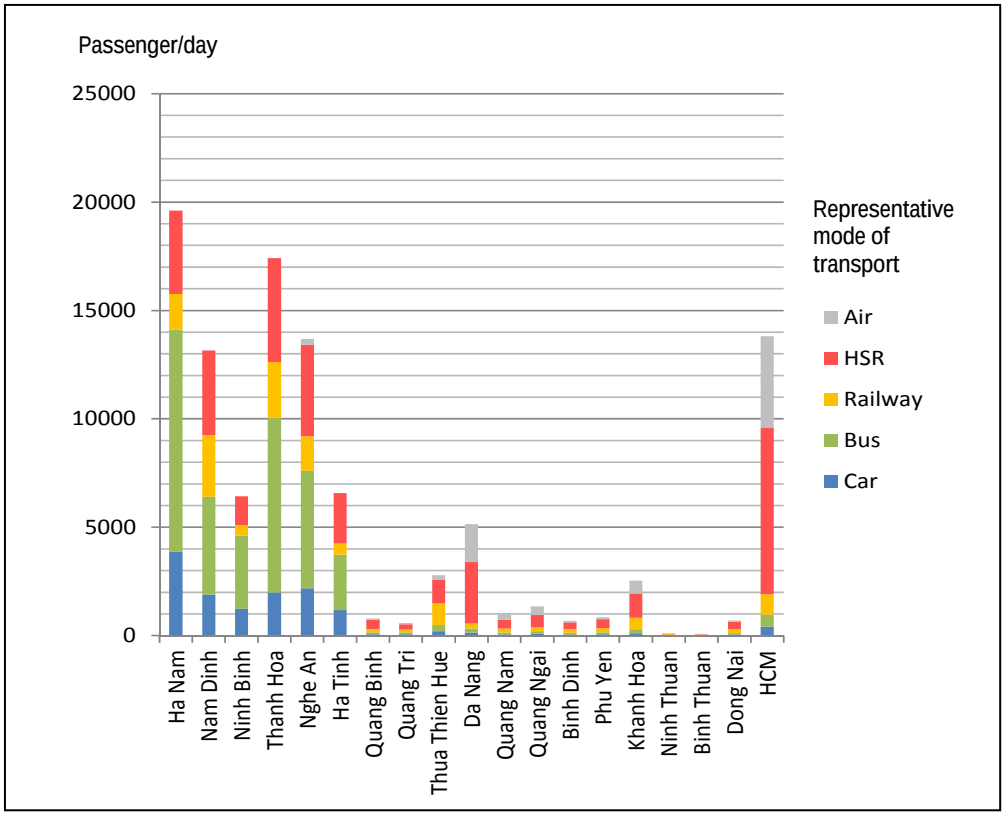
4.33 **Cross Sectional Traffic in the North-South Corridor:** Cross-sectional traffic of North-South corridor (coastal corridor) in 2030, under the assumption Hanoi-HCMC section is under operation, is shown in the following figure. The cross-sectional traffic demand of HSR account for 85-110 thousands, approximately 40% among all modes. In comparison with partial operations mentioned above, HSR absorbs much of air traffic share, seemingly including the share on trips between Hanoi-HCMC.



Source: JICA Study Team

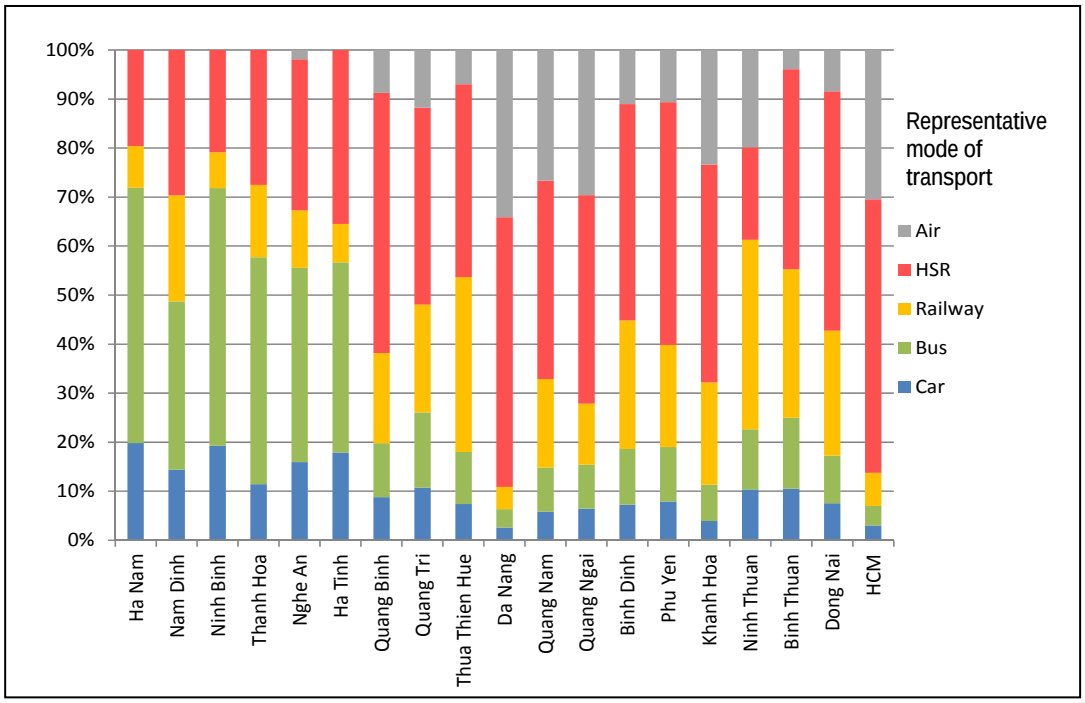
Figure 4.9.13 Cross Sectional Traffic (HSR: Hanoi – HCMC is under operation)

4.34 **Traffic Demand from Hanoi and from HCMC:** The modal share from Hanoi to the South and the one from HCMC to the North, in case Hanoi - HCMC section is under operation in 2030, are shown in the figures below. The share of HSR for Hanoi - HCMC is as high as approximately 60%, while ones from Hanoi to Danang and from HCMC to Danang are approximately 55%.



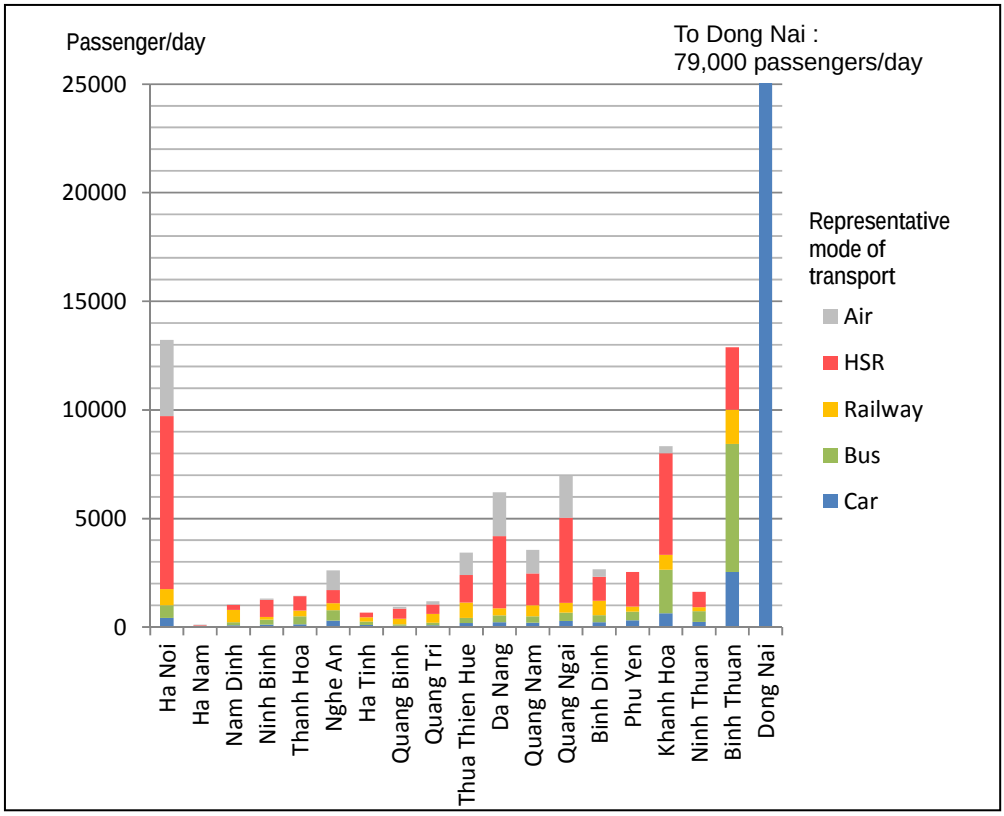
Source: JICA Study Team

Figure 4.9.14 Mode Share for Trips from Hanoi to the South (Hanoi-HCMC is under operation), 2030, No. of passenger



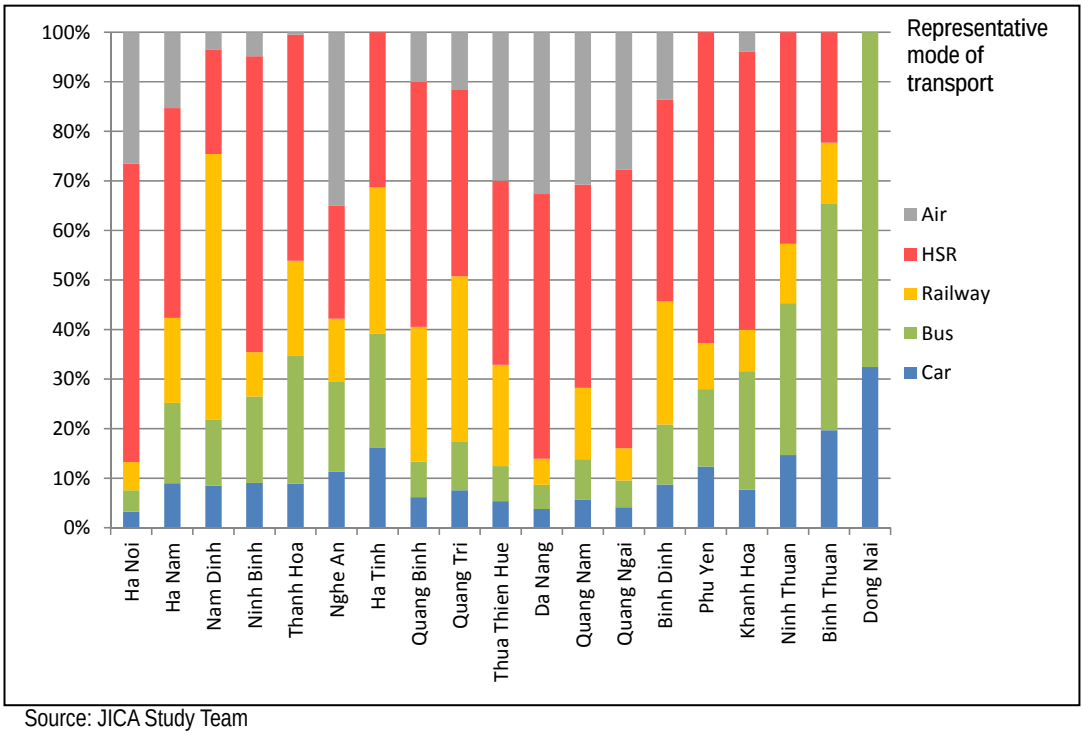
Source: JICA Study Team

Figure 4.9.15 Mode Share for Trips from Hanoi to the South (Hanoi-HCMC is under operation), 2030, percentage



Source: JICA Study Team

Figure 4.9.16 Mode Share for Trips from HCMC to the North (Hanoi-HCMC is under operation), 2030, No. of passenger



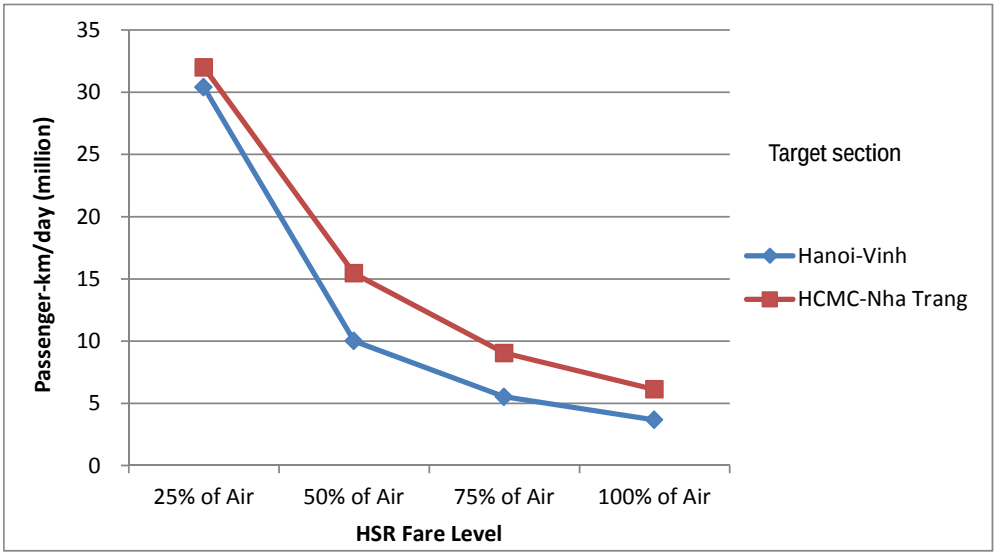
Source: JICA Study Team

Figure 4.9.17 Mode Share for Trips from HCMC to the North (Hanoi-HCMC is under operation), 2030, percentage

