PROJECT MANAGEMENT FOR HAI VAN TUNNEL CONSTRUCTION PROJECT IN VIETNAM

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ABSTRACT

The Hai Van Pass located in coastal Central Vietnam, was the biggest traffic bottleneck on the National Highway No.1 linking the capital Hanoi with Ho Chi Minh. The road was often blocked due to the landslide and slope failure during the rainy seasons. The tunnel, 6.3km long, construction was started on 1st October 2000 and cerebrated the tunnel traffic opening on 5 June 2005; the project scale is some Two Hundred Million US Dollars. Longitudinal ventilation system, invented and developed in Japan, was applied with SCADA (Supervisory Control And Data Acquisition system) in which all tunnel operation systems are integrated, monitored and controlled. An O&M agency was established by referring the Japanese practice of highway tunnel operation. Several times of overall emergency response on-site drills were executed inside the tunnel just before the opening. A consultant had been taking proactive initiative for work coordination among the contractors because all contractors are required to work simultaneously inside the tunnel in order to shorten the overall construction period. Weekly basis work coordination meetings had been held. Primavera P3 was used as a scheduling tool. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)* was referred to for the project management.

INTRODUCTION OF PROJECT

The Hai Van Pass

The Hai Van Pass located in coastal Central Vietnam (**see Figure 1**), was the biggest traffic bottleneck on the National Highway No.1, which is the most important North-south longitudinal artery linking the capital Hanoi with Ho Chi Minh. The Pass rises to a maximum elevation of 475 m within a length of 11 km with continuous small curves and steep grade. From the late 1990's, the rapid development of national economy has increased the logistic volume through the Pass, however, the heavy tracks have been forced to run slowly and fatal traffic accidents increased year by year. In addition, the road is often blocked due to the landslide and slope failure during the rainy seasons.

Figure 1 - Project Location Map

Distinct Points of the Project

Distinct characteristics of the project can be summarized in five (5) items; 1) 6.3km long highway tunnel, 2) 1st NATM (New Austrian Tunnelling Method) tunnel in Vietnam, 3) Longitudinal Ventilation System (**see Figure 2**), 4) SCADA (Supervisory Control And Data Acquisition) for Overall System Control, 5) O&M Company required.

Figure 2 - Tunnel Ventilation System

Project Major Features

Project major features are summarized in the following table (**see Table 1 and Figure 3**).

Table 1 - Project Major Features

Figure 3 – Typical Cross Section of Hai Van Tunnel

Project Organizations

Project organizations are summarized in the table below (**see Figure 4, Table 2 and Table 3**)

Figure 4 – Project Organizations

Table 2 – Project Organizations

Table 3 – Awarded Contractors

Project Implementation

The consulting service of the project was commenced on January 1998, consisting of 1) Special Survey, 2) Detailed Design, 3) Contract Tendering Assistance, 4) Construction Supervision, and 5) Training and Technology Transfer (**see Figure 5**).

Figure 5 – Consulting Services Schedule

The tunnel construction was started on 1st October 2000, the project had basically progressed very closely to the original schedule, although the tunnelling works encountered some unforeseeable geological conditions (**see Figure 6, Figure 7**). The tunnel traffic opening ceremony was nationwide and gracefully celebrated on 5 June 2005 (**see Figure 8 and Figure 9**). Since the opening, the long highway tunnel has been operated and maintained by Vietnamese tunnel operator to date without any serious operational problem.

Figure 6 – Encountered Unforeseeable Geological Condition (1)

Figure 7 – Encountered Unforeseeable Geological Condition (2)

Figure 8 – Tunnel Opening Ceremony (broadcasted by NHK)

Figure 9 – Project Implementation Schedule

Tunnel Emergency Response

The Consultant developed SOP (Standard Operation Plan) for the tunnel operation, and executed tunnel operation training for Vietnamese tunnel operation company that established in April 2004. Several times of overall tunnel emergency response on-site drills inside the tunnel was carried out until the fire police persuaded (**see Figure 10**).

Figure 10 – Tunnel Emergency Response Training

FIDIC Based Project

FIDIC (International Federation of Consulting Engineers) is widely used as conditions of contract for international construction contracts. Following FIDIC conditions of the contract were used in the project (**see Table 4**).

