

**1. Project Description**



Project Site



Main Tunnel (right) and Evacuation Tunnel

**1.1 Background**

National Highway No.1 is a major artery that crosses Vietnam from North to South. In Central Vietnam, it forms part of the East West Economic Corridor passing through Vietnam, Laos, Thailand and Myanmar<sup>1</sup>.

The Hai Van Pass segment of National Highway No.1 (approx. a 20-km segment in central Hue-Da Nang with a 475 meter- high peak) is a narrow and steep mountain road with many sharp curves. Moreover, during the rainy season, falling rocks and shoulder collapses are frequent occurrences. This makes it the most dangerous segment of National Highway No. 1 and very difficult to maintain. Traveling on this segment took approximately 1 hour by regular vehicle. It was, therefore, a bottleneck, impeding smooth transportation on National Highway No.1 and it thus held up development of the Central region.

**1.2 Project Outline**

To establish traffic safety and efficiency for National Highway No.1 at the Hai Van Pass section located between central Hue and Da Nang City in Central Vietnam through the construction of road tunnel(s), road bridge(s) and access roads, thereby contributing to economic development of the region.

Logical Framework Applied for Ex-Post Evaluation

Goal	Economic development in Central Vietnam and the whole country
Purpose	1) To establish traffic safety and efficiency for National Highway No.1 at the Hai Van Pass section 2) To meet the requirements of a drastic increase in vehicle traffic demand in the future (to 2025)
Outcome	1) Reduction of traffic accidents and losses from accidents 2) Reduction of travel time/ increase in travel speed

<sup>1</sup> A component of the Expansion Mekong Regional Development Plan. Based on the Feasibility Study conducted by ADB, several Japanese ODA loan projects are involved: Da Nang Port Improvement Project, Hai Van Pass Tunnel Construction Project and the 2nd Mekong International Bridge Project (Laos and Thailand).

	3) Reduction of vehicle operation costs (VOC) 4) Reduction of days of impassability due to weather conditions and accidents
Outputs (planned at appraisal)	1) Construction of tunnels and related facilities 2) Construction of approach roads and bridges (including Lang Co Bridge) 3) Construction of resettlement area 4) Consulting services
Inputs (Planned at appraisal)	Total project cost: 37,981 million yen out of which, Japanese ODA Loan: 31,824 million yen GOV contribution: 6,157 million yen  * The cost is the estimate as of the appraisal for the second Loan Agreement, as the details of the project scope including the tunnel route had been decided after the first Loan Agreement was concluded and the project started. See 3.2.2.3 Project Cost for the reason for a big gap between the planned Japanese ODA Loan and disbursed amount (as shown in the table below).

	Phase 1 (LA I)	Phase 2 (LA II)	Phase 3 (LA III)
Approved Amount/ Disbursed Amount	5,500 Million Yen / 5,487 Million Yen	10,000 Million Yen / 8,162 Million Yen	3,359 Million Yen / 1,666 Million Yen
Exchange of Notes Date/ Loan Agreement Signing Date	January 11, 1997 / March 26, 1997	March 29, 1999 / March 30, 1999	March 28, 2002/ March 29, 2002
Terms and Conditions	Interest Rate: 2.3% p.a. Repayment Period: 30 years (Grace Period: 10 years) Conditions for Procurement: General Untied	Interest Rate: 0.75% p.a.* or 1.8% p.a. Repayment Period: 40 years* or 30 years (Grace Period: 10 years) Conditions for Procurement: Bilateral Tied* or General Untied	Interest Rate: 1.8% p.a. Repayment Period: 30 years (Grace Period: 10 years) Conditions for Procurement: General Untied
Borrower / Executing Agencies	The Government of Socialist Republic of Vietnam / Ministry of Transport		
Final Disbursement Date	September, 2003	July, 2007	July, 2007
Main Contractor (Over 1 Billion yen)	Hazama Corporation (Japan) - Civil Engineering Construction Corporation No.6 (CIENCO 6) (Vietnam) (JV) / ABB OY(Finland), Kinden Corporation (Japan)- Vietnam Industrial Construction Corporation (Vietnam) (JV) / Dong Ah Construction Ind. Co., Ltd.(Korea) - Song Da Construction Corporation (Vietnam) (JV) / Thanh Long Construction (Vietnam) - Truong Son Construction Corp.(Vietnam) (JV) / Matsushita Electric Industrial Co. Ltd.(Japan) - Itochu Corporation (Japan) (JV)		
Main Consultant (Over 100 million yen)	Nippon Koei Co., Ltd.(Japan) - Louis Berger International Inc.(United States) - Transport Engineering Design Corporation (Vietnam) (JV).		
Feasibility Study, etc.	1996 World Bank		
Related Projects	Da Nang Port Improvement Project (Japanese ODA Loan; Loan Agreement signed in March 1999)		

Note: \*1) For Consulting Services

## 2. Outline of the Evaluation Study

### 2.1 Evaluator

The Vietnam-Japan Joint Evaluation Team 2009 consisted of three Working Groups, each of which evaluated different projects. This project was evaluated by the Hai Van Pass Tunnel Group joined by the following members:

Ms. Nguyễn Thanh Hằng, Ministry of Transportation (MOT)  
Mr. Nguyễn Đình Thảo, PMU 85  
Ms. Huỳnh Thị Ngọc Hoa, PMU 85  
Mr. Bùi Xuân Trường, Vietnam Road Administration (VRA)  
Mr. Trương Quang Hưng, Ministry of Planning and Investment (MPI)  
Mr. Phan Đức Hào, MPI  
Mr. Nguyen Ngoc Hai, Ministry of Transport (Evaluation Advisor)  
Mr. Bui Duc Tho, National Economic University (Vietnamese Evaluation Consultant)  
Mr. Mai The Cuong, National Economic University (Vietnamese Evaluation Coordinator)  
Takako Haraguchi, International Development Associates (Japanese External Evaluator)

### 2.2 Duration of Evaluation Study

For the ex-post evaluation, the study was conducted as per the following schedule.

