Introduction of Hai Van Pass Tunnel Construction Project in Vietnam

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Abstract

The Hai Van Pass Tunnel Construction Project is located near the city of Danang in Central Vietnam. The tunnel civil works were commenced in October 2000 and the breakthrough was celebrated in October 2003. Since then, installation of electrical and mechanical facilities has progressed rapidly aided by well-organized work coordination, and the tunnel is scheduled to open to the public in May, 2005. The author, as Project Manager of the Consultant Team, presents the project management practices with reference to the *Guide to the Project Management Body of Knowledge* (*PMBOK® Guide*) project management principles. Particular emphasis is given to human resource management and time management.

Introduction of Project

The Hai Van Pass

The Hai Van Pass located in coastal Central Vietnam (Exhibit 1), is 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 the 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.

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, 4) SCADA (Supervisory Control And Data Acquisition) for Overall System Control, 5) O&M Company required.

Exhibit 1 – Project Location Map

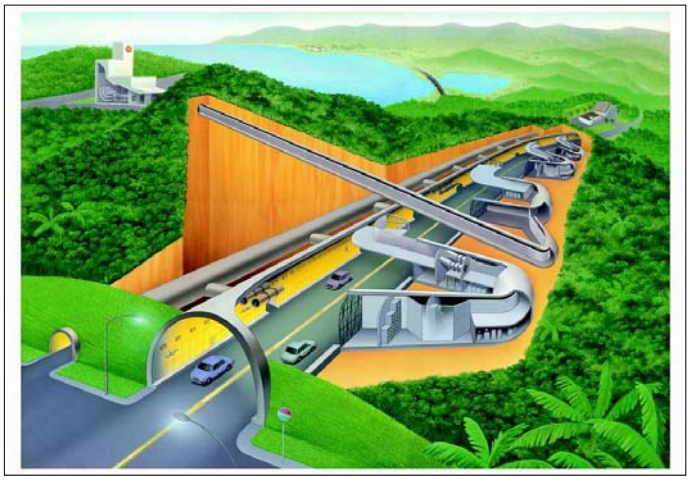

Exhibit 2 – Tunnel Ventilation System

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Project Major Features

Project major features are summarized in the following table (Exhibit 3).

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

Exhibit 3 – Project Major Features

Implementation Program of Project

The consulting services 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.

The construction was started on 1st October 2000, as of December 2004; the project has progressed very closely to the original schedule. The next major events will be; completion of civil works: Jan 05, completion of mechanical works: Apr 05, completion of electrical works: Apr 05, operation training: May 05, and traffic open: May 2005

Project Organizations

Project organizations are summarized in the table below (Exhibit 4, 5)

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

Exhibit 4 – Project Organizations

Contract Package	Awarded Contractor	Contract 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	(Not Yet, Under Bid Evaluation)	2,000,000
7: Infrastructure Development in the Resettlement Areas	Construction Company No. 185	413,000
		133,082,000

Exhibit 5 – Awarded Contractors

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FIDIC Based Project

FIDIC (International Federation of Consulting Engineers) is widely used as conditions of contract for international construction contracts.

The following FIDIC conditions of the contract are used in the project (Exhibit 6).

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)

Exhibit 6 – FIDIC Used in Project

Organization Structure

A construction contract is placed between the Employer and the Contractor, however, the Consultant, stipulated as the Engineer in the contract, is required to act impartially to the both (Exhibit 7).

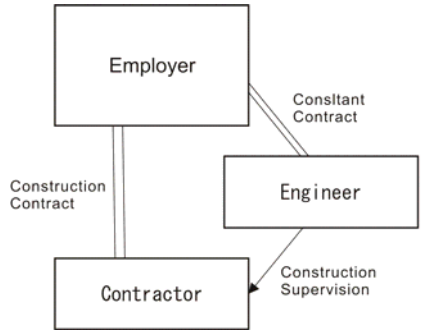

Exhibit 7 – Organization of FIDIC Project

Project Human Resource Management

Three Objects for Project Management

The Project Manager (PMR) of the Consultant team is responsible for management, not only for the Consultant Team but also the overall project. The PMR has been aware that the following three objects are his management targets and have been tried to establish good communication atmosphere among the project (Exhibit 8, Ishimoto 2004).