Table 4 - FIDIC Used in Project

PROJECT HUMAN RESOURCE MANAGEMENT

Three Objects for Project Management

Project Manager (PMR) of the Consultant team is responsible for management, not only for the Consultant Team but also the overall project. The PMR had been aware that the following three objects are his management targets and had tried to establish good communication atmosphere among the project (Ishimoto 2004) (**see Table 5**).

Table 5 - Project Management Objects

Application of PMBOK

The PMR has used the Construction Extent to the *Guide to the Project Management Body of Knowledge (PMBOK® Guide)* (PMI, 2003) as a guideline to his project management. Responsibilities of each knowledge area in the PMBOK have been carefully distributed to each team in the Consultant for the successful project management.

RAM for Consultant Team

Consultant Team consists of Core Team (CT), four Resident Teams (RT), Quantity Surveyor Team (QS), Geotechnical Team (GEO), Operation and Maintenance Team (OM), and Administration Team (ADM) (**see Figure 11**). Some 70 persons were joined with the team at the busiest time.

Figure 11 – Consultant Organization

Responsibility Assignment Matrix (RAM) for the Consultant team was set up as follows (**See Table 6**):

Table 6 - Responsibility Assignment Matrix of Consultant Team

RAM for Overall Project and Each Contract Package

Resident Engineer (RE) had much knowledge and experience in each field of the works than the PMR, therefore, responsibility of construction supervision of each contract package was mandated to each RE. This enabled the Project Manager to concentrate his responsibility for the overall project management (**see Table 7**).

Table 7 - Responsibility Assignment Matrix for Project

PROJECT TIME MANAGEMENT BY PRIMAVERA P3

Progressive Detailing of Work Schedule

The Consultant had taken a proactive initiative for work coordination among the contractors because the tunnel civil, electrical and mechanical contractors were required to work simultaneously inside the tunnel in order to shorten the overall construction period. Monthly coordination meetings were held until the tunnel breakthrough, subsequently weekly

coordination meetings had been held. Primavera P3 was effectively used, as a scheduling tool, for such meetings and schedule reports to the Client.

Project Milestone

Following major milestones existed in the project (**see Table 8**).

Table 8 - Project Milestone

Diagram Type for Scheduling

Time management had detailed progressively. The Consultant had developed the overall construction schedule in different diagram types in accordance with depth of scope of works (**see Table 9**).

Table 9 - Diagram Type of Overall Construction Schedule

Conventional Diagram

Time:Chainage Program had been used at the initial stage of construction until the tunnel breakthrough, October 2003. This expression is good to understand overall work relation, however, difficult to express the critical works(**see Figure 12**).

Figure 12 – Conventional Time: Chainage Program

Critical Path Method (CPM) Scheduling by Primavera P3

WBS (Work Breakdown Structure) was developed for the tunnel civil works, the electrical works and the mechanical works in order to establish a Critical Path Method (CPM) scheduling with tracking of the works running of the critical path (**see Figure 13**). WBS had updated when required. Configuration change management was executed to keep consistency in the time management.

Figure 13 - WBS for Electrical Works

On the basis of the WBS of each contractor, the Consultant developed a baseline schedule by Primavera P3. All interfaces had studied carefully and necessary linkages were made in the program (**see Figure 14**).

Figure 14 - Progress Tracking (Partial, by Primavera P3)

Monthly Progress Tracking Report

Since April 2004, the Consultant had issued a "Monthly Progress Tracking Report" to the Employer, copied to the Contractors, informing of 1) Change of WBS and work linkage during the previous month, 2) Overall progress of the project (summary), 3) Critical works (TF < 30 days), 4) Site Hand-over and Energization Forecast, 5) Detailed output as of the end of month. The report was also presented at URL:http://haivan.cadp.jp/05_progresstodate/work.htm.

CONCLUSION; KEYS TO SUCCESSFUL PROJECT MANAGEMENT

Communication Management with Clear RAM

As emphasized in the PMBOK, the communication management is the most important management area for the successful project implementation.

RAM (Responsibility Assignment Matrix) should be carefully established and disclosed in the project. Disclosure of RAM could reduce unnecessary communication barrier among people in the project, especially project in the developing countries where different cultural discipline usually exists. All the stakeholders should respect difference of culture of each staff in the project, however, should respect disclosed RAM at the same time, and it surely makes him/her to contribute to the project success.