Study Period: September 2009 – June 2010

On-Site Survey: November 30 – December 4, 2009 and January 16 – 27, 2010

### 2.3 Constraints during the Evaluation Study

As this was a joint evaluation with the dual purposes of (i) fulfilling the evaluation task of JICA and (ii) developing evaluation capacity of personnel concerned in Vietnam through actual involvement in evaluation activities, a large part of the study period was spent in the training of evaluation team members and in discussions within the team. At the same time, data/information for evaluation in some aspect, including comprehensive and detailed data on operation of Da Nang Port (related to the evaluation of Effectiveness and Sustainability), were not provided on time. Therefore, the evaluation team could not complete some analyses such as recalculation of internal rates of return.

## 3. Results of the Evaluation (Overall Rating: A)

### 3.1 Relevance (Rating: a)

#### 3.1.1 Relevance with the Development Plan of Vietnam

The evaluation team examined major policy/ planning documents from the project appraisal stage and the ex-post evaluation stage, such as the Socio-Economic Development Plan (SEDP) of Vietnam, SEDPs of Thua Thien Hue Province and Da Nang City, respectively, and the National Transportation Master Plans<sup>2</sup>. All of these documents mention the development of the Central region as a key priority, and the city and provincial SEDP regard the development of the Hai Van Pass Tunnel as an important measure in achieving this. Also, as



Hai Van Pass

<sup>2</sup> The Transportation Master Plan after 2001 refers to *The Study on the National Transport Development Strategy in the Socialist Republic of Vietnam (VITRANS) 1* (2001) and *VITRANS 2* (2010) prepared with JICA technical assistance.

mentioned in 1.1, this project is consistent with the Mekong regional development plan because the Hai Van Pass Tunnel constitutes a part of the East West Economic Corridor.

### 3.1.2 Relevance with the Development Needs of Vietnam

The feasibility study for this project by the World Bank (1996) and the Master Plan on Development of the Central Viet Nam by JICA (1996) both forecasted an increase in traffic demand for the Hai Van Pass section. According to the World Bank study, the rate of traffic increase per year for 2010 would be 13.2% p.a. for passengers and 11% p.a. for freight. However, as mentioned in *1.1 Background*, the Hai Van Pass section was the section that created most difficulties on National Highway No. 1, and was a bottleneck for middle- and long distance transportation.

### 3.1.3 Relevance to Japan's ODA Policy

In the Japanese country assistance policy for Vietnam (1994) the development of infrastructure is one of the five priority areas. As of FY1998, 30% of total Japanese ODA Loans since 1993 had been designated to the transportation sector.

This project has been highly relevant to Vietnam's development plans and development needs as well as to Japan's ODA policy, therefore its overall relevance is high.

## 3.2 Efficiency (Rating: b)

For a comparison of the plan and the actual outputs and inputs, which forms the basis for the efficiency evaluation, we considered the project plan of LA II, instead that for LA I, as the "original plan". This was because at the time of the LA I appraisal, the tunnel route had not yet been decided, there being two alternatives. These alternatives were quite different in design, cost estimation and construction duration. The tunnel route was decided upon using a Special Survey conducted as part of the LA I implementation, and this became the basis of the LA II appraisal, which is comparable to reality

### 3.2.1 Project Outputs

The main features of the Hai Van Pass Tunnel are as follows:

Main Tunnel : 2 Lanes (3.75m wide lanes, 1.25m wide shoulders), 89.0m<sup>2</sup> cross section, 6,280m long, Lay-by with 400m spacing

Evacuation Tunnel<sup>3</sup> : 15.5m<sup>2</sup> cross section, 6,286m long

Vehicular and Pedestrian Crossing Passages: 1Vehicular/Substation passage - 15.5m<sup>2</sup>, 11 Pedestrian passages - 8.1m<sup>2</sup> each

Ventilation System : Jet-fan Longitudinal Ventilation System with one intermediate ventilation adit (Supply and exhaust, 36.2m<sup>2</sup>, 1,810m long), and three Electrostatic precipitators (each 57.7m<sup>2</sup>, 153m long)

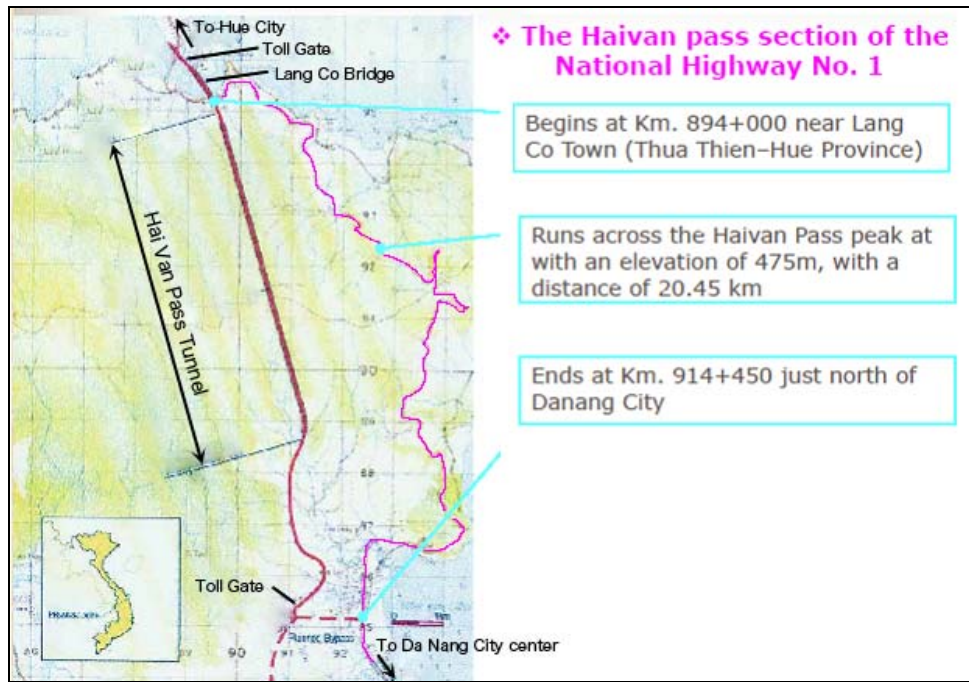
The outputs originally planned, including the construction of tunnels and related facilities, the construction of approach roads and bridges, the construction of a resettlement area, and consulting services were completed mostly as planned.

