No.

MINISTRY OF PUBLIC WORKS AND TRANSPORT
REPUBLIC OF COSTA RICA

THE STUDY
ON
CAPACITY DEVELOPMENT
IN
BRIDGE REHABILITATION PLANNING, MAINTENANCE AND MANAGEMENT
BASED ON
29 BRIDGES OF NATIONAL HIGHWAY NETWORK
IN
COSTA RICA

FINAL REPORT
1 of 3
EXECUTIVE SUMMARY

February 2007

JAPAN INTERNATIONAL COOPERTATION AGENCY

Oriental Consultants Company Limited

Chodai Company Limited

SD
JR
07-06

The following foreign exchange rates are applied in the Project:

USD 1.00 = 116.91 JPY (as of August 2006)

USD 1.00 = 515.86 CRC (as of August 2006) ※ CRC: Costa Rica Colon

PREFACE

In response to the request from the Government of the Republic of Costa Rica, the Government of Japan decided to conduct the Study on Capacity Development in Bridge Rehabilitation Planning, Maintenance and Management based on 29 Bridges of National Highway Network and entrusted to study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Dr. Masaaki TATSUMI of Oriental Consultants Co., Ltd. and consist of Oriental Consultants Co., Ltd. in association with Chodai Co., Ltd. to Costa Rica, between September 2005 and January 2007.

The team held discussions with the officials concerned of the Government of Costa Rica and conducted the technical assistance for Capacity Development in bridge maintenance and rehabilitation as well as reinforcement and rehabilitation design for 10 selected bridges at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report in February 2007.

I hope that this report will contribute to develop their capacity in bridge maintenance and rehabilitation of Costa Rica, and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Costa Rica for their close cooperation extended to the study.

February 2007

Kazuhisa MATSUOKA
Vice President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

February 2007

Mr. Kazuhisa MATSUOKA,
Vice President
Japan International Cooperation Agency (JICA)
Tokyo, JAPAN

We are pleased to submit to you the Final Report of the Study on Capacity Development in Bridge Rehabilitation Planning, Maintenance and Management based on 29 Bridges of National Highway Network.

This Study was conducted by Oriental Consultants Co., Ltd. in association with Chodai Co., Ltd. under a contract to JICA, during the period from September 2005 to January 2007. In conducting the Study, we have completed the technical assistance for Capacity Development in bridge maintenance and rehabilitation as well as reinforcement & rehabilitation design for 10 selected bridges.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, Ministry of Foreign Affairs of Japan, Ministry of Public Works and Transport (MOPT), National Road Counsel (CONACVI), JICA Costa Rica Office, and Embassy of Japan in Costa Rica for their cooperation assistance throughout the Study.

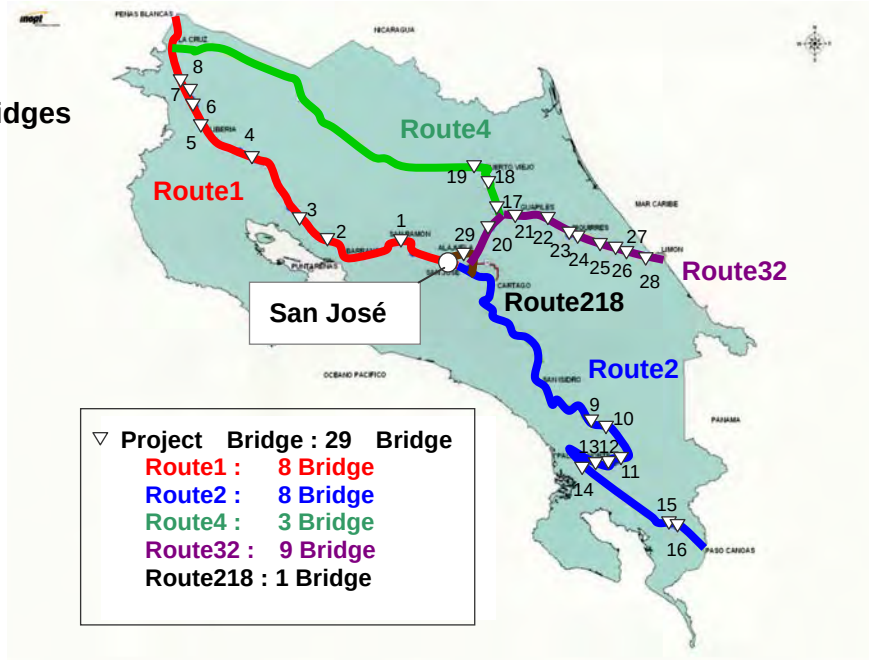
Finally, we hope this report will contribute to further cooperation of Costa Rica.