Time Management with WBS

Time is the most important target in the construction project in which multiple contractors are involved in. Effective monitoring unit should be established for overall work coordination. The PMBOK recommends a unit equivalent to about 80 working hours; however, physical working areas for 80 hours are usually very much different in civil works and electrical and mechanical works. It is requested to establish acceptable work units for each contractor, and such agreed unit should be used in the process of WBS development.

Milestone in the project, especially hand-over and hand-back between the contractors, should be clearly indicated in the WBS and the monitoring schedule. Progressive detailing of the schedule can be made when a milestone is realized, however, such configuration changes should be kept traceable in the project to avoid unnecessary EOT claim.

Utilization of Web, as Communication Tool, in PMO

Ishimoto (2001, 2002) reported that there exist four objects for IT management in the Project Management Office (PMO); 1) Office Infrastructure, 2) Work Tools, 3) Data Management, and 4) Web, and he has been reporting the innovative application of the Web technology for the project management.

Ishimoto (2003) proposed standardized contents of Project Office WEBsite (POWEB), including modules of public, project-consultant, project-coordination, company, etc. That practice is disclosed at URL: http://haivan.cadp.jp (**see Figure 15**).

Figure 15 – Project Office Website (Hai Van Tunnel Construction Project)

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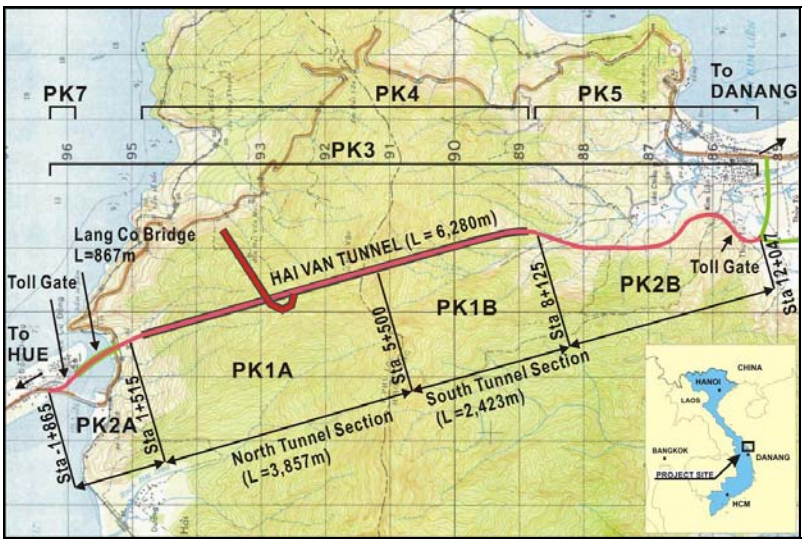