There were small modifications and additional works, as shown in Table 1, to better meet the actual situation and demands, and those changes are justifiable<sup>4</sup>.

<sup>3</sup> It is planned that when traffic in the Main Tunnel reaches full capacity, the Evacuation Tunnel is to be transformed to a Second Main Tunnel, and the capacity is thus to be doubled.

<sup>4</sup> For example, landscaping and monuments were added because the tunnel, being the first mountain tunnel in Vietnam, had a monumental significance for Vietnamese people. Also, the construction of three additional temporary

In addition to the planned outputs, by using the residual project budget, the Lang Co Bypass (10,935.98m in total length) was built as part of the project and completed on 31 May 2008. The objectives of the Lang Co Bypass were to i) provide support for running and maintaining the National Railway west of Lap An Swamp, especially in the case of railway accidents and to ii) maximize the benefits of this project by contributing to the improvement of the living conditions of inhabitants living to the west of Lap An Lagoon, right next to the project location, who were separated from nearby regions due to there being no road connection to the inland and Highway No.1.



Source: PMU 85

Figure 1: Map of the Project Site

Table 1: Comparison of Planned and Actual Project Outputs

Package	Plan	Actual
<b>Contract Package IA</b>	<b>Construction of North Tunnel Section</b> - 3,857 meters long, 2-lane main tunnel - 3,857 meters long evacuation tunnel - 403 meters long access road to adit building - Other related construction.	Same as planned with small modifications on access road to adit building (506 meters long) and additional works: - Landscaping of North Portal Plaza - Slope protection - Project Monument - Additional 3 Temporary Cross Passage from Main Tunnel to Evacuation Tunnel
<b>Contract Package IB</b>	<b>Construction of South Tunnel Section</b> - 2,417 meters long 2-lane main tunnel - 2,429 meters long evacuation tunnel - Other related construction.	Small modification and some additional works: - 2,379 meters long 2-lane main tunnel - 2,411 meters long evacuation tunnel - Landscaping of South Portal Plaza - Project Monument

cross passages from Main Tunnel and Evaluation Tunnel enabled the assignment of additional construction teams and thus accelerated the construction works.

Package	Plan	Actual
<b>Contract Package IIA</b>	<b>Construction of Lang Co Bridge Section</b> - Lang Co Bridge, 876.390 meters long, - Two lane roadway road width = 12.5m - A northern toll plaza; - 187m <sup>2</sup> enclosed car port	Same as planned with some minor additional works
<b>Contract Package IIB</b>	<b>Construction of Southern Highway Section</b> - Six bridges, totaling 959.390 meters length; - Two lane roadway, 3,922 meters length; road width of 12.5m. - A southern toll plaza - Pavements and road signs	Same as planned
<b>Contract Package III</b>	<b>Electrical works</b> 1. Electrical System 2. Lighting system 3. CCTV System 4. Lighting Control System 5. Fire Alarm and Detection System 6. Telecom System 7. Traffic Control System 8. Radio Rebroadcast System 9. Tunnel Power Distribution Monitoring and Control System 10. Main Supervised Control and Data Acquisition (SCADA) System	Same as planned
<b>Contract Package IV</b>	<b>Mechanical works</b> 1. Water Supply and Treatment 2. Tunnel Ventilation System	Same as planned
<b>Contract Package V</b>	<b>110/22kW substation and 110kV transmission lines</b>	Same as planned
<b>Contract Package VI</b>	<b>Maintenance equipment and vehicles</b>	Same as planned
<b>Contract Package VII</b>	<b>Infrastructure of resettlement area</b>	Same as planned
<b>Additional Scope</b>	<b>Construction of Lang Co Bypass with a total length of 10,935.98m.</b>	Same as planned

Source: PMU 85



Source: PMU 85



North Tunnel Section and Lang Co Bridge (Photograph provided by PMU85)

Figure 2: Tunnel Layout and Ventilation System

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Period (Sub-rating: b)

According to the appraisal of LA II, the project starting date (signing of LA I) was March 1997<sup>5</sup>, and the completion date<sup>6</sup> was planned to be November 2003, a total period of 81 months.

The actual completion date of the project in terms of the original scope was June 2005, with a total period of 100 months. The project was therefore 19 months or 23% longer than the plan. The completion of the additional scope – the Lang Co Bypass - was in May 2008.

Among all the Contract Packages, Packages 2A (Lang Co Bridge) and 2B (Southern Highway) had significant delays due to the insufficient financial and human resource capacity of the Contractor. As the bid price offered by the Contractor was too low in comparison with the cost estimates, the Contractor experienced difficulties in arranging financial resources for the package. In addition to this, the organization of the project team was not stable during package implantation, with frequent changes of Project Manager and some key staff. However, as these packages were not critical and were completed before the completion of the tunnel-related packages, they did not have a downstream impact on the entire project period.

As technical problems that arose in the courses of construction were due to unforeseeable conditions such as underground water in the ventilation adit, hard rock excavations, and a landslide in the South Tunnel Portal due to soft ground, delays in progress are acceptable and reasonable. Time extensions for these additional or unforeseeable conditions were strictly controlled. The construction schedule was strictly controlled and the construction period alone was in accordance with the approved schedule.