Very truly yours,

Masaaki TATSUMI
Team Leader, Study Team of the Study on Capacity Development in Bridge Rehabilitation Planning, Maintenance and Management based on 29 Bridges of National Highway Network

Project Location Map

29 targeted bridges Location



Project Outline

1. Country	Republic of Costa Rica
2. Name of Study	The Study on Capacity Development in Bridge Rehabilitation Planning, Maintenance and Management based on 29 Bridges of National Highway Network in Costa Rica
3. Counterpart Agency	Ministry of Public Works and Transport
4. Objectives of the Study	・ Assistance for the Capacity Development on the Bridge Rehabilitation Planning, Maintenance and Management ・ Implementation of Inspection, Diagnosis and Rehabilitation & Reinforcement Plan for Bridges on Trunk Roads ・ Establishment of Tools for the Bridge Maintenance（Bridge Management System (BMS), Manual & Guideline）

1. The Study Area

・29 bridges on National Road Network (Route 1, 2, 4, 32, 218) including 10 bridges for Rehabilitation & Reinforcement Planning

・Governmental Agencies, Stakeholders relevant to the Bridge Maintenance.

2. Components of the Study

1) Formulation and implementation of the Capacity Development Program for Bridge Management & Maintenance

a) Capacity gap assessment
b) Formulation of the Basic policy and the Plan of the capacity development
c) Implementation of the Capacity development

2) Evaluation of the Exiting Condition (Inspection/Diagnosis) : on 29 bridges

a) Establishment of the Inspection method and Implementation of the site inspection
b) Establishment of the Evaluation method of bridge deficiency and Selection of 10 prioritized bridges

3) Formulation of the Rehabilitation & Reinforcement Plan for Bridges：on 10 bridges

a) Implementation of the Detailed inspection
b) Implementation of Studies on natural conditions (River conditions, Geological examination)
c) Implementation of Bridge loading test (technical transfer of the testing procedure is a main objective)
d) Examination and Selection of construction plans for the rehabilitation & reinforcement
e) Elaboration of the Rehabilitation & reinforcement design and drawings.
f) Implementation of the Preliminary construction plan, Cost Estimation and Economic analysis
g) Implementation of IEE and Stakeholders meetings, Assistance on formulation of the ToR for EIA

4) Establishment of tools for the bridge maintenance (Bridge Management System (BMS), Manual & Guideline)

3. Narrative Description

Capacity Development

"Capacity Gap Assessment" was conducted in basis of interviews with relevant institutions in order to comprehend existing issues of the bridge maintenance on Individual, Organizational and Institutional/Social levels. Throughout the PCM method (Problem & Objective Analysis), Basic policies and CD program, which comprises 13 prototype modular projects, were formulated. As a main supporting body for the implementation of the program, "Bridge Maintenance Consulting Group (BMCG)" was organized sector-crossingly with members from Public-Private-Academic sectors. To enhance the implementation, 5 integrated modular projects were further clustered and allocated to 5 working groups formed in BMCG to prepare preliminary Work Breakdown Structure (WBS) & Action plans (PO). During the study period, Human Resource Development aimed at improvement of individual capacities were anticipated prior to initiation of the full-scale program, while an organizational structure was proposed for organizational capacity development by the Study team. At the end of the Study, PPP regional seminar were designed and conducted together with the Counterpart Agency in order for Costa Rica to initiatively disseminate outputs/outcomes amongst PPP countries. Through the presentations at the seminar by counterparts, a progress currently stepped of the capacity development was verified.

Rehabilitation & Reinforcement Plan and Tools for the Bridge Maintenance & Management

The site inspections were undertaken on 29 study bridges and the evaluation method for bridge deficiency was established. 10 prioritized bridges were selected to implement the detailed inspection, planning & designing for bridge rehabilitation/reinforcement, construction plans & cost estimation and economic analysis. After streamlining procedures in harmonization with actual states of the bridge maintenance in Costa Rica, BMS was thoroughly established. In addition, other supplemental tools for the bridge maintenance i.e. Bridge inspection manual, BMS operation manual and Guideline for the bridge management were elaborated.