4) Sensitivity Analysis for Priority Sections

(1) Fare Rate

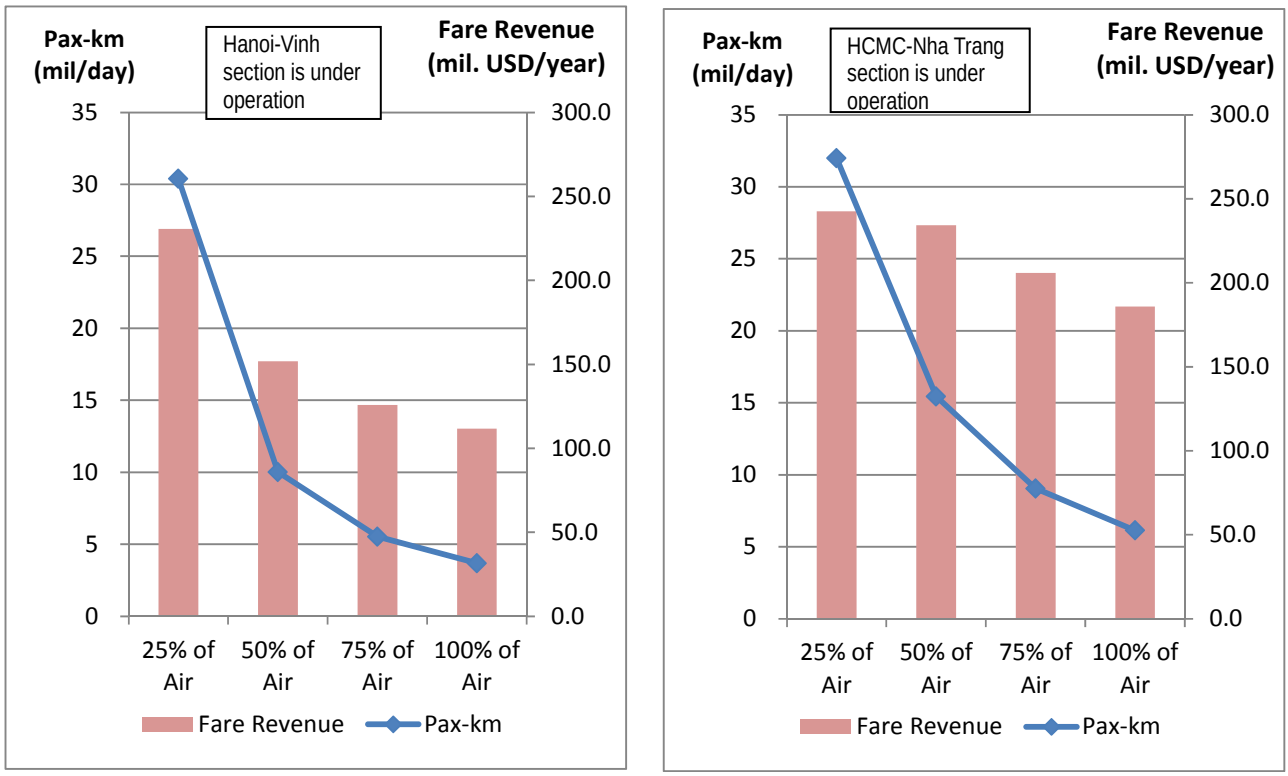
4.35 To find the most appropriate fare rate, the different levels of fare are applied on demand forecast analysis; four fare levels, 25%, 50%, 75% and 100% of air fare, are examined. The figure below shows the relation between fare level and HSR passenger-km. While the decreases of passenger-km, in case the fare level increases from 50% to 75% or 100% of air fare, are similar in both Hanoi-Vinh and HCMC-Nha Trang sections (in terms of percentage), the increases of passenger-km, in case the fare level decreases, are very different. In case of 25% of air fare, the passenger-km in Hanoi-VInh section will rise significantly to almost the same level with HCMC-Nha Trang section.



Source: JICA Study Team

Figure 4.9.18 Relation between Fare Level & HSR Passenger-km
(In cases HSR is under operation for Hanoi-Vinh or HCM-Nha Trang Section)

4.36 The figure below shows the relation between passenger-km and fare revenue by HSR fare level, which indicates the fare revenue is higher if fare level is set on a lower standard (at least to the level of 25% of air fare).



Source: JICA Study Team
Note: 50% of air fare is assumed to be 0.041 USD (873 VND) per passenger-km based on the air fare between Hanoi-HCMC (as of Oct 2011)

Figure 4.9.19 Relation between Fare Level & Fare Revenue (based on 2030 demand)

(2) Intensive Urbanization

4.37 The promotion of the urbanization in the cities along the route is one of the most significant positive impacts expected to be brought by HSR development although the quantitative evaluation methodology of such impact is yet to be established in general. On the other hand, the urban population along the route is primary determinative factor of HSR ridership. To secure the certain level of HSR ridership, the urban development policy in line with HSR development has to be prepared.

4.38 To assess the HSR ridership by the progress of urban development in the cities along the HSR route, in addition to the “base” case (referred as “low” case hereafter), two additional intensive urbanization scenarios are assumed, which are named “Medium” and “High” case (see Table 4.9.3) . Based on the assumed indicators, the demand analysis was conducted for the purpose of sensitivity analysis.

Table 4.9.3 Alternative Scenarios on Urbanization

		2010			2030								
					Low (base case)			Medium			High		
		Population (000)		% Urban	Population (000)		% Urban	Population (000)		% Urban	Population (000)		% Urban
		Total	Urban		Total	Urban		Total	Urban		Total	Urban	
North	Hanoi	6,562	2,710	41.3	8,200	5,048	61.6	8,200	5,599	68.3	8,200	6,150	75.0
	Ha Nam	786	82	10.5	837	258	30.8	837	338	40.4	837	418	50.0
	Nam Dinh	1,830	326	17.8	2,013	563	28.0	2,013	634	31.5	2,013	704	35.0
	Ninh Binh	901	161	17.9	962	391	40.7	962	460	47.8	962	529	55.0
	Thanh Hoa	3,407	358	10.5	3,647	491	13.5	3,647	792	21.7	3,647	1,094	30.0
	Nghe An	2,917	376	12.9	3,389	613	18.1	3,389	815	24.0	3,389	1,017	30.0
	Ha Tinh	1,228	184	15.0	1,320	311	23.5	1,320	353	26.8	1,320	396	30.0
	Quang Binh	849	129	15.1	955	204	21.4	955	245	25.7	955	287	30.0
	Quang Tri	601	171	28.4	694	317	45.7	694	332	47.9	694	347	50.0
Central	T. T. Hue	1,091	434	39.8	1,265	543	42.9	1,265	651	51.5	1,265	759	60.0
	Danang	926	805	87.0	1,203	1,110	92.3	2,000	1,923	96.1	2,000	2,000	100.0
	Quang Nam	1,425	271	19.0	1,568	592	37.8	1,568	688	43.9	1,568	784	50.0
	Quang Ngai	1,219	178	14.6	1,324	448	33.8	1,324	489	36.9	1,324	530	40.0
	Binh Dinh	1,490	413	27.7	1,671	831	49.7	1,671	875	52.4	1,671	919	55.0
South	Phu Yen	869	203	23.3	981	417	42.5	981	454	46.3	981	490	50.0
	Khanh Hoa	1,168	520	44.5	1,378	1,015	73.7	1,378	1,059	76.8	1,378	1,102	80.0
	Ninh Thuan	570	205	36.0	669	430	64.2	669	466	69.6	669	502	75.0
	Binh Thuan	1,177	460	39.0	1,372	759	55.3	1,372	826	60.2	1,372	892	65.0
	Dong Nai	2,569	859	33.4	3,356	2,001	59.6	3,356	2,259	67.3	3,356	2,517	75.0
	HCMC	7,397	6,158	83.3	9,723	8,333	85.7	9,723	9,028	92.8	9,723	9,723	100.0
Total		38,980	15,001	38.5	46,527	24,674	53.0	47,324	28,285	59.8	47,324	31,161	65.8

Source: JICA Study Team

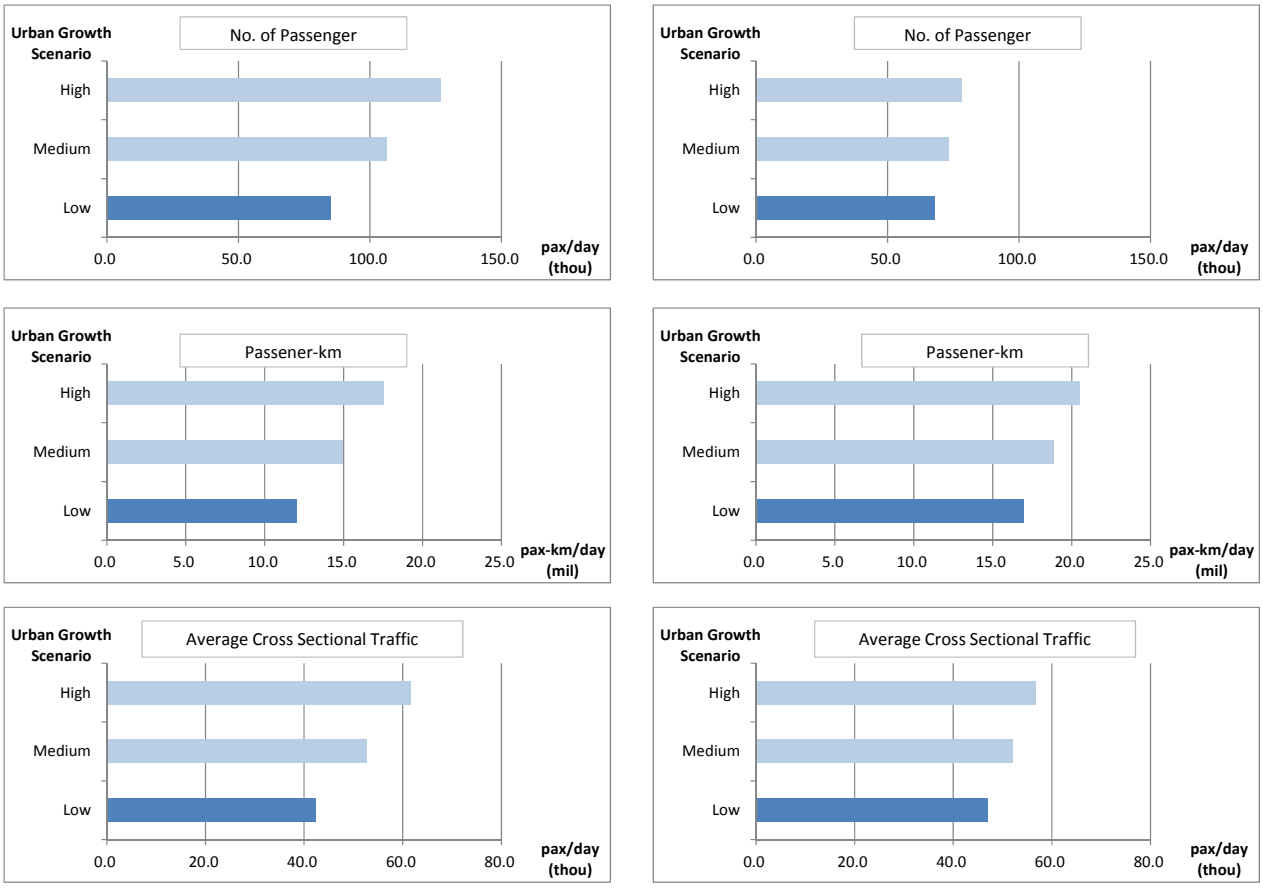
4.39 Table 4.9.4 and Figure 4.9.20 show the result of the analysis, in case HSR fare level is 50% of Air. In Medium and High case, the demand on passenger-km basis increases by 24% and 46% in the north section and 11% and 21% in the south section, respectively. The impact of intensive urbanization is more significant in the north than the south.