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

Exhibit 8 – Project Management Objects

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Application of PMBOK

The PMR has used the Construction Extension 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 *Guide to the Project Management Body of Knowledge (PMBOK® Guide)* have been carefully distributed to each team in the Consultant for the successful project management.

RAM for Consultant Team

The 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).

Responsibility Assignment Matrix (RAM) for the Consultant team was set up as follows (Exhibit 9):

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							

Exhibit 9 – Responsibility Assignment Matrix of Consultant Team

RAM for Overall Project and Each Contract Package

The Resident Engineer (RE) has a great deal of 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 (Exhibit 10).

Team	Overall Project			Each Package		
Knowledge Area	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						

Exhibit 10 – Responsibility Assignment Matrix for Project

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Project Time Management by Primavera P3

Progressive Detailing of Work Schedule

The Consultant has taken a proactive initiative for work coordination among the contractors because the tunnel civil, electrical and mechanical contractors are 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 have 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 exist in the project (Exhibit 11).

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	(Feb 2005)
7	Commissioning of Each Facility	(Mar-Apr 2005)
8	Emergency Response Training	(May 2005)
9	Tunnel Open	(May 2005)

Exhibit 11 – Project Milestone

Diagram Type for Scheduling

Time management has detailed progressively. The Consultant has developed the overall construction schedule in different diagram types in accordance with depth of scope of works (Exhibit 12).

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 – To date
BLP: BaseLine Program				

Exhibit 12 – 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.

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 (Exhibit 13).

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 (Exhibit 14).

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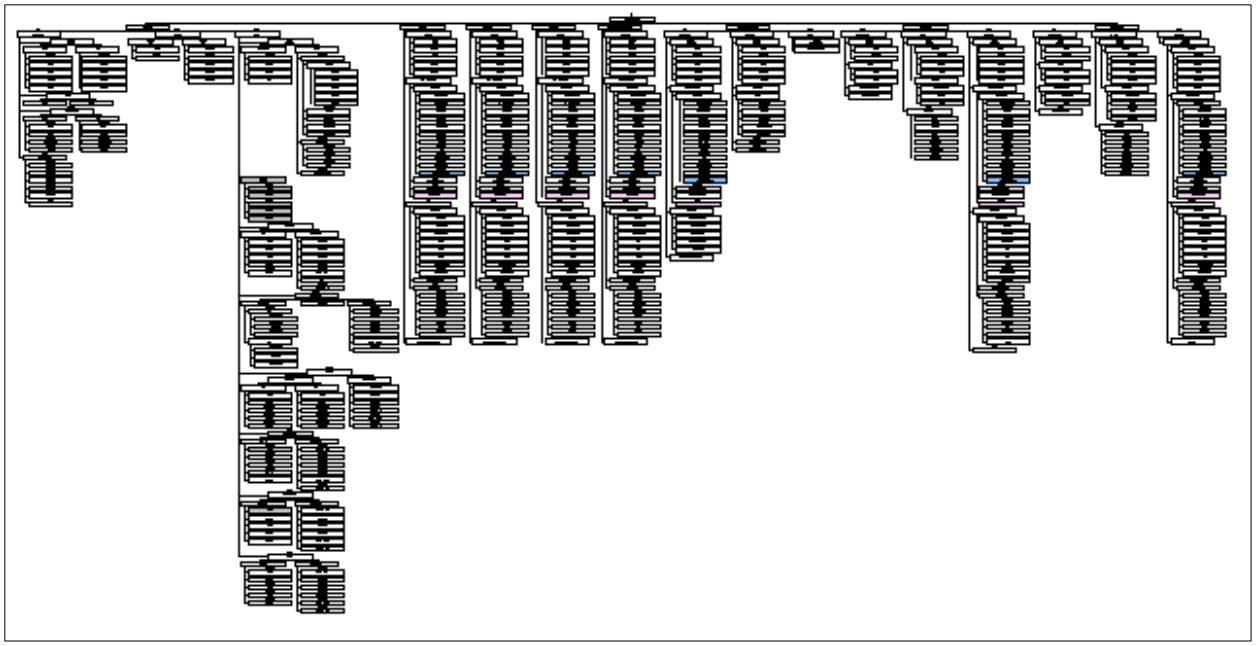