4. Conclusion and Recommendations

- 5 integrated modular projects were abstracted and streamlined throughout the Study. In addition, BMCG and Working groups were organized for further implementation. It is recommended that the bridge management is duly to be implemented in accordance with those 5 integrated modular projects for future scene of the bridge management in Costa Rica.
- It is recommended that each Working group is to be uninterruptedly operated focusing on the following aspects.
  - Individual Capacity Improvement of MOPT & CONAVI Officials
  - Long-term Human Resources Development & Technical Information Exchanges
  - Improvement of Regulations & Standards
  - Promotion of Advocacy of Government Officials & Public Relations
- Continuous Monitoring & Evaluation on Outcomes for Capacity Development Process is consequently to be required

SUMMARY OF PROJECT

Study Period: From September, 2005 to February, 2007
Counterpart Agency: Ministry of Public Works and Transports, National Road Counsel

S.1 Background and Objectives of the Study

The road network in Costa Rica reaches over 35,000 km of total length and comprises international trunk roads named Pan-American Highway. Since the overland mode is the most predominant transportation in the Central America comparing with the air or the marine transportation mode, improvement of the road network is a key factor on developing and integrating economy in the region. Consequently, it is a common understanding that deficiency on the road maintenance shall socio-economically produce immense and regional-wide impacts in the Central America.

Under the circumstances that most of 1,330 bridges on the national highway suffer from severe deteriorations caused by earthquakes, river flowing and increasing traffic volume, deficiency on the road maintenance has allowed those deteriorations to reach more critical levels. The National Development Plan of Costa Rica states that the bridge rehabilitation on trunk roads is particularly key tractions to accelerate the economic growth in the country.

Given the preceding, the Government of Costa Rica requested the Government of Japan to implement technical assistances on the bridge management system. In response to the request, the Study was decided to conduct. The Study was conducted on the 29 targeted bridges on trunk roads focusing on an assistance for the capacity development for the bridge reinforcement, rehabilitation and the bridge management with the following schedule.