Table 4.9.4 Traffic Demand by Urbanization Scenario (Fare Level: 50% of Air Fare)

		Hanoi-Vinh Section			HCMC-Nha Trang Section		
		pax/day (thou)	pax-km/day (mil)	cross section demand/day (thou)	pax/day (thou)	pax-km/day (mil)	cross section demand/day (thou)
Urban Growth Scenario	Low (base case)	84.9	12.0	42.4	67.9	17.0	46.9
	Medium	106.4	15.0	52.7	73.3	18.8	52.0
	High	126.8	17.5	61.7	78.3	20.5	56.6

Source: JICA Study Team

Hanoi – Vinh Section **HCMC – Nha Trang Section**



Source: JICA Study Team

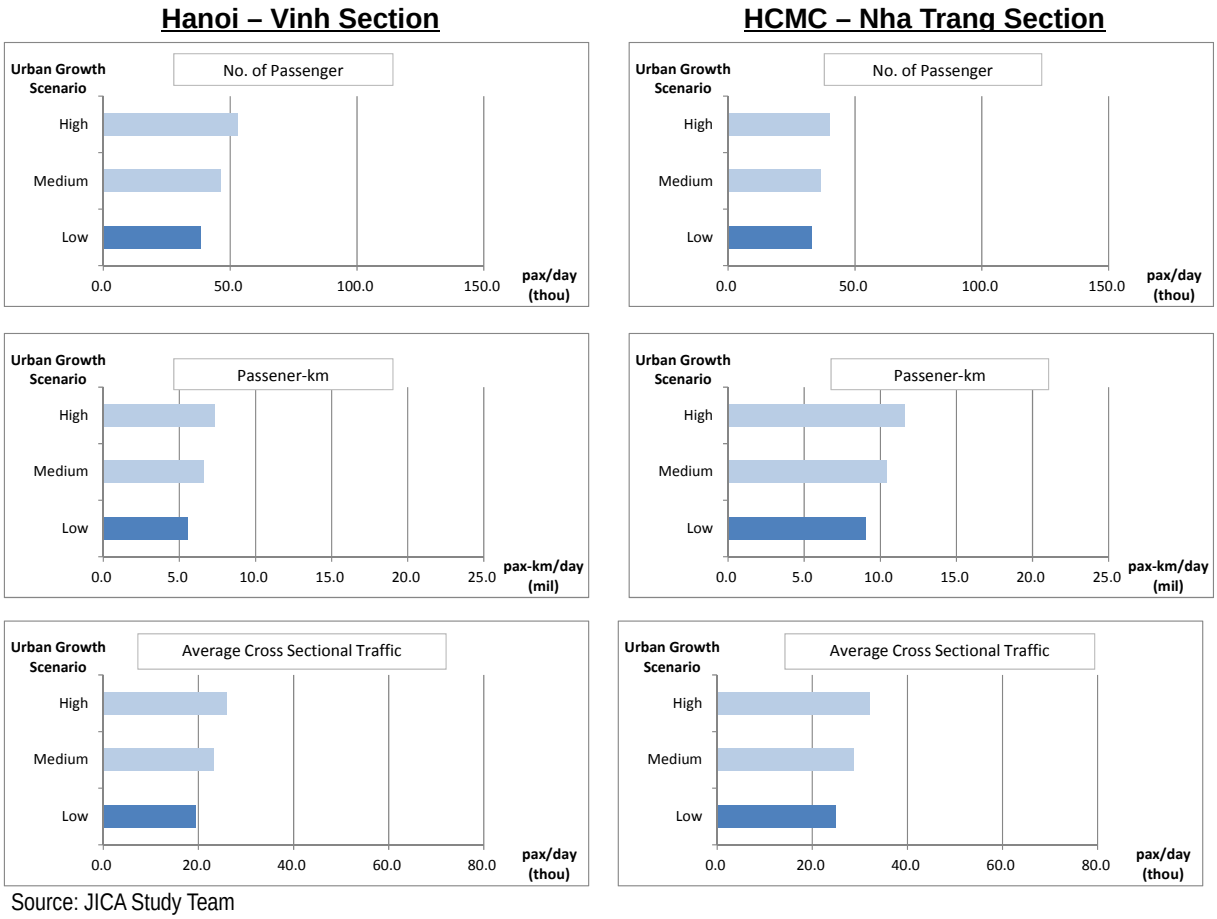
Figure 4.9.20 Traffic Demand by Urbanization Scenario (Fare Level: 50% of Air Fare)

4.40 Table 4.9.5 and Figure 4.9.21 show the result of the analysis, in case HSR fare level is 75 % of Air. In Medium and High case, the demand on passenger-km basis increases by 20% and 33% in the north section and 15% and 29% in the south section, respectively. Under the condition that the higher HSR fare level (than 50% to air fare) is applied, the impact of urbanization on HSR ridership is weaken in the north but intensified in the south.

Table 4.9.5 Traffic Demand by Urbanization Scenario (Fare Level: 75% of Air Fare)

		Hanoi-Vinh Section			HCMC-Nha Trang Section		
		pax/day (thou)	pax-km/day (mil)	cross section demand/day (thou)	pax/day (thou)	pax-km/day (mil)	cross section demand/day (thou)
Urban	Low	38.6	5.5	19.4	32.9	9.0	25.0
Growth	Medium	46.5	6.6	23.3	36.6	10.4	28.8
Scenario	High	53.2	7.4	25.9	39.9	11.6	32.1

Source: JICA Study Team



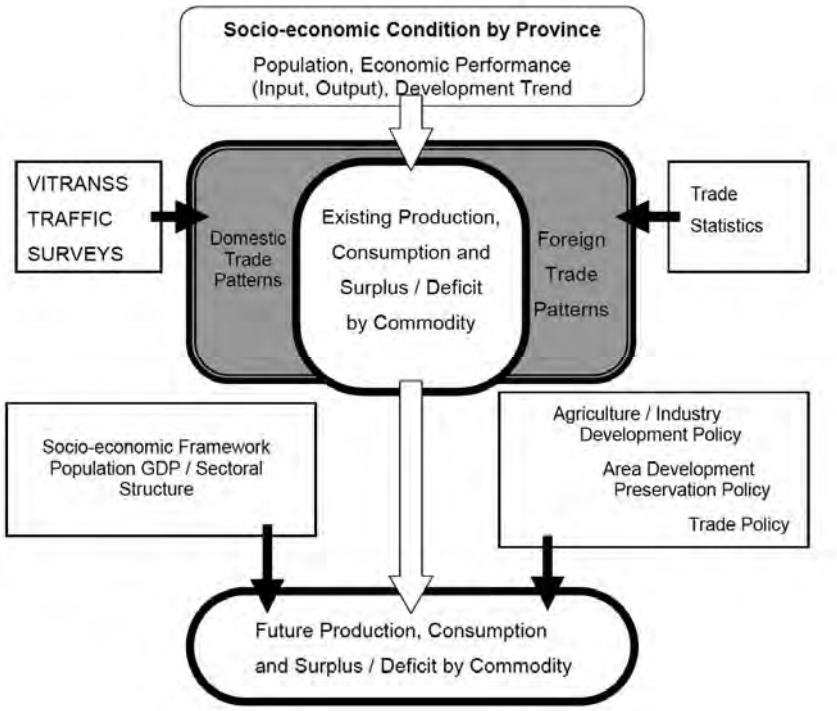
Source: JICA Study Team

Figure 4.9.21 Traffic Demand by Urbanization Scenario (Fare Level: 75% of Air Fare)

5 FREIGHT TRAFFIC DEMAND

5.1 Methodology

5.1 In terms of freight traffic demand, the output of VITRANSS2 is utilized for the study. VITRANSS 2 adopted the major commodities classified into 13 groups same as VITRANSS 1. As the first step, production and consumption was estimated by province and by commodity group. The province-wise surplus or deficit is usually considered the source of freight traffic. This forecast was done based on transportation surveys and existing trade statistics. Socio-economic growth trends and proposed/planned development projects were also taken into account.



Source: VITRANSS 2 (2010, JICA)

Figure 5.1.1 Forecast of Production/Consumption and Surplus/Deficit by Commodity

5.2 After this forecast, the usual four-step method was applied in the same manner as forecasting passenger transportation demand. Trip generation/attraction model, trip distribution model, as well as the modal split model and assignment model are described in subsequent pages together with the results.

5.2 Generation/Attraction: Domestic Movement

5.3 The following assumptions were introduced to forecast domestic freight transportation demand:

(i) If a province has much surplus (i.e., production is higher than consumption), it will generate more freight, or if a province has much deficit (i.e., consumption is higher than production), it will attract more freight;

(ii) More freight is generated by and attracted to a province with an adequate logistics infrastructure or delivery system. Usually, leading cities, such as Hanoi and Hai Phong, have good logistics infrastructure; and a lot of freight is delivered to the final destination via such cities. For this reason, socio-economic indicators were also used as exogenous variables; and

(iii) Export is regarded as consumption and import as production. Therefore, provinces with international ports will generate and attract more traffic.

5.4 Based on the above assumptions, multiple linear regression models were developed as follows:

$$Gi = a1 * Si + a2 * Xi + b$$
$$Aj = c1 * Dj + c2 * Xj + d$$

Where, Gi: Generation from Zone i
Aj: Attraction to Zone j
Si: Surplus in Zone i
Dj: Deficit in Zone j
Xi, Xj: Socio-economic indicator of Zone i&j
a1, a2, c1 and c2: Parameters
c and d: Constant

5.5 Using the socio-economic indicators in the equation above as explanatory variables, the total GRDP or sectoral GRDP that showed the strongest correlation was taken. In addition, the same indicators were used both for generation and attraction to avoid a possible imbalance in growth rates between the two. Export/Import was included in the generation/attraction of port provinces.

Table 5.2.1 Variables Used in the Regression Analysis

Commodity	Generation	Attraction
1. Paddy and Other Crops	Surplus, Tertiary GRDP	Tertiary GRDP
2. Sugar/Sugarcane	Surplus, GRDP	GRDP
3. Wood and Forest Products	Secondary GRDP	Deficit, Secondary GRDP
4. Steel	Surplus, Tertiary GRDP	Tertiary GRDP
5. Construction Materials	Surplus, Tertiary GRDP	Tertiary GRDP
6. Cement	Surplus, Tertiary GRDP	Tertiary GRDP
7. Fertilizer	Tertiary GRDP	Deficit, Tertiary GRDP
8. Coal	Surplus, Tertiary GRDP	Deficit, Tertiary GRDP
9. Petroleum Products	GRDP	Deficit, GRDP
10. Industrial Crops	Surplus, Tertiary GRDP	Deficit, Tertiary GRDP
11. Manufacturing Goods	Secondary GRDP	Secondary GRDP
12. Fishery Products	Surplus, GRDP	GRDP
13. Animal Meat and Others	GRDP	GRDP

Source: VITRANSS 2 (2010, JICA).

Table 5.2.2 Estimated Coefficients

Commodity	Production/Attraction	Constant	a1/c1	a2/c2
1. Paddy and Other Crops	Production	1,063.7	0.55	0.30
	Attraction	638.0		0.44
2. Sugar/Sugarcane	Production	107.2	0.13	0.00
	Attraction	-128.2		0.04
3. Wood and Forest Products	Production	313.2		0.03
	Attraction	387.7	1.68	0.00
4. Steel	Production	399.2	0.83	0.12
	Attraction	321.5		0.14
5. Construction Materials	Production	4,301.1	0.87	1.23
	Attraction	4,325.9		1.22
6. Cement	Production	619.4	2.98	0.49
	Attraction	929.5		0.38
7. Fertilizer	Production	-149.9		0.27
	Attraction	568.7	0.23	0.03
8. Coal	Production	1,727.5	7.66	0.09
	Attraction	1,405.4	0.23	0.19
9. Petroleum Products	Production	-707.2		0.22
	Attraction	326.6	0.13	0.07
10. Industrial Crops	Production	105.3	0.22	0.01
	Attraction	13.3	0.62	0.04
11. Manufacturing Goods	Production	737.9		0.84
	Attraction	496.7		0.93
12. Fishery Products	Production	-286.0	0.71	0.08
	Attraction	212.3		0.01
13. Animal Meat and Others	Production	273.3		0.17
	Attraction	537.2		0.13

Source: VITRANSS 2(2010, JICA)

5.6 The calculated values were then adjusted to the projected gross output (control total), and the results are shown below.

Table 5.2.3 Estimated Generation/Attraction of Commodities

Commodity	Generation/Attraction by Commodity (ton/day)					Annual Growth Rate (%)		
	1999	2008	2010	2020	2030	'08—'10	'10— '20	'20— '30
1. Rice	35,995	121,613	148,713	244,288	356,436	10.6	5.1	3.9
2. Sugar	6,464	8,617	14,744	56,585	83,982	30.8	14.4	4.0
3. Wood	6,881	24,619	27,703	73,132	103,460	6.1	10.2	3.5
4. Steel	6,924	45,900	54,935	122,652	206,311	9.4	8.4	5.3
5. Construction Materials	36,520	510,133	627,021	1,059,963	1,492,905	10.9	5.4	3.5
6. Cement	20,071	120,183	147,843	192,647	279,954	10.9	2.7	3.8
7. Fertilizer	24,042	41,598	44,967	55,871	63,779	4.0	2.2	1.3
8. Coal	39,548	117,124	138,959	146,930	146,930	8.9	0.6	0.0
9. Petroleum	22,652	47,030	56,444	88,486	120,528	9.6	4.6	3.1
10. Industrial Crops	4,176	8,043	10,165	19,222	29,989	12.4	6.6	4.5
11. Manufacturing Goods	30,416	194,481	213,704	375,424	729,767	4.8	5.8	6.9
12. Fishery	4,521	19,389	22,724	37,604	55,333	8.3	5.2	3.9
13. Meat	2,867	93,094	93,843	97,126	100,982	0.4	0.3	0.4
Total	241,077	1,351,824	1,601,766	2,569,930	3,770,356	8.9	4.8	3.9

Source: VITRANSS 2 (2010, JICA)

5.3 Distribution: Domestic Movement

5.7 The Fratar method was used to forecast future OD distribution. Since this method tends to lead to large traffic flows at longer distances, the result was proportionally adjusted to have as its upper limit three (3) times the average transportation distance by commodity. In a province with no trip generation/attraction at present, expected trip generation and attraction were estimated separately before the Fratar balancing calculation.

5.4 Modal Split Model

5.8 The modal split of freight traffic demand was estimated using the following formula:

$$Pij(Mk) = (1/GCij(Mk))2 / (1/GCij(M1))2 + (1/GCij(M2))2 + \cdots)$$

Where, M: mode
P: probability of selecting Mode k between zone I and j
GC: generalized cost of the Mode between zone I and j

5.9 Generalized cost is the sum of transportation cost and time cost of commodity.

5.10 **Overall Modal Split:** At present, inland waterways and roads handle the majority of freight in terms of tonnage with modal shares of over 40%. In terms of ton-kilometers, coastal shipping also shares a large percentage of nearly 30%. In VITRANSS2 the modal shares of road, rail, and coastal shipping were projected to increase steadily in the future, while inland waterway would gradually decrease. Modal preference differs by commodity. For instance, construction materials depend on inland waterways and roads, while manufacturing goods depend heavily on roads. Air transportation is used only for manufacturing goods. The summary of freight transportation demand forecast is shown in Table 5.4.1.