Figure 1 - Project Location Map

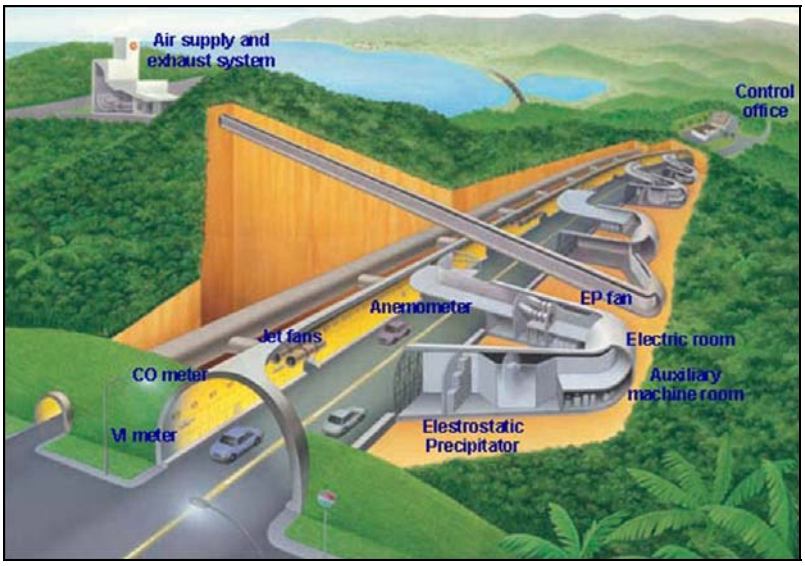

Figure 2 - Tunnel Ventilation System

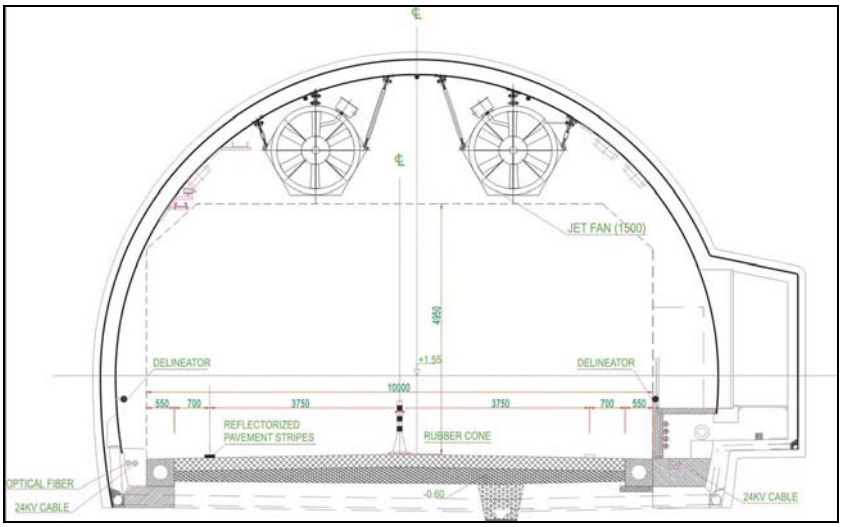

Figure 3 – Typical Cross Section of Hai Van Tunnel

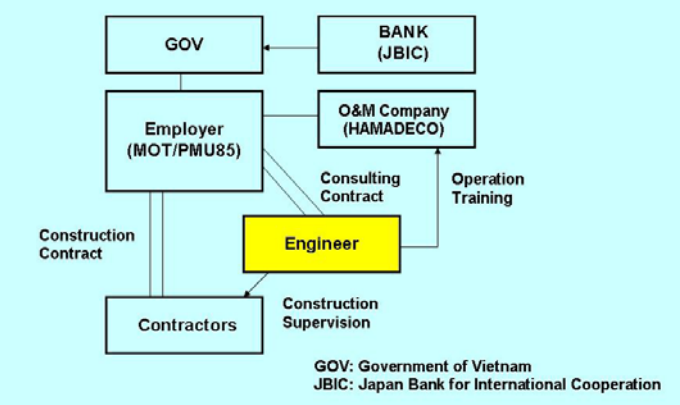

Figure 4 – Project Organizations

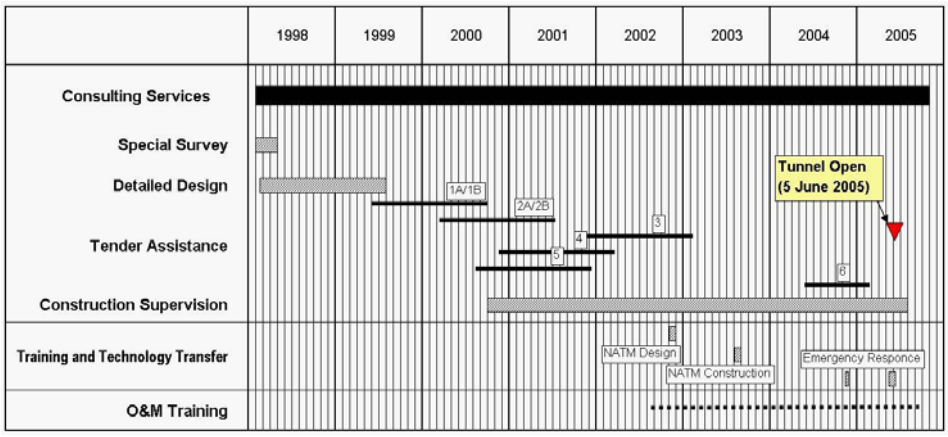

Figure 5 – Consulting Services Schedule

Figure 6 – Encountered Unforeseeable Geological Condition (1)

Figure 7 – Encountered Unforeseeable Geological Condition (2)

Figure 8 – Tunnel Opening Ceremony (broadcasted by NHK)