Table 2: Planned and Actual Period of the Project

	<b>PLANNED</b>	<b>ACTUAL</b>	<b>REMARKS</b>
OVERALL	Nov, 2003 (Signing of LA II)	June 2005 (Opening of the tunnel)	19 months behind (123% of plan)
Package 1A	30/09/2004	25/01/2005	4 months delayed due to underground water and hard rocks.
Package 1B	30/09/2004	25/01/2005	4 months delayed due to landslides at the soft ground section.
Package 2A	10/12/2003	31/12/2004	12 months delayed as Contractor encountered financial and human resource problems
Package 2B	25/03/2004	31/12/2004	9 months delayed as Contractor encountered financial and human resource problems.
Package 3	13/04/2005	15/05/2005	1 month delayed due to delayed approval of radio frequency
Package 4	12/3/2005	15/05/2005	2 months delayed due to additional emergency trials requested by Firefighting Police
Package 5	30/04/2004	19/08/2004	3.5 months delayed due to delays in connecting systems to the Lien Cieu Substation.
Package 6	17/08/2005	17/08/2005	As planned
Package 7	31/01/2002	29/04/2002	3 months delayed due to small modifications in quantity of work.

Source: PMU 85

Note: "Planned" for each package is the plan in the original contract.

<sup>5</sup> The actual starting month (March 1997) was the same as the plan made at the LA I appraisal (1996).

<sup>6</sup> Completion date is defined as the date of the opening of the tunnel.

### 3.2.2.2 Project Cost (Sub-rating: a)

According to the appraisal of LA II, the total project cost was JPY 37,981 million (excluding interest accrued during construction<sup>7</sup>), of which the Japanese ODA loan portion was JPY 31,824 million and the Government of Vietnam portion was JPY 6,157million.

The actual total project cost was JPY 17,472 million, of which the Japanese ODA loan portion was JPY 15,315 million and the Government of Vietnam portion was JPY 2,157 million. The total actual project cost was 54% lower than planned.

This big gap between the planned and actual project cost was mainly due to cost savings as a result of competitive bidding. However, unreasonably low bidding prices made project implementation difficult, especially in Packages 2A and 2B where local contractors won the bidding and this partly led to delays (see 3.2.2.1 *Project Period*).

As shown above, although the actual project cost was 54% lower than planned, the project period exceeded the plan by 23%. Therefore, the efficiency of the project is fair.

## 3.3 Effectiveness (Rating: a)

### 3.3.1 Quantitative Effects

#### 3.3.1.1 Results from Operation and Effect Indicators

(1) Improvement of traffic safety and efficiency - Effective

**Traffic accidents.** The project has improved traffic safety. Before the project, according to Hai Van Pass accident reports of the Phu Loc Police Department (Thua Thien Hue Province) and the Lien Chieu Police Department (Da Nang City), on average during 2000-2004, there were 8.4 serious accidents and 5.2 deaths per year. These figures were reduced sharply after project completion: on average during 2005-2009, there were 3.2 serious accidents and 2.8 deaths per year on both the Hai Van pass and in the tunnel. There have been 29 accidents inside the tunnel since 2005. However, none of them were serious accidents. These figures show that despite the increase in traffic volume, serious accident cases decreased after the project.

**Travel speed.** The project has also been effective in terms of increased travel speed<sup>8</sup>. Before the project, the average speed of a vehicle passing the Hai Van Pass section (approximately 20km in total length) was 23km/hour. In 2009, the average speed passing through the section tunnel (approximately 12km in length) was 46km/hour, 15% higher than targeted (40km/hour).

**Travel time.** Consequently, travel time has been shortened as expected. Before the project, on average, it took 60 minutes to pass the project section. After the project, by using the tunnel, the time to pass the project section had been shortened to an average of 15 minutes<sup>9</sup>.

**Vehicle operation cost (VOC).** Using the same approach applied at appraisal, the total VOC saving of the project was re-calculated at USD 456.1 million (2005 price), equivalent to USD 360.7 million (2001 price), which was lower than the plan (USD 386.9 million) possibly due to a slightly lower traffic volume than planned.

**Traffic impassability.** Before the project, the number of times that the Hai Van Pass was impassable<sup>10</sup> due to weather or accidents was 14 per year on average. After the tunnel opened,

<sup>7</sup> Interest during construction was excluded because the executing agency did not record it as a project cost.

<sup>8</sup> The speed regulation at the Hai Van Pass Tunnel is a minimum 40 Km/h and a maximum 70 Km/h.

<sup>9</sup> This was confirmed by PMU85, semi-structured interviews with beneficiaries and direct measurements by the ex-post evaluation team.

<sup>10</sup> Traffic impassability is defined as the closure for five hours or longer.



there was almost no traffic impassability at Hai Van Pass except on one occasion. There were also almost no occurrences of traffic impassability inside the tunnel. From 2005 to date, the tunnel has had to be closed 50 times due to accidents or fires. Each time, however, the closure has been only for short time, ranging from 5 minutes to 45 minutes at the most according to Hai Van Pass Tunnel Management and Development Company (HAMADECO), the tunnel operator. Thus, it did not become impassable for traffic.

(2) Meeting future traffic demand - Effective

**Traffic volume.** Traffic volume in the Hai Van Pass section in 1998 was 2,024 ADT (average daily traffic in terms of the number of vehicles), and in 2008, this increased 91% to 3,892 ADT, of which 3,866 ADT was through the tunnel and 26 ADT was through Hai Van Pass. The Hai Van Pass Tunnel is a factor which contributed to the traffic volume increase. All of the transportation companies interviewed (8 companies) recognized that they had more customers (passengers) as a result of the Hai Van Pass Tunnel, because people traveled more often and their customers switched from railway to road.

Table 3 shows the actual and forecast traffic volume. The actual volume for the Hai Van Pass Tunnel was almost the same as forecast every year except 2008 and 2009, when Vietnam faced an economic crisis. The sum of the actual traffic volume from 2005 to 2009 through the Hai Van Pass Tunnel (17,712 vehicles) was about 97% of the forecast traffic volume for the same period (18,228 vehicles). In this aspect, the project was effective.

**Demand forecast and tunnel capacity.** The actual capacity of the tunnel is 14,500 ADT which is the same as the design. According to the forecast made at the LA II appraisal (based on the Special Survey conducted in 1998)<sup>11</sup>, the tunnel can meet the traffic volume until 2025. Taking the above-mentioned actual traffic volume into consideration, the tunnel will meet traffic volume until 2025 as planned.