Table 5.4.1 Modal Shares of Freight Transportation, 2008 and 2030

		Road	Rail	Inland Waterway	Coastal Shipping	Air	Total
Volume transported (000 ton/day)	2008	604.9	25.5	643.0	58.1	0.3	1,351.8
	2030	2,132.7	155.1	1,317.0	125.8	1.0	3,731.6
Modal share (%, ton)	2008	45.4	1.9	48.3	4.4	0.0	100.0
	2030	57.2	4.2	35.3	3.4	0.0	100.0
Modal share (%, ton-km)	2008	36.6	4.3	30.5	28.5	0.1	100.0
	2030	53.0	9.7	19.9	17.2	0.2	100.0

Source: VITRANSS 2 (2010, JICA)

6 TRANSPORTATION OPERATION COST

6.1 Unit Vehicle Operation Cost (VOC)

1) Representative Model

6.1 In order to assess the current and future transport situation from the economic and financial points of view, vehicle operating cost (VOC) was estimated by type of vehicle. The vehicle classification is consistent with that adopted in the traffic surveys conducted in the Study. The following table (Table 6.1.1) shows the representative model chosen for the Study.

Table 6.1.1 Representative Model for Each Vehicle Classification

		Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Representative Model		Jupiter	Toyota Corolla	Hyundai County	Daewoo BC212MA	Hyundai Mighty DA4L	Thaco	Hyundai HD 250
Vehicle Price	Financial Price (US$)	1,050	25,000	40,000	62,000	23,000	44,000	54,000
	Vehicle Registration Cost (%)	5	12	2	2	2	2	12
	VAT, Import Tax, etc (%)	10	92	10	10	10	10	92
	Economic Price (US$)	913	12,255	35,714	55,357	20,536	39,286	26,471
Characteristics	No. of Tires	2	4	4	4	4	8	10
	Main Fuel	Gasoline	Gasoline	Diesel	Diesel	Diesel	Diesel	Diesel
	Annual Operation (km)1)	7,500	33,000	75,000	120,000	60,000	120,000	120,000
	Average Speed (km/h) 2)	30	40	30	30	30	30	30
	Annual Usage Hours (h)	250	825	2,500	4,000	2,000	4,000	4,000

Source: Various websites introducing models listed
Note: 1) Estimated based on interviews with and statistics of bus companies (in VITRANSS2) 2) Assumed by Study Team.

2) Fuel Cost

6.2 Based on information from the Vietnam National Petroleum Corporation, the costs of gasoline and diesel are USD 1.06/liter and USD 0.92/liter, respectively. Using the assumed ratio of fuel type, the average fuel costs for each type of vehicle are calculated and presented in Table 6.1.2 below.

Table 6.1.2 Composition of Fuel Consumption and Average Fuel Cost by Type of Vehicle

	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Fuel Type							
Gasoline (%)	100	100	20	0	50	0	0
Diesel (%)	0	0	80	100	50	100	100
Average Financial Cost (US$/liter)	1.06	1.06	1.036	1.03	1.045	1.03	1.03
Average Economic Cost (US$/liter)	0.92	0.92	0.896	0.89	0.91	0.89	0.89

Source: JICA Study Team based on the 2011 fuel cost data of Vietnam National Petroleum Corporation

6.3 Data on technical fuel consumption rates for each type of vehicle is gathered from the websites or interviews with car dealers. From this data, the fuel consumption rate for each operation speed is calculated. The difference in fuel consumption rates by speed is assumed based on past studies. Then, financial and economic fuel costs for each speed level are also calculated (see Table 6.1.3).

Table 6.1.3 Fuel Consumption Rate and Cost by Type of Vehicle

	Speed (km/hr)	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Fuel Consumption Rate	5	67.8	173.6	864.6	763.0	357.6	918.8	1438.1
	10	44.2	113.1	553.3	488.2	228.9	587.9	920.2
	20	32.0	81.8	400.0	353.0	165.5	425.1	665.3
	30	27.7	71.0	313.3	322.3	138.9	312.7	489.5
	40	25.6	65.5	276.7	300.0[1)]	133.0	259.6	406.3
	50	25.0[1)]	64.0[1)]	260.0	322.3	130.0[1)]	238.3	373.1
	60	25.8	66.1	250.0[1)]	369.9	133.0	230.0[1)]	360.0[1)]
	70	27.3	70.0	251.8	432.0	135.9	238.3	373.1
	80	29.6	75.7	261.5	496.9	147.7	258.1	404.0
	90	32.7	83.6	289.0	548.8	163.2	285.1	446.3
Financial Fuel Cost (US$/1000km)	5	71.9	184.0	895.7	785.9	373.7	946.3	1,481.2
	10	46.8	119.9	573.3	502.8	239.2	605.5	947.8
	20	33.9	86.7	414.4	363.6	172.9	437.8	685.3
	30	29.4	75.3	324.6	332.0	145.1	322.1	504.2
	40	27.1	69.4	286.6	309.0	138.9	267.4	418.5
	50	26.5	67.8	269.4	332.0	135.9	245.5	384.3
	60	27.4	70.1	259.0	381.0	138.9	236.9	370.8
	70	29.0	74.2	260.9	445.0	142.0	245.5	384.3
	80	31.3	80.2	271.0	511.8	154.4	265.8	416.1
	90	34.6	88.6	299.4	565.3	170.6	293.7	459.6
Economic Fuel Cost (US$/1000km)	5	62.4	159.7	774.7	679.1	323.6	817.7	1,279.9
	10	40.7	104.1	495.8	434.5	207.1	523.2	819.0
	20	29.4	75.3	358.4	314.1	149.7	378.3	592.2
	30	25.5	65.3	280.7	286.9	125.7	278.3	435.7
	40	23.5	60.2	247.9	267.0	120.3	231.0	361.6
	50	23.0	58.9	233.0	286.9	117.7	212.1	332.0
	60	23.8	60.8	224.0	329.2	120.3	204.7	320.4
	70	25.1	64.4	225.6	384.5	123.0	212.1	332.0
	80	27.2	69.6	234.3	442.2	133.7	229.7	359.5
	90	30.0	76.9	258.9	488.5	147.7	253.7	397.2

Source: JICA Study Team based on MMUTIS Technical Report 1998, JICA
Note: 1) Based on technical consumption rate collected by JICA Study Team

3) Oil Cost

6.4 Similar to fuel, the cost of oil consumption is also calculated. The unit cost of oil is obtained from the Petrolimex website (retail price is USD 4.05/liter) and, applying assumed oil consumption rates by speed based on past studies, the financial and economic costs are calculated (see Table 6.1.4).

Table 6.1.4 Oil Consumption Rate and Cost by Type of Vehicle

	Speed (km/hr)	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Oil Consumption Rate(Liter/1000Km)	5	0.45	3.48	4.10	8.01	6.86	8.01	10.81
	10	0.29	2.24	2.63	5.14	4.40	5.14	6.94
	20	0.20	1.54	1.81	3.53	3.03	3.54	4.78
	30	0.16	1.27	1.49	2.92	2.50	2.92	3.94
	40	0.15	1.13	1.33	2.68	2.22	2.68	3.62
	50	0.14	1.10	1.29	2.58	2.08	2.58	3.48
	60	0.14	1.09	1.28	2.36	1.80	2.36	3.19
	70	0.14	1.07	1.26	2.14	1.68	2.14	2.89
	80	0.13	1.00	1.18	1.87	1.52	1.87	2.52
	90	0.12	0.90	1.06	1.68	1.37	1.68	2.27
Financial Oil Cost (US$/1000km)	5	1.8	14.1	16.6	32.4	27.8	32.4	43.8
	10	1.2	9.1	10.7	20.8	17.8	20.8	28.1
	20	0.8	6.2	7.3	14.3	12.3	14.3	19.4
	30	0.7	5.1	6.0	11.8	10.1	11.8	16.0
	40	0.6	4.6	5.4	10.9	9.0	10.9	14.7
	50	0.6	4.5	5.2	10.4	8.4	10.4	14.1
	60	0.6	4.4	5.2	9.6	7.3	9.6	12.9
	70	0.6	4.3	5.1	8.7	6.8	8.7	11.7
	80	0.5	4.1	4.8	7.6	6.2	7.6	10.2
	90	0.5	3.6	4.3	6.8	5.5	6.8	9.2
Economic Oil Cost [1] (US$/1000km)	5	1.6	12.7	14.9	29.2	25.0	29.2	39.4
	10	1.1	8.2	9.6	18.7	16.0	18.7	25.3
	20	0.7	5.6	6.6	12.9	11.0	12.9	17.4
	30	0.6	4.6	5.4	10.6	9.1	10.6	14.4
	40	0.5	4.1	4.8	9.8	8.1	9.8	13.2
	50	0.5	4.0	4.7	9.4	7.6	9.4	12.7
	60	0.5	4.0	4.7	8.6	6.6	8.6	11.6
	70	0.5	3.9	4.6	7.8	6.1	7.8	10.5
	80	0.5	3.6	4.3	6.8	5.5	6.8	9.2
	90	0.4	3.3	3.9	6.1	5.0	6.1	8.3

Source: JICA Study Team based on MMUTIS Technical Report 1998, JICA
Note: 1) 10% VAT is considered to calculate economic cost

4) Tire Cost

6.5 Tire cost data is collected and the life of the tire is assumed based on interviews with car dealers, as shown in Table 6.1.5.

Table 6.1.5 Financial and Economic Costs of Tires

	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
No. of Tires (No./set)	2	4	4	4	4	8	10
Unit Financial Cost (US$)	10	60	100	240	100	260	300
Financial Cost (US$/Set)	20	240	400	960	400	2,080	3,000
Economic Cost (US$/Set) [1]	18	218	364	873	364	1,891	2,727
Tire Life (km)	12,000	45,000	50,000	50,000	45,000	50,000	50,000

Source: JICA Study team based on interviews with car dealers
Note: 1) 10% VAT is considered to calculate economic cost

6.6 Using the assumed tire consumption rates by speed based on past studies, the cost for tire consumption per distance is estimated (see Table 6.1.6).

Table 6.1.6 Tire Consumption Rate and Cost by Type of Vehicle

	Speed (km/hr)	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Tire Consumption Indices (56km/hr =100)	5	53	53	53	53	53	53	53
	10	56	56	56	56	56	56	56
	20	60	60	60	60	60	60	60
	30	67.0	67.0	67.0	67.0	67.0	67.0	67.0
	40	78.0	78.0	78.0	78.0	78.0	78.0	78.0
	50	92	92	92	92	92	92	92
	56	100	100	100	100	100	100	100
	60	107	107	107	107	107	107	107
	70	125	125	125	125	125	125	125
	80	151	151	151	151	151	151	151
	90	180	180	180	180	180	180	180
Financial Tire Cost (US$/1000km)	5	0.9	2.8	4.2	10.2	4.7	22.0	31.8
	10	0.9	3.0	4.5	10.8	5.0	23.3	33.6
	20	1.0	3.2	4.8	11.5	5.3	25.0	36.0
	30	1.1	3.6	5.4	12.9	6.0	27.9	40.2
	40	1.3	4.2	6.2	15.0	6.9	32.4	46.8
	50	1.5	4.9	7.4	17.7	8.2	38.3	55.2
	60	1.8	5.7	8.6	20.5	9.5	44.5	64.2
	70	2.1	6.7	10.0	24.0	11.1	52.0	75.0
	80	2.5	8.1	12.1	29.0	13.4	62.8	90.6
	90	3.0	9.6	14.4	34.6	16.0	74.9	108.0
Economic Tire Cost (US$/1000km)	5	0.8	2.6	3.9	9.3	4.3	20.0	28.9
	10	0.8	2.7	4.1	9.8	4.5	21.2	30.5
	20	0.9	2.9	4.4	10.5	4.8	22.7	32.7
	30	1.0	3.2	4.9	11.7	5.4	25.3	36.5
	40	1.2	3.8	5.7	13.6	6.3	29.5	42.5
	50	1.4	4.5	6.7	16.1	7.4	34.8	50.2
	60	1.6	5.2	7.8	18.7	8.6	40.5	58.4
	70	1.9	6.1	9.1	21.8	10.1	47.3	68.2
	80	2.3	7.3	11.0	26.4	12.2	57.1	82.4
	90	2.7	8.7	13.1	31.4	14.5	68.1	98.2

Source: JICA Study Team based on MMUTIS Technical Report 1998, JICA

5) Repair Cost

6.7 Vehicle repair cost is estimated assuming the percentage of annual repair cost to vehicle cost, exclusive of tire cost (see Table 6.1.7). Furthermore, under the assumption that vehicle repair cost per distance also changes by speed, the cost for each speed is also calculated (see Table 6.1.8).