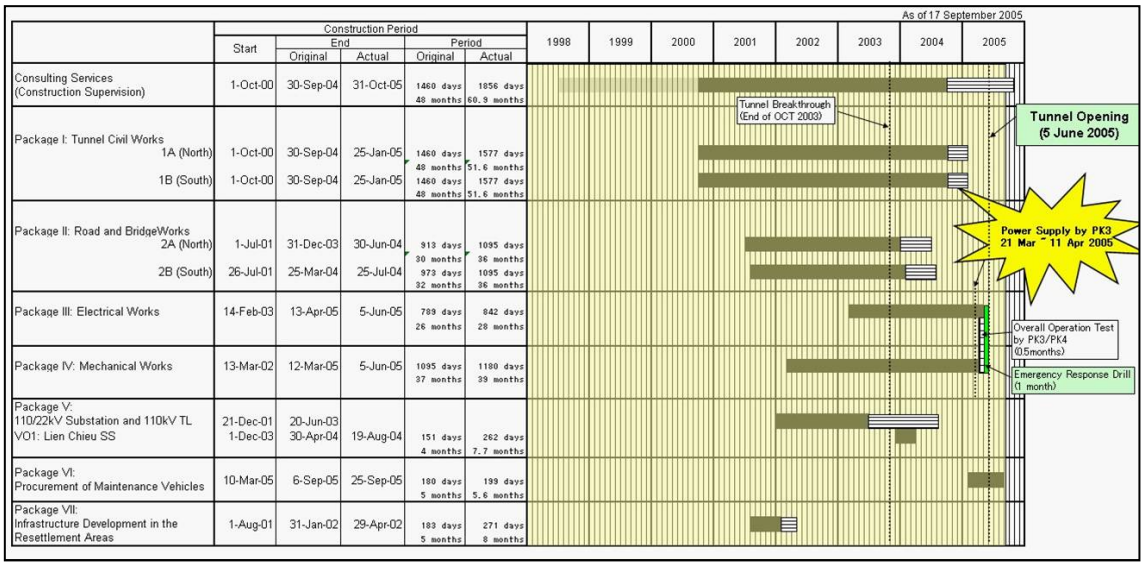

Figure 9 – Project Implementation Schedule

Figure 10 – Tunnel Emergency Response Training

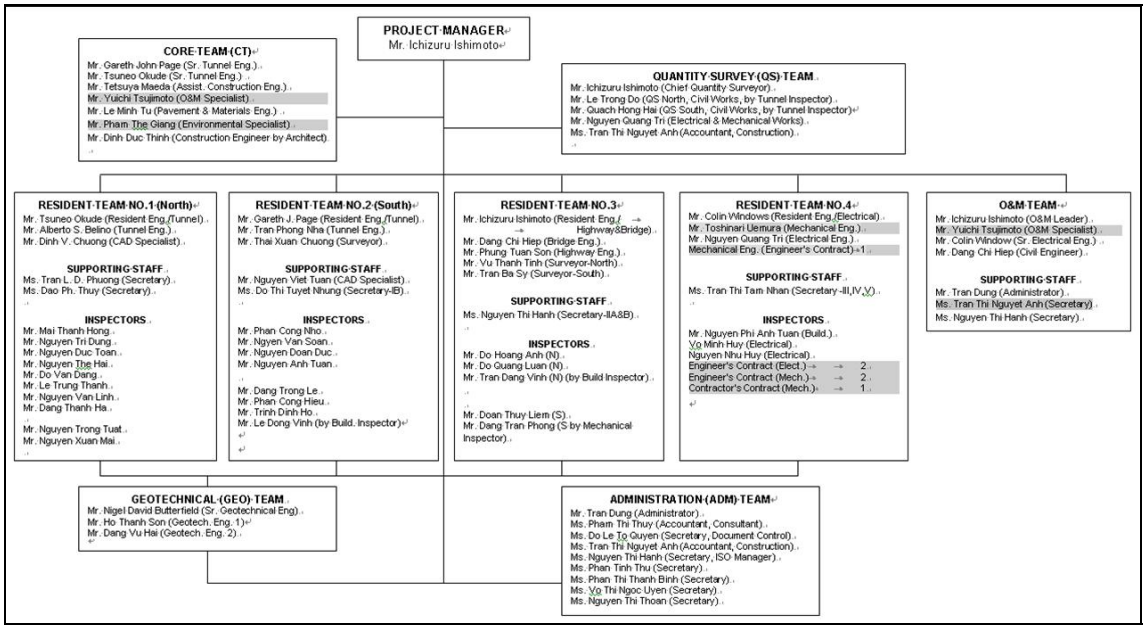

Figure 11 – Consultant Organization

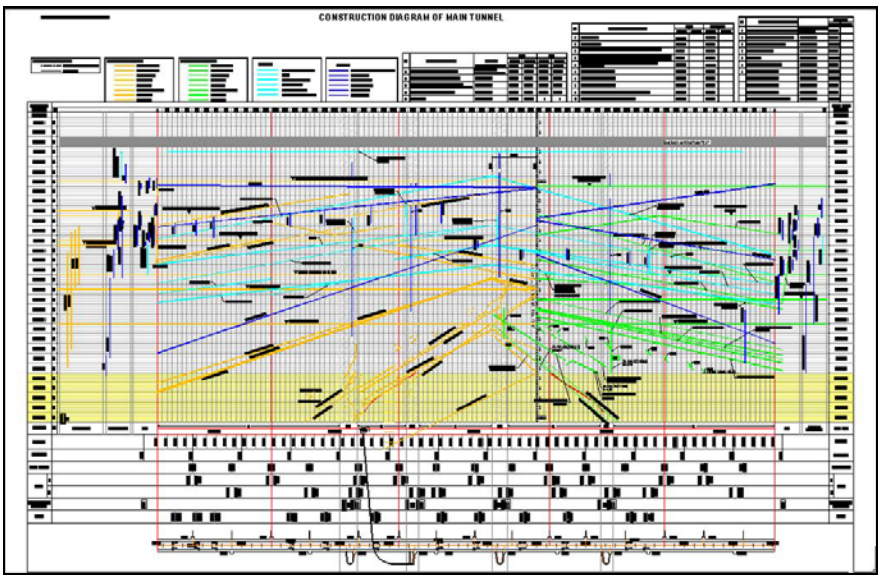

Figure 12 – Conventional Time: Chainage Program

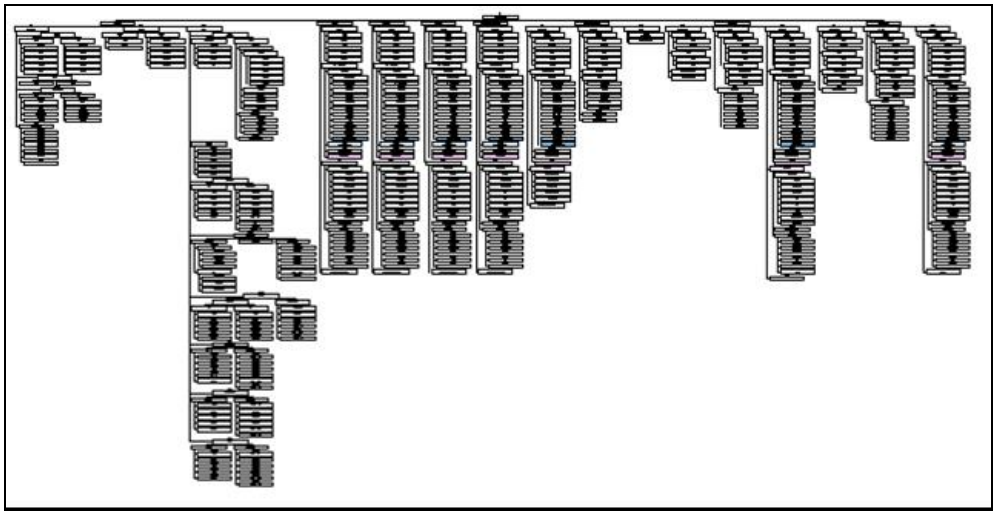

Figure 13 - WBS for Electrical Works

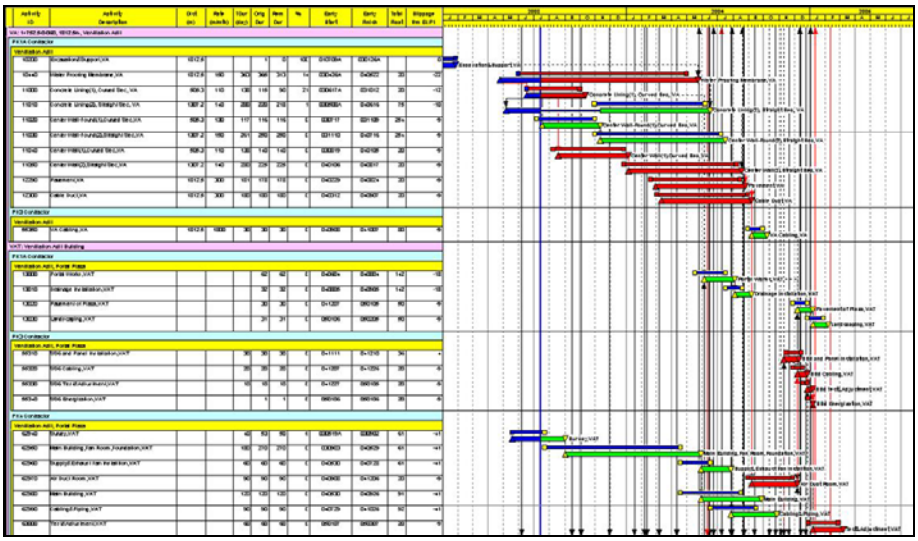

Figure 14 - Progress Tracking (Partial, by Primavera P3)

Figure 15 – Project Office Website (Hai Van Tunnel Construction Project)

URL: http://haivan.cadp.jp

Table 1 - Project Major Features

1) Project Length:	12,182m (incl. Tunnel = 6,280m, Bridges = 1,653m)
2) Traffic Lane:	2 Lanes (Stage 1)
	1.25 (shoulder) +3.75 (Carriageway) +3.75+1.25, Total 10.0m wide
3) Operation System:	SCADA (Supervisory Control And Data Acquisition)
4) Tunnel Length:	6,280m (Main Tunnel, MT), 6,286m (Evacuation Tunnel, ET),