Table 3: Forecast and actual traffic volume

Unit: ADT

Year	Tunnel		Hai Van Pass
	Forecast (Special Survey Report, 1998)	Actual	Actual
<b>Baseline</b>			
1998			2,024
<b>Actual</b>			
2005	2,976	3,273	17
2006	3,278	3,274	23
2007	3,612	3,631	25
2008*	3,979	3,813	26
2009*	4,383	3,721	
<b>Forecast</b>			
<b>2015</b>	7,834		
<b>2025</b>	14,495	Full capacity	

Source: Special Survey Report (1998), PMU 85 and Hai Van Tunnel Management Company (HAMADECO)

Note: The traffic volume data for the Hai Van Pass after the opening of the tunnel seems low in spite of the fact that very few vehicles are actually observed on this route now. However, the evaluation team could not find any other data.

<sup>11</sup> After the Special Survey (1998), the Supplementary Study (2001) requesting the construction of a second tunnel (conversion of the Evacuation Tunnel to a 2-lane motorway tunnel for one-way traffic), modified the demand forecast. This new forecast suggested greater demand and estimated that the tunnel would be full by 2017. However, by comparing the actual traffic volume up to 2009 with the forecast demand of the Special Survey and the Supplementary Study, it appears that the Special Survey projection is more acceptable. The SSE (Sum of Squares for Forecast Error) of the Special Survey projection is 1.2 million, while the SSE of the Supplementary Study is 38 million, which means that the Special Survey projection is more accurate than the Supplementary Study projection.

### 3.3.1.2 Results of Calculations of Internal Rates of Return (IRR)

#### (1) Financial Internal Rate of Return (FIRR)

In the FIRR calculation at appraisal, three cases were foreseen for the increase in the rate of tolls: the low case (with no rise in the toll rate), the middle case (a 3% increase) and the high case (a 6% increase). In fact, the low case applied (i.e., the toll rate has been maintained since the opening of the tunnel), and the corresponding FIRR at appraisal was negative.

At the ex-post evaluation, the FIRR was recalculated with updated data on investment costs, operation and maintenance (O&M) costs and toll revenues using the 2005 price. The result of the FIRR is positive at 0.2% which is better than the plan mainly because of a lower investment cost than was planned.

#### (2) Economic Internal Rate of Return (EIRR)

The EIRR was recalculated using the same method and conditions as applied at the appraisal.

The recalculated value was 12.6%, which was higher than planned (11.4%), possibly because of the lower investment cost as well as higher time saving values than planned (though the O&M cost was higher and VOC saving values were lower than planned).

Table 4: EIRR

	<b>Total</b>	<b>Plan (2001 price)</b>	<b>Actual (2005 price)</b>
Costs	Investment capital	\$ 170.8 mil.	\$163.1 mil.
	O&M Costs	\$23.4 mil	\$ 30.89 mil
Benefits	VOC Savings	\$ 386.9 mil.	\$ 456.1 mil.
	Time Saving	\$ 467.5 mil.	\$ 501.3 mil.
	EIRR	11.4%	12.2%

Source: made by the ex-post evaluation team based on data provided by PMU 85, HAMADECO and JICA

Note: Project life: 20 years from the start of the operation of the tunnel.

### 3.3.2 Qualitative Effects

#### (1) Satisfaction of beneficiaries

The ex-post evaluation team conducted structured interview surveys with 31 drivers and 12 passengers using the Hai Van Pass Tunnel<sup>12</sup>. Recalling past experience, 40% of the drivers and 52% of the passengers responded that they had felt unsafe when they had passed the project section via the Hai Van Pass. After project completion, they used the tunnel and felt much safer. Of the drivers and passengers interviewed, 100% said they felt safe and comfortable using the tunnel.

In the same survey and other surveys (semi-structured interviews with 8 transportation companies), respondents said that they believed that using the tunnel saved VOC and that the toll fee was much less than VOC savings, though they could not give the exact amount.

Interviewees also mentioned that the Hai Van pass route had become safer with less traffic. Some transportation companies said they used the Hai Van Pass on request of tourist customers. Most vehicles using the Hai Van pass are now tourist cars. After project completion, the Hai Van pass has become a tourist site not only for foreigners but also for Vietnamese.

When asked to rate their degree of satisfaction with the project on a five-point scale, 64.5% of

<sup>12</sup> Although the sample size is too small to draw a statistically-significant conclusion (mainly due to time constraints), sampling was made randomly to enhance representativeness of interviewees.

drivers interviewed (20 respondents) rated “Very much satisfied” while the remaining 35.5% (11 respondents) chose “Yes, satisfied to some extent.” Most of the transportation companies and also passengers interviewed said they were very satisfied with the project.

## (2) Convenience for motorcycles

For safety reasons, motorcycles are not allowed to use the Hai Van Pass Tunnel. However, HAMADECO, the tunnel operator, provides a regular transportation service for motorcycles. Trucks to carry motorcycles and buses to carry motorcycle drivers operate every 10-20 minutes at a very low tariff. In this way, motorcycles also benefit from the project.



Asking a driver to accept an interview



Service to carry motorcycles and their drivers

## (3) Recognitions and awards received

Though this was the first tunnel construction project in Vietnam with the fruitful cooperation of Japanese and Vietnamese stakeholders at all levels, the Hai Van Pass Tunnel Project has been nationally and internationally recognized as a very successful project in many aspects. These include quality, environment and technology transfer to the Vietnamese technical team. The following awards have been granted to the project:

- One of the best 24 global projects by ACEC (The American Council of Engineering Companies)
- Environment Award by TDF America (Transport Development Fund of America)
- Best Quality Award by the Construction Management Association of America

Apart from these awards, the project was evaluated highly by the State Inspection and Taking-Over Committee in terms of quality.

This project has largely achieved its objectives, therefore its effectiveness is high.