Table 6.1.7 Repair Cost Estimation by Type of Vehicle

	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Financial Vehicle Cost w/o Tire (US$)	1,030	24,760	39,600	61,040	22,600	41,920	51,000
Economic Vehicle Cost w/o Tire (US$)	895	12,037	35,351	54,484	20,172	37,395	23,743
Annual Repair Cost							
% of Vehicle Cost	4.0	4.0	8.0	8.0	6.0	8.0	8.0
Financial Cost (US$)	41	990	3,168	4,883	1,356	3,354	4,080
Economic Cost (US$)	36	481	2,828	4,359	1,210	2,992	1,899
Annual Operation (km)	7,500	33,000	75,000	120,000	60,000	120,000	120,000
Average Speed (km)	30	40	30	30	30	30	30
Financial Repair Cost (US$/1000km)	5.5	30.0	42.2	40.7	22.6	27.9	34.0
Economic Repair Cost (US$/1000km)	4.8	14.6	37.7	36.3	20.2	24.9	15.8

Source: JICA Study Team

Table 6.1.8 Repair Cost Estimation by Type of Vehicle and by Speed

	Speed (km/hr)	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
	5	141	141	142	142	134	159	159
Repair Cost Rate	10	133	133	131	131	126	147	147
by Speed (%)	20	118	118	111	111	113	124	124
	30	105	105	89	89	100	100	100
	40	95	95	74	74	94	83	83
	50	94	94	72	72	93	81	81
	60	100	100	79	79	100	88	88
	70	108	108	88	88	107	98	98
	80	115	115	100	100	114	112	112
	90	122	122	112	112	120	125	125
Financial Repair Cost	5	7.7	42.3	60.1	57.9	30.3	44.5	54.1
(US$/1000km)	10	7.3	39.9	55.4	53.4	28.5	41.0	49.9
	20	6.5	35.4	46.9	45.2	25.5	34.7	42.2
	30	5.8	31.5	37.5	36.2	22.6	27.9	34.0
	40	5.2	28.5	31.4	30.3	21.3	23.3	28.3
	50	5.2	28.2	30.5	29.4	21.1	22.6	27.5
	60	5.5	30.0	33.3	32.1	22.6	24.5	29.8
	70	5.9	32.4	37.1	35.7	24.1	27.2	33.2
	80	6.3	34.5	42.2	40.7	25.7	31.2	38.0
	90	6.7	36.6	47.4	45.7	27.2	34.9	42.5
Economic Repair Cost	5	6.7	20.6	53.6	51.7	27.0	39.7	25.2
(US$/1000km)	10	6.3	19.4	49.4	47.6	25.5	36.6	23.2
	20	5.6	17.2	41.9	40.4	22.7	31.0	19.7
	30	5.0	15.3	33.5	32.3	20.2	24.9	15.8
	40	4.5	13.9	28.1	27.0	19.0	20.8	13.2
	50	4.5	13.7	27.2	26.2	18.8	20.2	12.8
	60	4.8	14.6	29.7	28.7	20.2	21.8	13.9
	70	5.2	15.8	33.1	31.9	21.5	24.3	15.4
	80	5.5	16.8	37.7	36.3	22.9	27.8	17.7
	90	5.8	17.8	42.3	40.8	24.3	31.2	19.8

Source: JICA Study Team based on MMUTIS Technical Report 1998, JICA

6) Depreciation Cost

6.8 Vehicle depreciation cost is calculated by assuming the percentage of salvage value to vehicle cost and ratios of depreciations subject to use and time. The results of this estimation are shown in Table 6.1.9.

Table 6.1.9 Depreciation Cost Estimation by Type of Vehicle

	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Vehicle Cost w/o Tire							
Financial	1,030	24,760	39,600	61,040	22,600	41,920	51,000
Economic	895	12,037	35,351	54,484	20,172	37,395	23,743
Salvage Value							
% of Vehicle Cost	25	25	15	20	20	15	15
Financial Cost (US$)	258	6190	5940	12208	4520	6288	7650
Economic Cost (US$)	224	3009	5303	10897	4034	5609	3561
% of Depreciation of Use & Time							
Subject to use (%)	50	50	70	70	70	70	70
Subject to time (%)	50	50	30	30	30	30	30
Depreciable Amount							
Financial							
Subject to use (US$)	386	9,285	23,562	34,182	12,656	24,942	30,345
Subject to time (US$)	386	9,285	10,098	14,650	5,424	10,690	13,005
Total (US$)	773	18,570	33,660	48,832	18,080	35,632	43,350
Economic							
Subject to use (US$)	336	4,514	21,034	30,511	11,296	22,250	14,127
Subject to time (US$)	336	4,514	9,014	13,076	4,841	9,536	6,055
Total (US$)	671	9,028	30,048	43,588	16,138	31,786	20,182

6.9 Regarding the depreciation cost subject to use, the cost per distance is calculated for each level of speed assuming the fluctuation of cost by speed (see Table 6.1.10).

Table 6.1.10 Estimation of Depreciation Cost Subject to Use by Type of Vehicle & Speed

	Speed (km/hr)	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Indices for Depreciation Cost subject to Use (Ave. Speed = 100)	5	136	136	131	131	126	146	146
	10	119	119	123	123	121	137	137
	20	102	102	108	108	110	119	119
	30	100	100	100	100	100	100	100
	40	90	100	81	81	96	86	86
	50	85	85	80	80	95	85	85
	60	93	93	84	84	100	90	90
	70	102	102	91	91	106	98	98
	80	110	110	99	99	111	109	109
	90	121	121	109	109	116	120	120
Financial Depreciation Cost subject to Use (US$/1000km)	5	7.0	32.0	34.2	31.1	22.2	25.3	30.8
	10	6.1	27.9	32.3	29.3	21.2	23.6	28.8
	20	5.3	23.9	28.3	25.7	19.3	20.6	25.1
	30	5.2	23.4	26.2	23.7	17.6	17.3	21.1
	40	4.6	23.4	21.1	19.1	16.8	14.9	18.1
	50	4.4	19.9	20.9	19.0	16.7	14.8	18.0
	60	4.8	21.8	22.1	20.0	17.6	15.7	19.1
	70	5.3	23.9	23.8	21.6	18.6	17.0	20.7
	80	5.7	25.8	26.0	23.6	19.5	18.8	22.9
	90	6.2	28.3	28.6	25.9	20.3	20.8	25.3
Economic Depreciation Cost subject to Use (US$/1000km)	5	6.1	15.6	30.6	27.7	19.8	22.6	14.3
	10	5.3	13.6	28.8	26.1	18.9	21.1	13.4
	20	4.6	11.6	25.3	22.9	17.2	18.4	11.7
	30	4.5	11.4	23.4	21.2	15.7	15.5	9.8
	40	4.0	11.4	18.8	17.1	15.0	13.3	8.4
	50	3.8	9.7	18.7	17.0	14.9	13.2	8.4
	60	4.2	10.6	19.7	17.9	15.7	14.0	8.9
	70	4.6	11.6	21.2	19.2	16.6	15.2	9.6
	80	4.9	12.5	23.2	21.1	17.4	16.8	10.7
	90	5.4	13.8	25.5	23.1	18.2	18.5	11.8

Source: JICA Study Team
Note: Costs are calculated applying assumed annual operation distance, average speed and vehicle life.

6.10 The daily and hourly depreciation costs subject to time are shown in Table 6.1.11.

Table 6.1.11 Estimation of Depreciation Cost subject to Time by Type of Vehicle

	Unit	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Financial Cost								
Daily Cost		0.13	2.58	2.81	4.07	1.51	2.97	3.61
Hourly Cost		0.15	0.94	0.34	0.31	0.23	0.22	0.27
Economic Cost								
Daily Cost		0.11	1.25	2.50	3.63	1.34	2.65	1.68
Hourly Cost		0.13	0.46	0.30	0.27	0.20	0.20	0.13

Source: JICA Study Team

7) Capital Opportunity Cost

6.11 Capital opportunity cost is calculated using the average vehicle cost, that is, the mean of vehicle cost (without tire) and salvage value, and interest rate of 14%. The results of this cost estimation are shown in Table 6.1.12.

Table 6.1.12 Capital Opportunity Cost by Type of Vehicle

	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
1. Vehicle Cost w/o Tire							
Financial	1,030	24,760	39,600	61,040	22,600	41,920	51,000
Economic	895	12,037	35,351	54,484	20,172	37,395	23,743
2. Salvage Value							
% of Vehicle Cost	25	25	15	20	20	15	15
Financial	258	6,190	5,940	12,208	4,520	6,288	7,650
Economic	224	3,009	5,303	10,897	4,034	5,609	3,561
3. Average Vehicle Cost							
Financial	644	15,475	22,770	36,624	13,560	24,104	29,325
Economic	559	7,523	20,327	32,691	12,103	21,502	13,652
Interest rate (i = 14%)	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Operational Information							
Annual Operation (km)	7,500	33,000	75,000	120,000	60,000	120,000	120,000
Average Speed (km/hr)	30	40	30	30	30	30	30
Vehicle Life (year)	10	12	12	12	12	12	12
Financial Cost							
Daily Cost (US$/Day)	0.30	7.22	10.63	17.09	6.33	11.25	13.69
Hourly Cost (US$/Hr)	0.36	2.63	1.28	1.28	0.95	0.84	1.03
Economic Cost							
Daily Cost (US$/Day)	0.26	3.51	9.49	15.26	5.65	10.03	6.37
Hourly Cost (US$/Hr)	0.31	1.28	1.14	1.14	0.85	0.75	0.48

Source: JICA Study Team

8) Crew Cost, Overhead Cost and Other Costs

6.12 The estimated crew cost, overhead cost and other costs by type of vehicle are shown in Table 6.1.13. Driver's wages are investigated through interviews with transport companies. Also, driver's wages in 2030 are estimated using the ratio of the estimated per-capita GDP in 2030 and per-capita GDP in 2010. Similarly, other related costs are also re-estimated for 2030 (see Table 6.1.14).

Table 6.1.13 Crew Cost, Overhead Cost and Other Costs by Type of Vehicle (2010)

	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Monthly							
Driver's Wage (US$/month) 1)	0	0	170	220	200	270	300
Overhead (%)	0	0	20	30	20	20	20
Annual Crew Cost							
Financial (US$/year)	0	0	2,040	2,640	2,400	3,240	3,600
Economic (US$/year)	0	0	2,040	2,640	2,400	3,240	3,600
Annual Overhead and Other Costs2)							
Financial (US$/year)	3	26	517	978	525	725	822
Economic (US$/year)	3	18	507	966	514	714	811
Daily Total Cost							
Financial (US$/day)	0.01	0.09	8.52	12.06	9.75	13.22	14.74
Economic (US$/day)	0.01	0.06	8.49	12.02	9.71	13.18	14.70
Hourly Total Cost							
Financial (US$/hour)	0.01	0.03	1.02	0.90	1.46	0.99	1.11
Economic (US$/hour)	0.01	0.02	1.02	0.90	1.46	0.99	1.10

Source: JICA Study Team

Note: 1) Driver's wage is assumed based on interviews with transport companies
2) Other costs include vehicle inspection and insurance

Table 6.1.14 Crew Cost, Overhead Cost and Other Costs by Type of Vehicle (2030)

	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Monthly							
Driver's Wage (US$/month)	0	0	170	220	200	270	300
Overhead (%)	0	0	20	30	20	20	20
Annual Crew Cost							
Financial (US$/year)	0	0	5,155	6,671	6,065	8,187	9,097
Economic (US$/year)	0	0	5,155	6,671	6,065	8,187	9,097
Annual Overhead and Other Costs							
Financial (US$/year)	3	26	1,140	2,187	1,258	1,715	1,922
Economic (US$/year)	3	18	1,130	2,175	1,247	1,704	1,911
Daily Total Cost							
Financial (US$/day)	0.01	0.09	20.98	29.53	24.41	33.01	36.73
Economic (US$/day)	0.01	0.06	20.95	29.49	24.37	32.97	36.69
Hourly Total Cost							
Financial (US$/hour)	0.01	0.03	2.52	2.21	3.66	2.48	2.75
Economic (US$/hour)	0.01	0.02	2.51	2.21	3.66	2.47	2.75

Source: JICA Study Team
Note: 1) Driver's wage is assumed based on interviews with transport companies

9) Total Vehicle Operation Cost by Type of Vehicle

6.13 Total VOC for vehicle operation is estimated by summing the estimated costs mentioned above. VOC subject to use, which includes fuel cost, oil cost, tire cost, repair cost and depreciation cost, is shown in Table 6.1.15. VOC subject to time, which includes depreciation cost, capital opportunity cost, and crew and overhead cost is shown in Table 6.1.16. Total VOC is shown in Table 6.1.17.