	1,888m (Ventilation Adit, VA)
5) Tunnelling Method:	NATM (New Austrian Tunnelling Method)
6) Cross-section:	89m2(MT), 15.5(ET), 36.2(VA)
7) Cross-Passage:	400m interval
8) Ventilation System:	Longitudinal System, 23 Jet Fans, 3 EPs, 1 VA
9) Bridge Number and Length:	8 bridges, 1,653m in total length
10) Toll Plazas:	Two plazas on both ends of project roads

Table 2 – Project Organizations

Financing Agency	Japan Bank for International Cooperation (JBIC)
Loan Amount	L/A No. VNIV-5, March 26, 1997, Loan Amount: JPY 5.5 billion L/A No. VNVI-5, March 30, 1999, Loan Amount: JPY 10.0 billion L/A No. VNIX-4, March 29, 2002, Loan Amount: JPY 3.359 billion (Total JPY 18.859 billion)
Executing Agency	Project Management Unit No. 85 (PMU85) under Ministry of Transport and Communications (MOT)
O&M Company	HAMADECO (HAi van tunnel MAnagement and Development COmpany)
Consultant	Joint Venture of Nippon Koei Co., Ltd., Japan and Louis Berger International Inc., USA in association with Transport Engineering Design Incorporation (TEDI), Vietnam

Table 3 – Awarded Contractors

Contract Package	Awarded Contractor	Amount (USD)
1A: Tunnel Civil Works, North Tunnel Section	JV Hazama – Cienco 6	43,256,000
1B: Tunnel Civil Works, South Tunnel Section	JV Dong Ah – Song Da	27,863,000
2A: Road and Bridge Works, Lang Co Bridge Section	JV Thang Long – Truong Son	4,633,000
2B: Road and Bridge Works, Southern Highway Section	JV Cienco 1 – Lung Lo – Vinawaco	3,920,000
3: Electrical Works	JO of ABB – Kinden – Vinainco	20,686,000
4: Mechanical Works	Matsushita – Itochu Consortium	23,055,000
5: 110/22kV Substation and 110kV Transmission Line	JO of ABB – Kinden – Vinainco	7,256,000
6: Procurement of Maintenance Vehicles	Itochu Corporation	1,623,000
7: Infrastructure Development in the Resettlement Areas	Construction Company No. 185	413,000
		132,705,000