### 3.4 Impact (Rating: a – as part of the effectiveness rating)

#### 3.4.1 Intended Impacts

In the period 2000-2004, the GDP of Vietnam increased on average 7.17% p.a. After project completion, the GDP of Vietnam grew at a higher rate on average, at 7.8% p.a. (2005-2008) (IMF). Although there is no clear evidence for the contribution of the tunnel to economic growth, it has provided great support to the development of road transportation and trading, given the fact that the Hai Van Pass Tunnel eliminated the biggest bottleneck of National Highway No. 1, which is the main artery of the country. Also, the tunnel supported trade with neighboring countries with recently accelerating development through the East West Economic Corridor. From 2000 to 2004, the total import and export values at the Lao Bao cross border

gate were USD 201 million. After project completion, from 2005 to 2009, the total import and export value at the Lao Bao cross border gate increased to USD 737.5 million.

The socio-economic picture of Da Nang and Thua Thien Hue did change considerably as the result of the Hai Van Pass Tunnel. In the year 2000, there were 28 FDI companies in Da Nang with a total value of USD 33.5 million, while foreign direct investment (FDI) in Thua Thien Hue was USD 2.8 million. After project completion, in 2008, there were 46 FDI companies in Da Nang with a total value of USD 602 million. FDI in Thua Thien Hue increased to USD 1,096 million (GSO). This huge development of FDI, industrial parks and economic zones can be partly attributed to the Hai Van Pass Tunnel. For example, according to an interview with the management board of the Lang Co-Chan May Economic Zone and two companies investing in Da Nang and Thua Thien Hue, the companies considered local infrastructure and the transportation system as major criteria for choosing a place to base their companies or factories. They recognize that the Hai Van Pass Tunnel has improved the transportation network and made their business easier in both buying and selling goods and services. It was one of the factors that led them to chose Da Nang or Thua Thien Hue for investment.

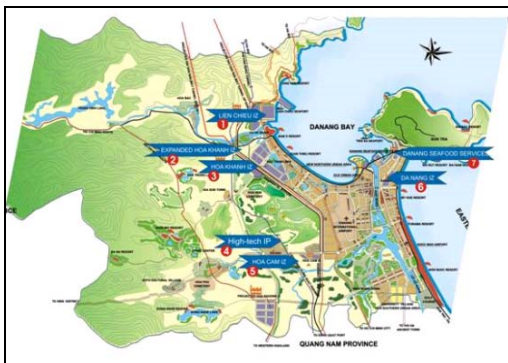


Figure 3: Da Nang Industrial Park

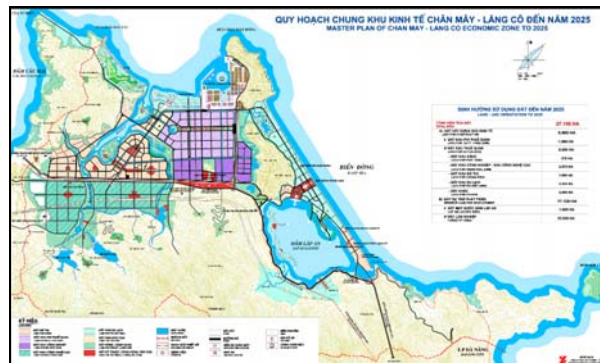


Figure 4: Lang Co-Chan May Economic Zone

All other beneficiaries interviewed: 8 transportation companies, 6 local residents and local authorities, also see the Hai Van Pass Tunnel as a factor which has contributed to central economic development.

Beneficiaries of the Hai Van Pass Tunnel not only include transportation companies but also all drivers and passengers who use the tunnel in daily life and for their businesses. Moreover, the communities that drivers and passengers belong to, as well as company customers, are also indirect beneficiaries. The number of the project beneficiaries can thus be said to be uncountable. At the very least, it can be said that the drivers and passengers of more than 1 million vehicles using the tunnel each year directly benefit from the project<sup>13</sup>.

### 3.4.2 Other Impacts

#### (1) Management and technology transfer

Vietnam has learned technology for tunnel construction and O&M. Such technology was applied when the Ngang Pass Tunnel in Ha Tinh Province was constructed in 2003-2004.

Researchers and lecturers from different universities and institutions have also been invited to training sessions provided by the project and have learned about the technology. It is expected

<sup>13</sup> For reference, the populations of Da Nang City and Thua Thie Hue Province are 752 thousand and 1,120 thousand, respectively (2004).

that they will transfer the technology to others through classes and seminars.

(2) Reduction of loss of goods transferred through the project section

According to transportation companies interviewed, before project completion, they often faced the problem of loss of goods on the Hai Van Pass as their trucks went slowly and it was possible for thieves to break in and take goods. After project completion, traffic inside the tunnel is monitored by the control room of HAMADECO, and no such losses are possible.

(3) More opportunities for workers from other provinces to find jobs in Da Nang

After the project, workers and staff from Hue were able to find jobs in Da Nang due to the large improvement in access to the Da Nang side. Within an hour, workers in Lang Co-Thua Thien Hue can come to offices in the Lien Chieu Industrial Zone. This was impossible using the Hai Van Pass.

(4) Impact on the Natural Environment

Air quality inside the tunnel is continually monitored by the Control Center of the Hai Van Pass Tunnel, and the ventilation system is operated to maintain the quality level within the standard<sup>14</sup>.

Table 5: CO and Visibility levels in the Hai Van Pass Tunnel

Year	CO (ppm)	Visibility (%)
2006	2.87	79
2007	2.02	84
2008	2.73	82.5
2009	5.08	81.5

Source: HAMADECO

HAMADECO does not measure air quality and noise level outside the tunnel (around the air exhaust outlets near the top of the hill), but the ex-post evaluation team observed clean air and a silent atmosphere in the area. The 6 local residents interviewed said that they had no complaints about the environmental impact of the Hai Van Pass Tunnel in terms of air, drainage water quality and noise.

Therefore, the project can be said to have no negative environmental impact.