Table 6.1.15 VOC Subject to Use (US$/1,000 km)

	Speed (km/hr)	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
	5	89.3	86.5	275.2	265.0	1010.9	917.4	458.7
	10	62.4	59.8	199.8	192.3	676.0	617.0	311.7
	20	47.4	45.0	155.5	149.3	501.8	460.3	235.3
	30	42.1	36.9	139.0	132.7	399.7	416.6	201.4
	40	38.9	36.6	130.1	123.4	350.8	384.2	192.9
	50	38.2	35.8	125.3	118.8	333.4	408.5	190.2
	60	39.9	37.4	131.7	124.6	327.6	461.8	195.3
	70	42.5	39.8	140.5	133.1	335.4	531.5	201.1
	80	45.9	42.9	151.2	143.1	354.0	607.7	216.8
	90	50.5	47.2	165.3	156.0	391.7	672.7	237.1
Economic Cost	5	77.7	75.2	211.0	202.8	877.7	796.9	399.8
	10	54.2	51.9	147.9	141.9	587.7	536.7	272.1
	20	41.2	39.1	112.6	107.7	436.5	400.7	205.6
	30	36.6	32.1	99.9	95.0	347.9	362.7	176.1
	40	33.8	31.8	93.4	88.1	305.3	334.5	168.7
	50	33.2	31.2	90.8	85.4	290.3	355.5	166.4
	60	34.7	32.5	94.8	89.1	285.4	401.8	170.8
	70	37.0	34.6	100.8	94.8	292.3	462.1	175.9
	80	40.0	37.3	108.6	102.1	308.7	528.3	189.6
	90	44.0	41.0	119.1	111.6	341.6	584.9	207.3

Source: JICA Study Team

Table 6.1.16 VOC Subject to Time (US$/Hour)

	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Financial Cost							
Depreciation	0.155	0.055	0.938	0.748	0.337	0.305	0.226
Capital Opportunity Cost	0.364	0.361	0.140	2.626	1.280	1.275	1.282
Crew and Overhead Cost	0.012	0.012	4.781	0.031	5.849	2.518	2.215
Total	0.527	4.976	3.595	7.877	4.130	3.802	4.837
Economic Cost							
Depreciation	0.134	0.048	0.456	0.366	0.300	0.272	0.202
Capital Opportunity Cost	0.316	0.313	0.121	1.277	0.626	1.138	1.144
Crew and Overhead Cost	0.012	0.012	4.781	0.022	5.844	2.514	2.212
Total	0.460	4.950	1.754	6.836	3.953	3.628	4.705

Source: JICA Study Team

Table 6.1.17 Total VOC (US$/1000 km)

	Speed (km/hr)	Motor-cycle	Car	Minibus	Standard Bus	Small Truck	Big Truck	Container Truck
Financial Cost	5	194.8	1081.7	994.2	1840.4	1836.8	1677.8	1426.0
	10	115.1	557.4	559.3	980.0	1089.0	997.2	795.3
	20	73.8	293.8	335.2	543.2	708.3	650.3	477.1
	30	59.7	202.7	258.8	395.3	537.4	543.3	362.6
	40	52.0	161.0	220.0	320.3	454.0	479.3	313.9
	50	48.7	135.4	197.2	276.3	416.0	484.5	287.0
	60	48.7	120.3	191.6	255.9	396.4	525.2	275.9
	70	50.0	110.9	191.9	245.6	394.4	585.8	270.2
	80	52.5	105.1	196.2	241.5	405.6	655.2	277.2
	90	56.4	102.5	205.2	243.5	437.6	714.9	290.8
Economic Cost	5	169.6	1065.3	561.9	1570.0	1668.3	1522.5	1340.8
	10	100.2	547.0	323.4	825.5	983.0	899.5	742.5
	20	64.2	286.7	200.3	449.5	634.2	582.2	440.8
	30	52.0	197.1	158.4	322.9	479.7	483.6	332.9
	40	45.3	155.6	137.2	259.0	404.1	425.2	286.3
	50	42.4	130.2	125.8	222.1	369.3	428.1	260.5
	60	42.4	115.0	124.1	203.1	351.3	462.2	249.2
	70	43.6	105.3	125.9	192.5	348.8	513.9	243.1
	80	45.7	99.2	130.6	187.5	358.1	573.6	248.4
	90	49.1	96.0	138.6	187.6	385.5	625.2	259.6

Source: JICA Study Team

6.2 Railway Operation Cost

1) Introduction

6.14 Two types of railway operating cost were surveyed for the purpose of economic and financial analysis. One is the operating cost obtained from current operation of VR and the other is operating cost for inter-city electrified railway, which estimated from the actual costs of railway operations in Japan.

2) Current Operation Costs of Vietnam Railways (VR)

6.15 Although it was intended to estimate the costs of the current railway operation of the Transport Division of VR (i.e., excluding capital and maintenance costs for infrastructure), similar to the calculation of VOCs of road vehicles, it is difficult to determine accurately the operating costs of VR separately for passenger and freight due to unavailability of detailed data. Therefore, it was assumed that all expenses could be allocated to passenger and freight in proportion to revenues from these two sources (see Table 6.2.1). In addition, the unit operating cost for 2030 is also estimated taking into consideration the increase in salaries of the railway workforce resulting from economic growth. The results are shown in Table 6.2.2 and Table 6.2.3.

Table 6.2.1 VR Income and Expenditure, 2010

Unit: billion VND

Item	2010
1. Income	3,096
1) Passenger Income [1)]	1,861
2) Freight Income [1)]	1,163
3) Baggage Income	50
4) Other Income [2)]	22
2. Expense	3,094
1) Salary	751
2) Social Insurance	120
3) Materials [3)]	269
4) Fuel	839
5) Electricity	
6) Basic Depreciation	418
7) Large Repair [4)]	40
8) Others	
9) Collection on Capital	
10) Other Expenses [5)]	657
a. Infrastructure Tax [6)]	246
b. Revenue Tax	

Source: Vietnam Railways

Notes:

1) Fare system of passenger and freight are determined by railway law and MOT's regulation. However, tariff formulation has been revised by the MOF and MOT, in case of special market mechanism.
2) New policy for renting store, ground, etc.
3) New locomotive and rolling stock replace aged ones, therefore, there are savings in cost of parts.
4) Locomotive, rolling stock and others.
5) Include transactions, meeting, land tax, etc.
6) For usage of infrastructure (10% of transport review).

Table 6.2.2 Actual and Estimated Personnel Cost, 2010 and 2030

	2010	2030
Personnel Cost per Staff (Bil. VND)	871	
No of Staff	39,590	
Ave Personnel Cost/staff-year (mil VND)	22	
Exchange Rate (ave 2006)	21,000	
Ave Personnel Cost/staff-year (USD)	1,048	2,910 (Estimated ratio of GDP per Capital (2030/2010): 2.5)

Source: Vietnam Railways and JICA Study Team

Table 6.2.3 VR Operating Cost, 2010 and 2030

	Expenditure (VND billion) (2010)			Transport Quantity		Unit Operating Cost (2010)		Unit Operating Cost (2030)[1)]	
	Passenger	Freight	Total	pass-km (million)	Ton-km (million)	USD per 1000 pass-km	USD per 1000 ton-km	USD per 1000 pass-km	USD per 1000 ton-km
Including infrastructure charge	1,904.1	1,189.9	3,094.0	4,302.4	3,681.8	21.1	15.4	30.1	22.0
Excluding infrastructure and rolling stock charge	1,587.1	991.9	2,579.0			17.6	12.8	26.6	19.4

Source: JICA Study Team estimates based on VR statistics
Note: 1) Estimated based on Estimated GDP per Capita in 2030

3) Operation Cost for Electrified Railways

(1) O&M Cost (Excluding Personnel Cost and Taxes)

6.16 Due to unavailability of data, it is difficult to precisely estimate the O&M costs. To overcome this problem, some railway statistics were collected from Japanese sources, as shown in Table 6.2.4.

Table 6.2.4 Statistics of O&M Cost (Excluding Personnel Cost and Taxes) of Selected Private Railway Companies of Japan

Railway Company	Variable Cost (JPY/pass-km)	Fixed Cost (JPY million/route-km/year)	Route-km (km)	Transport Density (000 pass/route-km/day)
Odakyu	1.18	154	120.5	245.4
Keihin Kyukou	1.59	162	87.0	197.6
Tsukuba Express	1.10	57	58.3	73.9
Touyou Kousoku	1.63	71	16.2	71.2
Aichi Kanjou	3.67	22	45.3	8.5
Hokuetsu Kyukou	2.25	24	59.5	8.1
Abukuma Kyukou	4.49	7	54.9	1.8

Source: Ministry of Land, Infrastructure and Transport, Japan

6.17 Using the above data, regression analysis was conducted for both fixed and variable O&M cost. The results are presented in Table 6.2.5 and Table 6.2.6, and illustrated in Figure 6.2.1. For both analyses, transport density is the explanatory variable. Note that the values are all expressed in Japanese Yen (JPY).

Table 6.2.5 Estimate of Fixed O&M Cost (Excluding Personnel Cost and Taxes)

Railway Company	Transport Density (000 pass/route-km/day) X	Fixed Cost (JPY million/route-m/year) Y	Fixed Cost (JPY million/route-km/year) Y calculated
Odakyu	245.4	154	172
Keihin Kyukou	197.6	162	141
Tsukuba Express	73.9	57	63
Touyou Kousoku	71.2	71	61
Aichi Kanjou	8.5	22	21
Hokuetsu Kyukou	8.1	24	21
Abukuma Kyukou	1.8	7	17
Note: Y=aX+b	a=0.634	b=16.055	(R=0.979)

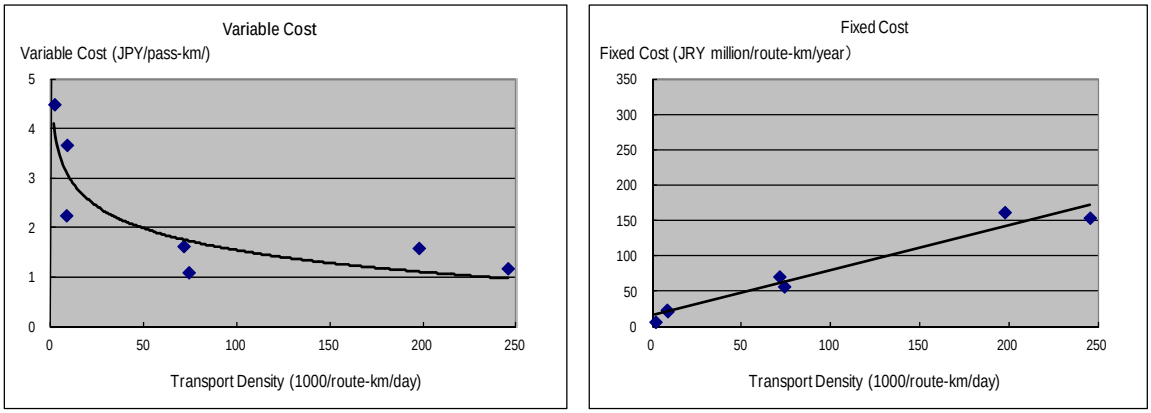
Source: Ministry of Land, Infrastructure and Transport, Japan

Table 6.2.6 Estimate of Variable O&M Cost (Excluding Personnel Cost and Taxes)

Railway Company	Transport Density (000 pass/route-km/day) X (logarithmic)	Variable Cost (JPY/pass-km) Y	Variable Cost (JPY/pass-km) Y calculated
Odakyu	5.50	1.18	0.97
Keihin Kyukou	5.29	1.59	1.11
Tsukuba Express	4.30	1.10	1.73
Touyou Kousoku	4.27	1.63	1.76
Aichi Kanjou	2.14	3.67	3.11
Hokuetsu Kyukou	2.09	2.25	3.13
Abukuma Kyukou	0.56	4.49	4.10
Note: Y=aX+b	a=-0.633	b=4.457	(R=0.901)

Source: Ministry of Land, Infrastructure and Transport, Japan

Figure 6.2.1 Estimated of O&M Cost (Excluding Personnel Cost and Taxes)



Source: Ministry of Land, Infrastructure and Transport, Japan

(2) Personnel Cost

6.18 In order to estimate the personnel cost for electrified railways, Japan Railways' (JR's) transport performance in terms of passenger-km per employee was first reviewed. It was 7,070 Transport Units per employee. Transport Unit is the sum of pass-km and ton-km. In Vietnam, however, this performance is hardly expected due to the difference in operational scale and quality of assets. Therefore, given a transport volume in terms of passenger-km (PKT), the personnel cost is calculated as follows:

Total no. of employees: NE = PKT/(7070/2) - half performance of JR
Total personnel cost: PC = NE x 2,910 (USD)
(refer Table 6.2.2 for estimation of unit personnel cost)

6.3 Air Transport Operation Cost

1) Operation Cost Established by ICAO

6.19 The data for actual operation cost of air transport in Vietnam is not available for the study. On the other hand, the International Civil Aviation Organization (ICAO) publishes the estimated world average air transport operation cost, which is 9.3 cents/passenger-km in 2007 (the figures range from 6.9 cents/passenger-km to 14.2 cents/passenger-km for individual route groups). Assuming a relatively lower cost for air operation than the average, say, 80% of world average, the cost of 7.4 cents/passenger-km is applied.

7 PASSENGER TRANSPORT FARE

7.1 Bus Transportation Tariff

7.1 At present, central government does not set official passenger fare for inter-city bus services; it is the provinces that set the "guideline" in determining inter-city bus fares. In case of Hanoi, interprovincial bus operators have the right to launch their own fares based on their own calculation considering the market condition. The table below shows interprovincial bus fares to/from Hanoi obtained through interviews with bus operators in November 2011. As is apparent, the fare rate (VND/km) largely fluctuates by route due to service quality, road condition and possibly market condition.