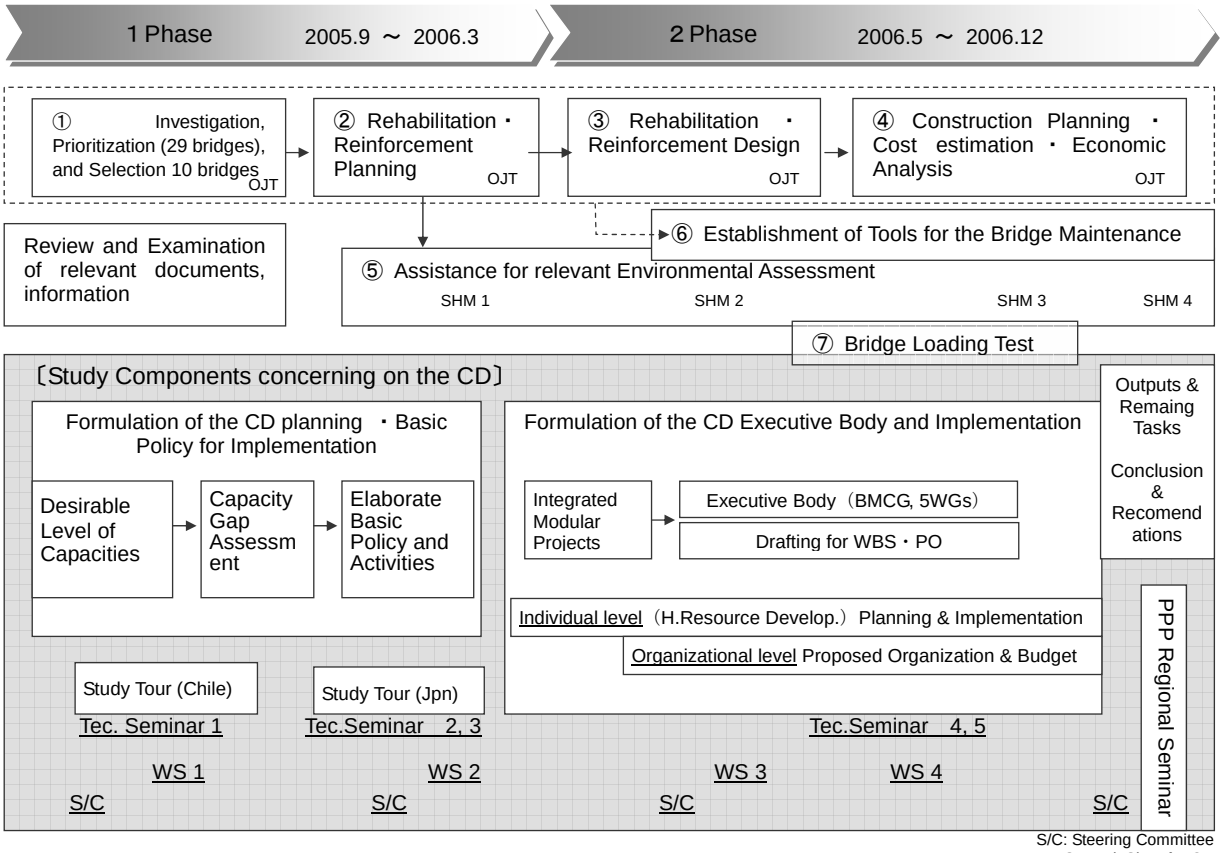


Figure 1.1. Components and Schematic Process of the Study

S.2 Review and Examination of Relevant Documents and Data

National and Socio-economic conditions were reviewed on the following items.

- Natural condition: geography, climate, seismic
- Socio-economic state: Land use, Population data/Social index, Economy and Industry
- Present state of the road network
- Present state of the road maintenance

S.3 Existing Condition of Bridges and Status of Bridge Maintenance

In order to comprehend a present state of bridges and the bridge maintenance, the following items are examined.

- Existing condition of bridges in Costa Rica
- Bridge Design Standards
- Bridge Maintenance (Executive organization, Bridge maintenance system)

S.4 Capacity Gap Assessment

The full-scale capacity gap assessment was jointly conducted with counterpart officials of MOPT and CONAVI in order to evaluate capacities at "Individual", " Organizational" and "Institutional and Social" levels in terms of the bridge maintenance, and thereby to identify existing problems. The assessment was implemented throughout interviews with relevant institutions as follows:

a) MOPT, its related departments and regional offices
b) CONAVI, its related departments and regional offices
c) Other relevant government ministries and agencies such as MOH, MIDEPLAN, CNC, MINAE, SETENA and etc.
d) University of Costa Rica and its related research institutes such as LANAMME
e) Costa Rica Architect and Engineering Association
f) Private sector such as contractors and design companies
g) Users such as truckers, passengers and citizens

The procedures for the capacity gap assessment include the following steps. 1) Designing capacity gap assessment score sheets, 2) Interviews and collection of data/information from relevant stakeholders, 3) Preliminary assessment of capacity gaps as well as Full-scale assessment of capacity gaps. PCM (Project Cycle Management) analysis including the problem analysis and the objective analysis were employed to solve the bottleneck against the ideal bridge management.

Upon the problem analysis, the core problem of "Inappropriate Bridge Maintenance" was derived from i) insufficient bridge maintenance capacity, ii) weak organizational structure on bridge maintenance, iii) insufficient budget for bridge maintenance, iv) insufficient enforcement of laws, regulations and standards, and v) insufficient knowledge management on bridge maintenance.

S.5 Basic Policies For Capacity Development

In order to solve problems identified by the problem analysis, the program for the total management of the bridge maintenance and rehabilitation, which is composed of the cluster of 13 proto-type modular projects, is consequently proposed throughout the objective analysis and the alternative analysis.

S.6 Implementation of Capacity Development for Comprehensive Bridge Maintenance Program

13 proto-type modular projects identified were integrated into 5 full-scale modular projects. Throughout formulation of PDM (Project Design Matrix), the cluster of 5 integrated full-scale modular projects is regarded as the bridge maintenance program.