Exhibit 13 – WBS for Electrical Works

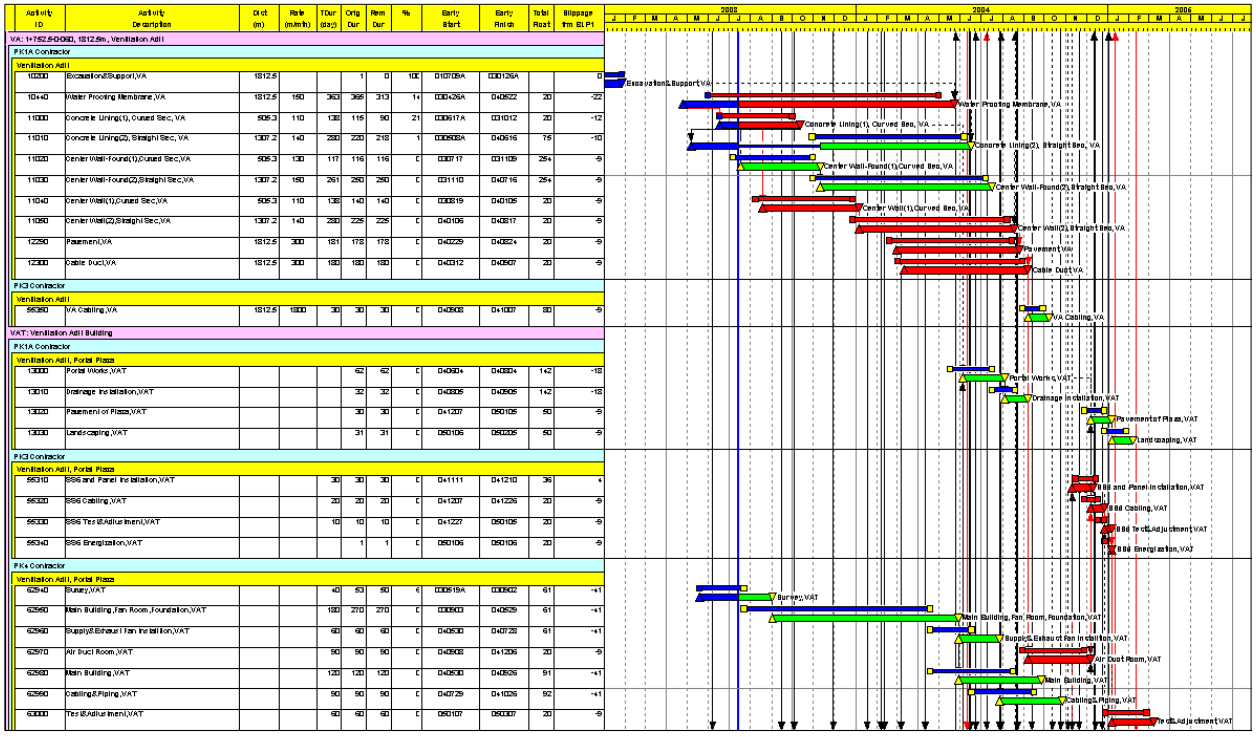

Exhibit 14 – Progress Tracking (Partial, by Primavera P3)

Monthly Progress Tracking Report

Since April 2004, the Consultant has issued a "Monthly Progress Tracking Report" to the Employer, copied to the Contractors, informing of 1) Overall progress of the project (summary), 2) Critical works (TF < 30 days), 3) Site Hand-over and Energisation Forecast, 4) Detailed output as of the end of month. The report is also presented at URL:http://haivan.cup.com/05_progresstodate/work.htm.

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Summary; 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 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 project in which multiple contractors are involved. 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 those contractors and the unit should be used for the WBS development.

Milestones in the project, especially hand-over and hand-back between the contractors, should be clearly indicated in 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.cup.com.

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