Table 4 - FIDIC Used in Project

Contract Package	FIDIC Conditions of Contracts
Civil Works 1A: Tunnel Civil Works, North Tunnel Section 1B: Tunnel Civil Works, South Tunnel Section 2A: Road and Bridge Works, Lang Co Bridge Section 2B: Road and Bridge Works, Southern Highway Section	Conditions of Contract for Works of Civil Engineering Construction, PART I GENERAL CONDITIONS, 4th Edition, 1987 (Red Book)
Electrical and Mechanical Works 3: Electrical Works 4: Mechanical Works 5: 110/22kV Substation and 110kV Transmission Line	Conditions of Contract for Electrical and Mechanical Works, 3rd Edition, 1987 (Yellow Book)

Table 5 - Project Management Objects

No.	Management Object
A	Consultant Team
B	Project
B-1	Overall Project
B-2	Each Contract Package

Table 6 - Responsibility Assignment Matrix of Consultant Team

Team / Knowledge Area	PMR	CT	RT	GEO	QS	OM	ADM
4. Project Integration Management	●	○					
5. Project Scope Management	●	○					
6. Project Time Management	●	○					
7. Project Cost Management	●						○
8. Project Quality Management	●	○	○	○	○	○	○
9. Project Human Resorce Management	●	○	○	○	○	○	○
10. Project Communication Management	●	○	○	○	○	○	○
11. Project Risk Management	●	○	○				
12. Project Procurment Management	●						○
13. Project Safety Management	●	○	○				
14. Project Environmental Management	●	○	○				○
15. Project Financial Management	●						○
16. Project Claim Management	●	○	○		○		
PMR: Project Manager, CT: Core Team, RT: Resident Team, GEO: Geotechnical Team QS: Quantity Surveyor Team, OM: Operation and Maintenane Team, ADM: Administration Team							
●: Primary Responsibility ○: Secondary Responsibility							

Table 7 - Responsibility Assignment Matrix for Project

Team / Knowledge Area	Overall Project			Each Package		
	PMR	RE	Other	PMR	RE	Other
4. Project Integration Management	●	○		●	○	
5. Project Scope Management	●	○	QS	○	●	
6. Project Time Management	●	○		○	●	
7. Project Cost Management	●		QS		○	QS
8. Project Quality Management	●				●	GEO
9. Project Human Resorce Management	●	○		●	○	
10. Project Communication Management	●	○	ADM	○	●	ADM
11. Project Risk Management	●	○	QS	○	●	
12. Project Procurment Management	●		ADM	●	○	ADM
13. Project Safety Management	●	○		○	●	
14. Project Environmental Management	●	○		○	●	
15. Project Financial Management	●		QS	●	○	QS
16. Project Claim Management	●		QS	●	○	QS
PMR: Project Manager, RT: Resident Team, GEO: Geotechnical Team QS: Quantity Surveyor Team, ADM: Administration Team						
●: Primary Responsibility ○: Secondary Responsibility						

Table 8 - Project Milestone

No.	Milestone	Actual (Schedule)
1	Commencement of Each Contract Package	CP3 Feb 2003, CP4 Mar 2002
2	Tunnel Breakthrough	28 Oct 2003
3	Site Hand-Over from Tunnel Civil to Mechanical	Oct 2003 – Mar 2004
4	Site Hand-Over from Mechanical to Electrical	Nov - Dec 2004
5	Site Hand-Over from Tunnel Civil to Electrical	Nov 2003 – Aug 2004
6	Power Distribution from Electrical to Mechanical	Mar 2005 (Feb 2005)
7	Commissioning of Each Facility	May 2005 (Mar-Apr 2005)
8	Emergency Response Training	May 2005 (May 2005)
9	Tunnel Traffic Open	5 June 2005 (May 2005)

Table 9 - Diagram Type of Overall Construction Schedule

No.	Diagram Type	Tool	Work Unit Interval	Applied Period
0	Bar Chart	MS-Excel	No Work Zone	Tunnel Civil Contractors
1	Time:Chainage Program	AutoCAD	Approx. 1000 m	May 2003 – Oct 2003
2	CPM (BLP 1)	Primavera P3	Approx. 1000 m	Jun 2003 – Mar 2004
3	CPM (BLP 2)	Primavera P3	Approx. 400 m	Apr 2004 – Jun 2005
BLP: BaseLine Program				