(5) Impact of Land Acquisition and Resettlement

In the original plan made at appraisal, 32 households from the Lang Co Township were to be relocated to a resettlement site developed by the project. After the detailed design, the number of households to be evacuated was re-counted at 60 households. However, because the construction of the resettlement site was delayed, most of these found new land in other places and moved there by themselves with supporting allowances for life rehabilitation and house rental paid by the project. Also, many resettled people could not buy land at the resettlement site as land prices there were higher in 2003 when land was sold to the resettled people than the land prices of 2001-2002 on which their compensation was based. Thus, they sold their vouchers (rights to buy land in the resettlement site) to others and moved to other places where land was cheaper. Under such circumstances, the exact number of households that were actually moved to the resettlement site was not available. Currently, there are 17 households living in the resettlement site. However, some of these are not resettled people but the households who have bought land from resettled people.

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<sup>14</sup> The standard for CO is below 11ppm and for visibility, above 45%.

At the time of the hand over of the project to the local authority, the resettlement site had sufficient water supply, electricity system and waste water system facilities. However, at present, there have been damages to the water supply facilities<sup>15</sup>. According to interviews with 6 resettled people, other facilities other than the water supply are also in a poor condition due to insufficient maintenance. Also, they said that some families who were farmers or had small businesses lost their jobs after they moved to the resettlement site, because they lost their farmland or because the new location was not as attractive to shop customers.



Resettlement area developed by the project

In 2005, an impact survey on people affected by the project was conducted<sup>16</sup>. The survey results revealed that a majority of relocated people (including those who moved themselves) suffered a lack of funds for the building of new houses and delays in the development of the resettlement site. This was despite the fact that the land acquisition process and compensation by Thua Thien Hue Province followed Vietnam's laws and regulations.

### 3.5 Sustainability (rating: a)

#### 3.5.1 Structural Aspects of Operation and Maintenance

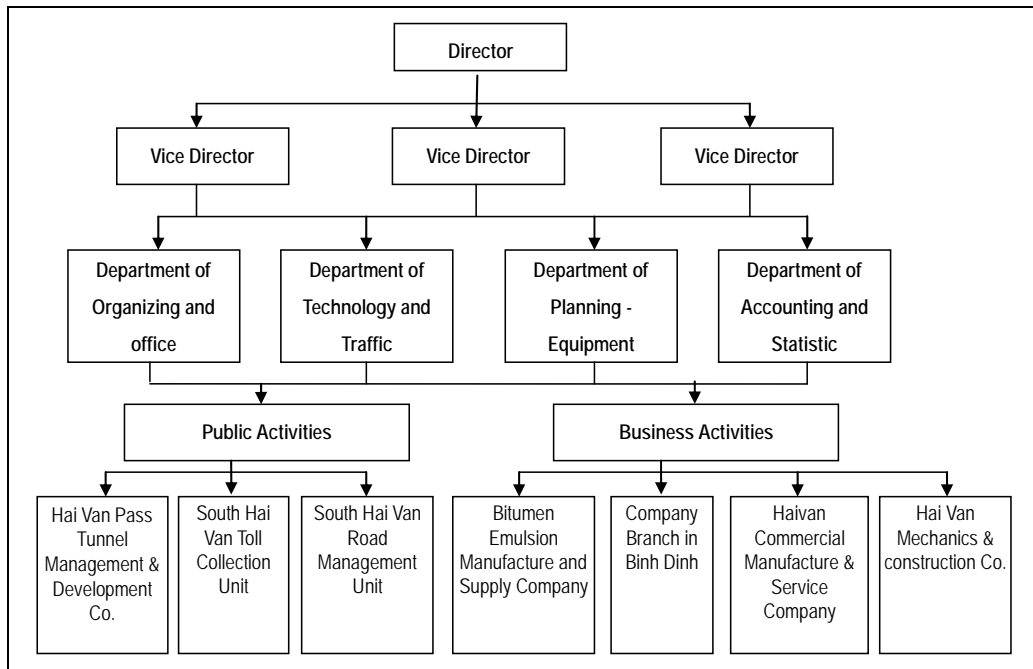
The state-owned Hai Van Pass Tunnel Management and Development Company (HAMADECO) is responsible for the operation and maintenance (O&M) of the Hai Van Pass Tunnel and its related facilities<sup>17</sup>. In accordance with the operation and maintenance plan at appraisal (i.e., to set up a Special Management Unit for the Tunnel), HAMADECO was established in 2005 by restructuring a state-owned road and bridge management and development company under the Regional Road Management Unit No.5 (RRMU 5) of the Vietnam Road Administration (VRA), Ministry of Transport (MOT). At the beginning, HAMADECO had an organizational structure that resembled a Japanese O&M system recommended by Japan, but later it changed its organization chart in a way that better fits a Vietnamese context. Currently, HAMADECO has 380 staff members. The Hai Van Pass Tunnel management and development company (HAPACO) has 189 staff members who are directly responsible for O&M of Hai Van Pass Tunnel.

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<sup>15</sup> People interviewed and the local authority said that the construction works for Lang Co Bypass damaged the water supply facilities of the resettlement site. Under the Civil Contract, it was the contractor's responsibility to restore any damage caused by them during construction or to negotiate with the local authority (the property owner) for compensation. Agreement was reached between the local authority and the contractor without any further claims to the executing agency (PMU 85), and the contractor paid compensation to the local authority as agreed. Without water supply facilities, people dug wells to get water.

<sup>16</sup> Vietnam Academy of Social Sciences (2005), *Baseline Survey on Social Assessment: Hai Van Pass Tunnel Construction Project*.

<sup>17</sup> The operation responsibility of HAMADECO included toll collection until 2009, but then this was transferred to another state-owned toll collection company.



Source: HAMADECO

Figure 4: Organization Chart of HAMADECO

The other project outputs, namely, the approach roads, bridges and the bypass, are operated and maintained by RRMU 4 (Hue side) or RRMU 5 (Da Nang side) of VRA.

### 3.5.2 Technical Aspects of Operation and Maintenance

At HAMADECO, 120 staff are in charge of the operation and maintenance of the Hai Van Pass Tunnel. HAMADECO considers that the number and the capacity of their O&M staff is sufficient. This is due to well-advanced preparation of the organizational structure and training for O&M staff during project implementation.