Table 7.1.1 Inter-Provincial Bus Fare

Terminal	To/from	Fare (vnd)	Distance (km)	Fare/km (vnd)	Travel time (h:m)
My Dinh	Tuyen Quang	80,000	165	485	4
My Dinh	Yen Bai	90,000	168	536	4
My Dinh	Phu Tho	63,000	120	525	3
My Dinh	Lai Chau	300,000	504	595	12
My Dinh	Ha Giang	180,000	320	563	8
My Dinh	Cao Bang	190,000	285	667	7
My Dinh	Cam Pha	120,000	200	600	5
My Dinh	Mong cai	230,000	380	605	10
My Dinh	Lang Son	90,000	167	539	4
My Dinh	Bac Kan	70,000	160	438	4
My Dinh	Thai Binh	75,000	120	625	3
My Dinh	Hoa Binh	40,000	100	400	3
My Dinh	Lao Cai	230,000	354	650	8:50
My Dinh	Phuc Yen	30,000	42	714	1
My Dinh	Thanh Hoa	85,000	162	525	4
My Dinh	Ninh Binh	60,000	95	632	2:30
My Dinh	Viet Tri	45,000	87	517	2
My Dinh	Thai Nguyen	45,000	85	529	2
My Dinh	Bai Chay	90,000	167	539	4
My Dinh	Dien Bien	350,000	500	700	12
Giap Bat	Thanh Hoa	80,000	160	500	4
Giap Bat	Ninh Binh	60,000	90	667	3
Giap Bat	Gia Lai	720,000	1189	606	32
Giap Bat	Da Nang	270,000	778	347	14
Giap Bat	Buon Me Thuot	650,000	1400	464	35
Giap Bat	Dac Nong	750,000	1500	500	38
Giap Bat	Tp. HCM	920,000	1754	525	34
Giap Bat	KonTum	700,000	1237	566	34
Giap Bat	Da Lat	750,000	1495	502	36
Giap Bat	Nam Dinh	60,000	90	667	3:15
Giap Bat	Thai Binh	70,000	120	583	3
Giap Bat	Ha Nam	40,000	60	667	2
Giap Bat	Thai Nguyen	55,000	85	647	2:30
Giap Bat	Phu Tho	65,000	120	542	3
Giap Bat	Dien Bien	350,000	500	700	12

Terminal	To/from	Fare (vnd)	Distance (km)	Fare/km (vnd)	Travel time (h:m)
Giap Bat	Lai Chau	320,000	504	635	12
Giap Bat	Son La	190,000	310	613	7:30
Giap Bat	Tuyen Quang	80,000	165	485	4:30
Giap Bat	Yen Bai	80,000	180	444	4:30
Giap Bat	Cao Bang	190,000	285	667	7
Giap Bat	Ha Giang	180,000	320	563	8
Giap Bat	Lang Son	80,000	150	533	4:15
Giap Bat	Bac Giang	45,000	70	643	2

Source: JICA Study Team (Data collection in November, 2011)

7.2 User Charges and Road Transport Fees

7.2 Road users have to pay toll fees for use of certain roads. These charges are determined based on type of vehicle and transport distance, shown in the following tables (see Table 7.2.1 and Table 7.2.2):

Table 7.2.1 Toll Fees for Roads Invested from State Budget

(Enforcement based on Circular 90/2004/TT-BTC dated 07/9/2004 of MOF)

No	Vehicle type	Toll Fee (VND)		
		One-time ticket	Monthly Ticket	Quarterly Ticket
1		1,000	10,000	-
2		4,000	120,000	300,000
3	Car < 12 seats, truck < 2 T and buses	10,000	300,000	800,000
4	Car from 12-30 seats; Truck from 2T-under 4T	15,000	450,000	1,200,000
5	Car > 31 seats and truck from 4T-under 10T	22,000	660,000	1,800,000
6	Truck from 10T-under 18T and 20' container truck	40,000	1,200,000	3,200,000
7	Truck >18 T and 40' container truck	80,000	2,400,000	6,500,000

Note: Distance between 2 toll plazas is at least 70km.

Table 7.2.2 Toll Fee of NH5 and 2 Special BOT Projects

Vehicle Type	National Road No5 (Circular 90/2004/TT-BTC)		YenLenh Bridge (BOT) (Decision 46/2004/QD-BTC)		Ansuong-Anlac (BOT) (Decision 78/2004/QD-BTC)	
	Monthly ticket (VND/Month)	Quarterly ticket (VND/Quarter)	One-time ticket (VND/time)	Monthly ticket (VND/month)	One-time ticket (VND/time)	Monthly ticket (VND/month)
Motorcycle	20,000		1,000	10,000	5,000	150,000
Lambro, tractor, car < 7 seats	240,000	600,000	6,000	180,000		
Car < 12 seats, truck < 2 T and Public car and bus	600,000	1,600,000	15,000	450,000	10,000	300,000
Car 12-30 seats; truck from 2 T-under 4 T	900,000	2,400,000	23,000	700,000	15,000	450,000
Car > 31 seats; truck from 4 T-under 10 T	1,320,000	3,600,000	33,000	1,000,000	25,000	750,000
Truck 10 T-under 18 T; 20' container truck	2,400,000	6,400,000	60,000	1,800,000	30,000	900,000
Truck >18 T; 40' container truck	4,800,000	13,000,000	120,000	3,600,000	40,000	1,200,000

Note: Toll fees charged to road vehicles are based on the following: (1) distance between 2 toll plazas set at least 70km, (2) type of vehicle (smaller vehicles such as cars which do not cause much damage to the roads are charged lower, while heavy vehicles such as trucks (carrying 4-10 tons and more) are charged double), and (3) toll fee to ensure that BOT investment be fully recovered during concession period.

7.3 Railway Passenger Fare

7.3 Vietnam Railway (VR) can set the passenger tariff by themselves. There is no fare setting formula provided but the calculation of rail fare considers the type of train, type of seat and air conditioner. Total fare for a specific route is equivalent to the sum of unit fare per km, according to the type of train and seat, multiplied by travel distance plus an insurance premium. It is noted that fare per pass-km decreases gradually as the travel distance increases. Student fares are discounted – or are currently subsidized by the government. Table 7.3.1 shows the passenger fare for trip from Hanoi in 2011.

Table 7.3.1 Railway Passenger Fare from Hanoi (SE1), October 2011

Station	Km	Hard Seat		Soft Seat		Hard Sleeper						Soft Sleeper			
		Non-A/C (NC)	A/C (NCL)	Non-A/C (NM)	A/C (NML)	Level 1 Non-A/C (BnT1)	Level 2 Non-A/C (BnT2)	Level 3 Non-A/C (BnT3)	Level 1 A/C (BnLT1)	Level 2 A/C (BnLT2)	Level 3 A/C (BnLT3)	Level 1 Non-A/C (AnT1)	Level 2 Non-A/C (AnT2)	Level 1 A/C (AnLT1)	Level 2 A/C (AnLT2)
Hanoi	0														
Phu ly	56	20	32	25	35	40	38	33	50	50	40	43	42	54	53
Nam Dinh	87	33	50	40	54	63	60	50	78	75	64	66	64	83	82
Ninh Binh	115	43	65	50	70	84	78	66	103	100	84	87	85	110	108
Thanh Hoa	175	65	98	77	107	127	118	100	157	150	128	132	130	166	164
Vinh	319	117	178	140	194	230	214	183	285	273	232	240	234	300	298
Dong Hoi	522	202	308	240	335	398	370	315	493	470	400	413	405	520	515
Dong Ha	622	240	367	287	400	474	440	375	587	562	477	492	482	620	613
Hue	688	266	406	317	442	524	488	415	708	677	574	544	534	748	740
Da Nang	791	306	466	364	508	603	560	477	784	750	637	626	613	828	820
Tam Ky	865	323	492	384	535	635	590	503	787	753	640	660	647	830	822
Quang Ngai	928	343	522	408	570	675	628	535	836	800	680	700	687	883	873
Dieu Tri	1,096	405	617	482	672	797	740	630	988	945	802	828	810	1,043	1,030
Tuy Hoa	1,198	443	674	527	734	870	810	690	1,080	1,030	877	905	887	1,140	1,127
Nha Trang	1,315	504	768	600	836	992	923	786	1,352	1,294	1,100	1,030	1,010	1,482	1,412
Thap Cham	1,408	554	845	660	920	1,090	1,015	864	1,447	1,385	1,175	1,133	1,110	1,582	1,510
Muong Man	1,551	573	873	682	950	1,128	1,050	893	1,453	1,390	1,180	1,170	1,148	1,535	1,518
Bien Hoa	1,698	600	915	715	996	1,182	1,100	936	1,480	1,416	1,202	1,228	1,204	1,563	1,545
Sai Gon	1,726	607	925	723	1,008	1,196	1,112	947	1,482	1,418	1,203	1,240	1,217	1,565	1,547
Fare (000 VND/km)		352	536	419	584	693	644	549	859	821	697	718	705	907	896

Source: Vietnam Railways, October 2011
Note: A/C means a train with air conditioner and Non-A/C means a train without air conditioner.

7.4 Air Transport Passenger Fare

7.4 Table 7.4.1 presents the current airfare of domecti flights of Vietnam Airlines (flag carrier) and major two low-cost carriers in Vietnam. For same major routes , low-cost carriers offer much cheaper prices than Viietnam Airlines; for example, the regular price of economcy class for Hanoi – HCMC route offered by Jet Star is 1,309 thousand VND while the price of Vietnam Airlines for the same route is 2,227 thousand VND although it should be noted that the share of Vietnam Airlines in air transport industry is still neary 80%.

Table 7.4.1 Airfare on Domestic Routes (Economy Class)

Route		Length (km)	Class	Fare (VND 000)1), 2), 3)		
				Vietnam Airlines	Jet Star	Air Mekong
Hanoi	Buon Ma Thuot	1,001	Y	1,850	N/A	1,385
			Y	2,227	N/A	2,152
Hanoi	Danang	633	Y	1,200	490	N/A
			Y	1,481	1,300	N/A
Hanoi	Dien Bien Phu	314	Y	900	N/A	N/A
			Y	1,100	N/A	N/A
Hanoi	Hue	575	Y	1,200	N/A	N/A
			Y	1,481	N/A	N/A
Hanoi	Da Lat	1,107	Y	1,850	N/A	1,385
			Y	2,227	N/A	2,152
Hanoi	Nha Trang	1,075	Y	1,850	N/A	N/A
			Y	2,227	N/A	N/A
Hanoi	Tp.HCM	1,276	Y	1,850	805	1,385
			Y	2,227	1,309	2,152
HCMC	Ban Me Thuot	275	Y	900	N/A	650
			Y	1,100	N/A	1,035
HCMC	Da Lat	212	Y	900	N/A	653
			Y	1,100	N/A	1,035
HCMC	Danang	643	Y	1,200	583	N/A
			Y	1,481	583	N/A
HCMC	Hai Phong	1,253	Y	1,650	1,050	N/A
			Y	1,850	1,850	N/A
HCMC	Vinh	1,057	Y	1,850	950	1,385
			Y	2,227	1,650	2,152
HCMC	Hue	709	Y	1,200	490	N/A
			Y	1,481	770	N/A
HCMC	Nha Trang	346	Y	900	N/A	N/A
			Y	1,100	N/A	N/A
HCMC	Phu Quoc	319	Y	900	N/A	650
			Y	1,100	N/A	1,035
HCMC	Pleiku	423	Y	900	N/A	750
			Y	1,100	N/A	1,035
HCMC	Quy Nhon	451	Y	900	N/A	650
			Y	1,100	N/A	1,035
HCMC	Rach gia	192	Y	700	N/A	N/A
			Y	863	N/A	N/A
HCMC	Tuy Hoa	432	Y	800	N/A	N/A
			Y	1,100	N/A	N/A
HCMC	Con Dao	232	Y	800	N/A	850
			Y	1,000	N/A	1,035
HCMC	Ca Mau	195	Y	1,000	N/A	N/A
			Y	1,100	N/A	N/A
HCMC	Buon Ma Thuot	368	Y	900	N/A	N/A
			Y	1,100	N/A	N/A
Danang	Nha Trang	442	Y	1,200	N/A	N/A
			Y	1,481	N/A	N/A
Danang	Pleiku	220	Y	900	N/A	N/A
			Y	1,100	N/A	N/A
Rach Gia	Phu Quoc	127	Y	700	N/A	N/A
			Y	863	N/A	N/A

Source: Websites of Vietnam Airlines, Jet Star and Air Mekong
Note: 1) N/A: Not available (No flight), 2) Price in October, 2011, 3) Upper airfare shows promotional price due to advanced reservation.

8 CARGO TRANSPORT TARIFF

8.1 Summary of Cargo Transport Cost

8.1 For cargo transport, the costs for haulage, loading/unloading and other related charges are considered as operation cost. Table 8.1.1 shows the summary of cargo transport cost.

Table 8.1.1 Summary of Cargo Transport Cost

	Truck		Haulage (000VND/ton-km)					Loading/Unloading and Other Charges (000VND/ton)				
	Load Factor	VOC	Truck	Rail	Inland waterway	Coastal shipping	Air	Truck	Rail[1)]	Inland waterway[1)]	Coastal shipping [1)]	Air [1)]
1. Paddy and food crop	5.5	11.0	2.01	0.28	0.33	0.16	13.7	28.8	46.6	55.8	80.5	258.8
2. Sugar/sugarcane	11.1	11.0	0.99	0.31	0.33	0.16	13.7	28.8	45.6	55.8	80.5	258.8
3. Wood/forestry	2.3	11.0	4.79	0.28	0.33	0.21	13.7	28.8	45.6	55.8	80.5	258.8
4. Steel	9.3	11.0	1.19	0.28	0.33	0.22	13.7	28.8	45.6	55.8	80.5	258.8
5. Construction material	8.8	11.0	1.25	0.28	0.33	0.21	13.7	28.8	45.6	55.8	80.5	258.8
6. Cement	11.7	11.0	0.94	0.28	0.33	0.25	13.7	28.8	46.6	55.8	80.5	258.8
7. Fertilizer	8.7	11.0	1.27	0.28	0.33	0.16	13.7	28.8	45.6	55.8	80.5	258.8
8. Coal	7.5	11.0	1.47	0.27	0.33	0.21	13.7	28.8	45.6	55.8	80.5	258.8
9. Petroleum product	8.3	11.0	1.33	0.28	0.33	0.25	13.7	28.8	46.6	55.8	80.5	258.8
10. Industrial crop	6.3	11.0	1.75	0.28	0.33	0.16	13.7	28.8	45.6	55.8	80.5	258.8
11. Manufactured goods	5.6	11.0	1.97	0.31	0.33	0.37	13.7	28.8	45.6	55.8	80.5	228.8
12. Fishery product	3.3	11.0	3.34	0.34	0.33	0.37	13.7	28.8	45.6	55.8	80.5	238.8
13. Animal meat	4.8	11.0	2.30	0.31	0.33	0.37	13.7	28.8	45.6	55.8	80.5	238.8

Source: JICA Study Team
Note: 1) Transfer cost to/from truck is included.

8.2 Truck Cost

1) Haulage Cost

8.2 Data on haulage cost by truck was collected through interviews with truck operators. Depending on origin and destination, and on volume and type of cargo, the prices vary. The range of prices obtained from the interviews is shown in Table 8.2.1. From this data, the truck haulage cost is roughly calculated as around 0.3 ~ 2.0 VND/ton-km.

Table 8.2.1 Cargo Haulage Cost

Location	Hanoi		Hai Phong		HCMC		Danang		Quy Nhon	
	20 ton	40ton	20 ton	40ton	20 ton	40ton	20 ton	40ton	20 ton	40ton
Hanoi	1.8-2.0	2.3-2.6	1.7-2.0	2.4-2.7	14-16	17-20	10-13	12-16	13-15	14-17
HCMC	14-16	17-20	13-15	17-20	1.7-1.9	2.3-2.6	12-14	16-19	8-10	12-15
An Giang					6.1-8.6	9.4-12.2				

Source: Based on the interview with truck operators

8.3 Besides the obtained data mentioned above, for this study, the haulage cost by truck is calculated based on vehicle operation cost estimated in Chapter 6 (the cost for velocity of 30km/h by big truck is applied here) and load factor for each type of cargo, which is obtained by traffic survey. Costs for most cargo type is estimated below around 2.0 VND/ton-km excluding wood/forestry, fishery product and animal meat.

2) Loading/Unloading Costs

8.4 Loading/Unloading charge is assumed as 27,500 VND/ton (including VAT) based on interview with several truck companies.

8.3 Railway Cost

1) Haulage Cost

8.5 Based on the Decision No.168/QD-CTH dated 20 May 2011 of Railway Freight Transport Company, the cargo tariff of VR was amended. The basic cargo tariff of VR is calculated on the basis of full wagon load. It includes VAT, and it also depends on transport distance and transport charge level (determined by cargo type), as shown in Table 8.3.1. The tariff for the distance of 151 km – 500 km is selected as representative tariff for analysis in the Study. For calculating economic cost, 15% of tax (10% VAT and 5 % for other tax) is assumed.

Table 8.3.1 Railway Freight Tariff

Level	≤ 30km (VND/Ton)	31km -150km (VND/Ton.km)	151km - 500km (VND/Ton.Km)	501km-900km (VND/Ton.Km)	901km -1.300km (VND/Ton.Km)	≥1.301 km (VND/Ton.Km)
1	27.483	470	256	193	189	185
2	28.929	495	269	203	199	195
3	30.452	521	283	214	209	205
4	33.638	574	313	237	229	227
5	36.973	615	336	255	247	243
6	42.090	706	384	290	282	278

Source: Decision No.168/QD-CTH dated 20 May 2011 of Railway Freight Transport Company
Note: These tariffs have been applied since 01 June 2011

- Level 1: Container cover, free stone, macadam, gravel, sand, soil, iodine salt, common salt;
- Level 2: Peat, coal dust, fat coal, cinder, brick, tile, shell, sugarcane, wood, snail shell, oil cake, and soybean cake, salt for industry, waste and crude apatite;
- Level 3: Machine, metal, packed cement, clinker, vegetable, pastel;
- Level 4: Refined apatite, chemical, rubber, rubber product, charcoal, kinds of glass, ashlars paving stone, wooden frame in full, plywood, wood products, seed, manufactured aquatic products, flavor, peanut;
- Level 5: Kinds of wine, fish sauces (transported by specialized car), sport gun and ammunition, coffee, chocolate, traditional medicines, fresh aquatics, chemical (transported by specialized car);
- Level 6: Valuable and rare forest products, pictures, art statue, currencies, antique, pets

2) Loading/Unloading Costs

8.6 The loading/unloading costs for railway are assumed based on the actual amount in Danang Railway station (Table 8.3.2).

Table 8.3.2 Cargo Handling Charges at Danang Railway Station, 2010

No.	Commodity	Unit	Rate (VND/ton)
1	Beer, beverage (bottle-can)	ton	12,500
2	Mineral water	ton	12,500
3	Plastic powder, plastic grains	ton	12,500
4	Fish/shrimp bran	ton	12,500
5	Ore, stone, clinker, sand	ton	12,500
6	Wheat flour, tapioca	ton	12,500
7	Nitrogenous fertilizer, phosphate	ton	12,500
8	Glutamate, seasoning powder	ton	12,500
9	Sliced manioc	ton	14,500
10	Manioc roots	ton	16,000
11	Unrefined salt, rock salt	ton	12,500
12	Chemical salt - soda	ton	14,500
13	Caustic soda	ton	24,000
14	Cement	ton	13,500
15	Powdered lime, quicklime blocks	ton	14,500
16	Bean, sesame, rice	ton	13,500
17	General cargo (bulky)	wagon	450,000
18	Coffee, cosmetics	wagon	300,000

No.	Commodity	Unit	Rate (VND/ton)
19	Plastic table/chair/chest of drawer	wagon	300,000
20	Empty bottle	wagon	300,000
21	Noodle, rice noodle, vermicelli	wagon	300,000
22	Grain cotton	wagon	300,000
23	Bale cotton	wagon	550,000
24	Sawn timber	cubic meter	60,000

Source: Danang Railway Station
Note: Excluding VAT

8.4 Coastal Shipping

8.7 The following Table 8.4.1 shows the costs of shipping obtained from four shipping companies. Based on the data, the haulage cost per ton-km and handling cost per ton are roughly estimated to be 110-832 VND/ton-km (different by route, item and packaging) and VND 52,000/ton (per place).

Table 8.4.1 Railway Freight Tariff

	Shipping Co.	Route (O-D)	Type of Cargo								
			Bulk (VND/ton)				Container (VND/container)				
			Clinker	Nitro fertilizer	Cement	Steel	Laden		Empty		Term
							20ft	40ft	20ft	40ft	
(i) Haulage (excl. (ii)	VINALINES	Hai Phong-Sai Gon					6,500,000	7,500,000			CY/CY
		Sai Gon-Hai Phong					7,500,000	15,500,000			CY/CY
		Hai Phong-Da Nang					4,700,000	6,800,000			CY/CY
		Da Nang-Hai Phong					7-8,500,000	12,000,000			CY/CY
		Sai Gon-Da Nang					6,200,000	11,000,000			CY /CY
	Vinafreight	Sai Gon-Hai Phong					6,700,000				CY/CY
	T.H.I Group VN	Hai Phong-Sai Gon	230,000				6,500,000	7,500,000			CY/CY
		Sai Gon-Hai phong	230,000				6,200,000	7,200,000			CY/CY
		Hai Phong-Da Nang	210,000								
		Da Nang-Hai Phong	210,000								
		Sai Gon-Da Nang									
		Sai Gon-Hai Phong									
(ii) Loading/unloading and other charges			Loading/unloading: at 1 location: VND45,000 /ton				VND55,000 – 200,000/set depending on each company				
(i) Haulage	Vien Phat On-land & Waterway Transport and Trade Investment JSC.	Hai Phong-Sai Gon	230,000				5,500,000	7,500,000			CY/CY
		Sai Gon-Hai Phong		170,000			5,200,000	7,200,000			CY/CY
		Hai Phong-Da Nang			185,000						
		Da Nang-Sai Gon				180,000					
		Sai Gon-Da Nang		170,000							
(ii) Loading/unloading and other charges			Loading/unloading: at 1 location: VND35,000/ton				VND55,000 – 200,000/set depending on each company				

Source: Data collected from shipping companies

8.5 Inland Waterway Cost

8.8 Table 8.5.1 shows the tariff for inland waterway cargo transport obtained by interviews with inland waterway transport companies. Based on the data, the average haulage and loading/unloading charges are calculated as 334 VND/ton-km and 27 VND/ton per location, respectively.

Table 8.5.1 Inland Waterway Freight Tariff

No.	Name of Transport Co.	Type of Cargo	Transport Route	Charge (VND/ton)
Haulage	Vietnam Inland Waterway Transport Corporation	Clinker	Ninh Binh-Hon Gai	70-75,000
		Coal	Ninh Binh-Hon Gai	107,000
	Hai Phong Traco	Gypsum, clinker	Hon Gai-Bac Giang	68,000
			Hon Gai-Thai Nguyen	70,000
Loading/unloading and other charges			- Loading/unloading (ship crane): VND 12-15,000/ton	
			- Loading/unloading (shore crane): VND 35,000/ton	
			- Cargo Examination: VND 2,000/ton	

Source: Data collected from inland waterway transport companies

8.6 Air Transport Cost

1) Haulage Cost

8.9 Table 8.6.1 shows the haulage cost for domestic cargo. Based on the data in the table, the average haulage cost was calculated (the cost for Type N was applied). The estimated economic cost is VND 11.9/kg-km, and financial cost is VND 13.7/kg-km assuming 15% of tax (10% VAT and others).

Table 8.6.1 Domestic Air Freight Cost (Economic)

Unit: VND/kg

No.	Type	Ha Noi – HCM City	Ha Noi – Da Nang	HCM City – Vinh	HCM City – Hai Phong	HCM City – Da Nang
1.	M	170,000	130,000	120,000	180,000	120,000
2.	N	11,000	6,800	10,000	14,000	10,000
3.	Q45	9,500	5,600	7,000	10,600	6,500
4.	Q100	8,400	4,800	6,000	9,800	5,500
5.	Q300	7,900	4,000			
6.	Q500			5,500	9,100	4,700

Source: CAAV
Notes: Excluding VAT, additional charges for petrol and gasoline, and other fees/additional charges, if any.
M: Minimum charge for one freight lot.
N: Applied for freight lots with charging weight of less than 45kg but the total rate must not be less than the minimum charge (M).
Q45: Applied for freight lot with charging weight of 45kg - 99.5kg.
Q100: Applied for freight lot with charging weight of 100kg - 499.5kg.
Q500: Applied for freight lot with charging weight of 500kg and above.

8.10 International air freight cost is also shown in Table 8.6.2 for reference.

Table 8.6.2 International Air Freight (Economic)

Unit: USD/kg

	Air Route	Cargo Type	Weight Level				
			45	100	300	500	1000
1	Ha Noi-Bangkok	Normal	TACT	1.6 - 2.1	1.5 - 1.7	1.5 - 1.7	1.45-1.65
2	Ha Noi-Narita	Normal	TACT	2.0 - 2.3		1.8 - 2.1	1.6 - 1.9
3	Ha Noi-Hongkong	Normal	TACT	1.8 - 2.1	1.7 - 2.0	1.5 - 1.8	1.45-1.75
4	Ha Noi-Singapore	Normal	TACT	1.95 - 2.35	1.9 - 2.3	1.85 - 2.25	1.8 - 2.1
5	Ha Noi-LAX	Normal	TACT	3.3 - 3.6		3.2 - 3.5	3.2 - 3.5
6	Ha Noi-Helsinki	Normal	9.3-9.6	4.8 - 5.1	4.6 - 4.9	4.3 - 4.6	3.9 - 4.2
7	Ha Noi-South of Africa	Normal	TACT	4.8 - 5.2		4.7 - 5.0	4.5 - 4.8
8	Ha Noi-Sydney	Normal	TACT	3.0 - 3.3	2.8 - 3.1	2.7 - 3.0	2.6 - 2.9

Source: CAAV
Notes: Excluding VAT, security examination charge, bill charge.

2) Loading/Unloading Cost

8.11 Loading/Unloading charge at Noi Bai International Airport is shown in Table 8.6.3. The costs shown in the table are applied for the analysis in the study.

Table 8.6.3 Domestic Cargo Handling Charges-No.01.BG02/NCTS/XL/ND (Noi Bai International Airport)

No	Description	Charged Unit	Inbound Cargo	Outbound Cargo
1	General cargo			
	- Rates	Kg	200	200
	- Minimum charge	AWB/time	17,000	17,000
2	Valuable cargo			
	- Rates	Kg	440	440
	- Minimum charge	AWB/time	150,000	150,000
3	Vulnerable			
	- Rates	Kg	230	230
	- Minimum charge	AWB/time	50,000	50,000
4	Perishable cargo			
	- Rates	Kg	210	210
	- Minimum charge	AWB/time	25,000	25,000
5	Stevedore peach branch, apricot branch/branch			
	- Rates	Branch	2,100	2,100
	- Minimum charge	AWB/time	35,000	35,000
6	Live Animals			
	- Rates	Kg	230	230
	- Minimum charge	AWB/time	70,000	70,000
7	Dangerous goods			
	- Rates	Kg	230	230
	- Minimum charge	AWB/time	70,000	70,000
8	Human remains in coffin, ashes			
	- Minimum charge	Coffin/ashes	340,000	340,000
9	Express cargo, quick delivery cargo or cargo acceptance after cut-off time			
	- Requesting for cargo delivery within 2 hours after ATA or for cargo acceptance after the cut-off time	Kg	230	230
	- Minimum charge	AWB/time	70,000	70,000
10	Heavy cargo(*)			
	- Rates	Kg	230	230
11	Overhang cargo(*)			
	- Rates	Kg	230	230
	- Minimum charge	AWB/time	30,000	30,000
12	Services provided out of working time			
	-Services provided from 16h00 to 22h00 on the working day	A 30% surcharge of the applicable fee should be applied		
	-Services provided from 22h00 to 07h30 on the working day	A 30% surcharge of the applicable fee should be applied		
	-Services provided on Saturday, Sunday	A 30% surcharge of the applicable fee should be applied		
	-National Holiday and legal-regulated day-off			

Source: http://www.noibaicargo.com.vn/ArticleDetail/tabid/12178/ArticleID/89643/tid/12231/language/en-US/Default.aspx