During project implementation, a total 41 staff from the preceding company received major training (including overseas training) on aspects such as tunnel operation and emergency measures both from VRA and from the contractors. Other staff also received numerous other O&M-related training. At present, 90% of the trainees who had overseas training still remain at HAMADECO and provide training to new staff.

The O&M manual is well established and used. After a three-year operation of the tunnel, learning from PMU 85 and from abroad, HAMADECO revised the O&M manual themselves based on their experience, and this was approved by MOT. The manual is strictly followed by O&M staff, and their performance is inspected by RRMU 5.

The ex-post evaluation team observed that the tunnel is operated smoothly without technical problems. According to HAMADECO, there are neither accidents nor tunnel closures due to technical problems.



Control Room



New O&M Manual

### 3.5.3 Financial Aspects of Operation and Maintenance

All expenses for the O&M of the Hai Van Pass Tunnel are covered by the state budget on a request-basis. At appraisal of this project, the total O&M cost for the Tunnel was planned to be approximately USD 1.1 million, equivalent to 20 billion VND, annually. As shown in Table 6, the actual O&M budget is higher than planned<sup>18</sup>. The toll revenue from the Tunnel exceeds the O&M budget, and is even more than the total budget of HAMADECO (38 billion VND in 2007)<sup>19</sup>.

Table 6: Toll collection and the O&M budget of the Hai Van Pass Tunnel

Unit: million VND

	<b>Tolls collected</b>	<b>O&amp;M budget allocated</b>
2005	15,797	11,156
2006	40,749	29,622
2007	47,506	33,239
2008	50,107	45,282

Source: HAMADECO

### 3.5.4 Current Status of Operation and Maintenance

No major problems have been observed in the operation and maintenance system, therefore sustainability of the project is high<sup>20</sup>. Maintenance of the tunnel and the facilities is regularly performed in accordance with the O&M manual. Although many spare parts are not produced any more or are very specialised (and thus have to be imported), consistency in replacement is mostly ensured. Currently, the purchase of additional equipment and spare parts totaling 12 billion VND is underway.

On the operation side, all vehicles as well as conditions inside the tunnel are carefully monitored and recorded by the Control Room, and necessary action (such changes in the

<sup>18</sup> A possible factor for the higher O&M cost than planned is the electricity cost, which accounts for almost half of the total O&M cost. However, the evaluation team could not identify the true reasons since information was not available on the breakdown of the planned O&M cost.

<sup>19</sup> Collected tolls are sent to the Treasury and then appropriated as O&M budget for national roads and bridges (including tunnels).

<sup>20</sup> There is damage on the surface of the north approach road, but repairs are planned.



settings of the ventilation system, the stopping of traffic offenders, etc.) is taken immediately. Two emergency rescue teams are ready at both entrances 24 hours a day. Also, the ex-post evaluation team observed that the tunnel was kept clean and had good visibility.



Conditions inside the tunnel



Rescue team standing by

## 4. Conclusion, Lessons Learned and Recommendations

### 4.1 Conclusion

In light with the above, this project is evaluated to be highly satisfactory.

### 4.2 Recommendations

#### 4.2.1 Recommendations for the related agencies

- 1) It is recommended that HAMADECO maintain and further enhance its current good O&M practices of the tunnel.
- 2) It is recommended that the Executing Agency makes maximum use of the experience gained from this project for future tunnel construction projects by continuing to disseminate technology used by the project and through human exchange.

#### 4.2.2 Recommendation for JICA

Not specifically.

### 4.3 Lessons Learned

- (1) The resettlement area should be constructed in a convenient location and in a timely manner to secure the livelihood of people affected by the project.

Even if land acquisition plans follow the laws and regulations of Vietnam, there is a possibility that the people relocated are negatively affected. To avoid such a possibility, the following actions could be suggested based on experience from this project:

- That the executing agency work with the local authorities to find resettlement site locations that are convenient for affected people.
- That the executing agency give priority to completing the construction of the resettlement area before the removal of displaced persons.
- That the executing agency confirm, at the hand-over of the resettlement site, the local authorities' commitment to maintaining infrastructure and utilities.
- That PMU have good coordination and communication with the local authority in

order, as much as possible, to reduce the period between the valuation of land in the resettlement site and the selling of it, and be keen to improve the negative impacts of the project on the local area.

- (2) A project that applies new technology should have advanced preparation for O&M during the construction period

As seen in detail in the sustainability section, O&M undertaken by HAMADECO has proved to be highly effective from the tunnel opening to the present, even though this was the first time that Vietnam had applied the new and advanced tunnel technology.

This success can be attributed to the well prepared plan for O&M which was prepared in advance, covering the construction phase with an initial set-up plan, a designed organization chart and with various kinds of training programs, including on-site training, local and oversea training. The well prepared plan and the close connection between the project owner and the user (O&M) in the implementation phase has contributed to the smooth operation and maintenance of the completed works.

### Comparison of Original and Actual Scope of the Project

Item	Original	Actual
1. Project Outputs 1) Construction of tunnels and related facilities  2) Construction of approach roads and bridges  3) Construction of resettlement area  4) Consulting services	Main tunnel (6,274m long, 2 lanes) and Evacuation tunnel, electric works, mechanical works  2-lane roadway (4,704m), Lang Co Bridge (876m long), 6 other bridges  Infrastructure  Special Survey for route selection, detailed design, tender assistance, environmental monitoring	Mostly same as planned  Mostly same as planned  Same as planned  TOR same as planned Foreign 479.27 MM Local 1,311 MM  Additional works: Lang Co Bypass (10,936m)
2. Project Period	March 1997-November 2003 (81 months)	March 1997-June 2005 (100 months)
3. Project Cost Amount paid in Foreign Currency  Amount paid in Local Currency  Total  Japanese ODA Loan Portion  Exchange Rate	19,494 Million Yen  18,487 Million Yen (1,849 Billion VND)  37,981 Million Yen  31,824 Million Yen  1 VND= 0.01Yen (As of October 1998)	12,803 Million Yen  4,669 Million Yen (259 Billion VND)  17,472 Million Yen  15,315 Million Yen  1 VND = 0.0083Yen (Average during period from 1996 to 2009)