Integrated Modular Project 1 (MP-1): Individual Capacity Building Project for MOPT and COMAVI		
1	Individual Capacity Improvement Project for Inspection and Diagnosis	"Individual" level
2	Individual Capacity Improvement Project for BMS Operation, Priority Selection and Rehabilitation Planning of Bridges	"Individual" level
3	Individual Capacity Improvement Project for Implementation of Rehabilitation of Bridges	"Individual" level
Integrated Modular Project 2 (MP-2): Institutional Building Project for MOPT and CONAVI		
1	Organization Strengthening Project for Direction of Bridges of MOPT	"Organizational" level
2	Organization Strengthening Project for New Bridge-related Department of CONAVI	"Organizational" level
Integrated Modular Project 3 (MP-3): Long-term Human Resources Development and Technical Exchange Project		
1	Long-term Human Resources Development Project	"Individual" level
2	Public-Private-Academic Technical Exchange Project	"Organizational" level
3	PPP Countries Technical Exchange Project	"Social" level
Integrated Modular Project 4 (MP-4): Regulation and Standards Improvement Project		
1	Technical Regulations and Design Standards Improvement Project	"Institutional" level
2	Procurement Regulations and Procedures Improvement Project	"Institutional" level
Integrated Modular Project 5 (MP-5): Promotion of Public Relations and Advocacy Project		
1	Asset Management Advocacy Project for Financial and Planning Authorities	"Institutional" level
2	Bridge Users Public Relations and Advocacy Project	"Social" level
3	Tax Payers Public Relations and Advocacy Project	"Social" level

As a main body for the implementation of the capacity development program, "Bridge Maintenance Consulting Group (BMCG)" which consists of representatives from various organizations was established to form 5 working groups. In order to concrete the program implementation, the preliminary WBSs as well as POs are drafted. The full-scale WBSs and POs will be formulated as the 5 years plan in the course of a series of the BMCG meetings held in the financial year 2007 in order for the plan to be initiated from the financial year 2008.

As a part of assistances for the organizational capacity development, the study team proposed both an organizational structure and a budgetary arrangement for the bridge maintenance.

In order to realize further dissemination toward PPP countries, PPP Regional Seminar was held at the end of the study, which allowed to introduce the outline and to extend outputs/outcomes of the study to neighboring countries on the bridge management.

S.7 Human Resource Development

The Human Resource Development plays a part of roles of the capacity development program upon the individual level, which comprises mainly technical training activities for the bridge management. These activities were anticipated to the initiation of the program development and regarded as inputs for the Program (integrated modular project 1, 3).

Technical training activities have been introduced and initiated essentially aiming upon the counter-parts technical staff at the beginning of the study. The activities were thoroughly practiced in manner of both On-the-Job (OJT) and Technical Seminar basis to aim an enhancement of Knowledge, Skill & Attitude. In addition, it is remarked that an Overseas Study Tour was applied for the study, which was aimed to obtain supplementary effects and amplify effectiveness on both the technical training and dissemination.

S.8 Existing Condition and Site Inspection of the Study Bridges

29 Study Bridges (17 bridges of the concrete girder type, 12 bridges of the steel girder type) were examined and visually inspected. The relevant documents and data, e.g. bridge inventories in MOPT, drawings, the history of repair, traffic volume, topography map, river information, were collected and reviewed to comprehend the condition of each bridge. The bridge engineers from MOPT joined with the Study Team to implement the visual inspection for all bridges as the "On-Job-Training", effectively using the inspection sheets.

Member	Results (Deterioration)	Bridge No.	Remarks（Possible cause）
Superstructure	Deck slab is severely damaged.	14 bridges	Heavy traffic volume is one of the major. all bridges on Route 1 have damaged on their deck slabs, whereas the bridges on Route 2, which were constructed in 1960s to 1970s same as the bridges on the Route 1
	Damages of connection nodes between a stringer and a crossbeam are largely observed.	Steel truss	Caused by the lack of rigidity of the floor frames.
	Bearings were broken by the earthquake. (main girders displaced by 10 cm along the transversal direction)	No.26, 27, 28	Bridges are located on the Route 32 nearby the Limon port where the earthquake occurred
	Deformations of main girders are observed for the PC Box girder bridges.	No.17, 20	Predominantly caused by an insufficient quality control during construction.
Substructure	Slope collapses around abutment are observed.	Most of the bridges	
	Scouring around foundation at piers or abutments is also observed.	Some of the bridges	Bridge No. 16, the pile foundation is exposed more than 2 m below the bottom of footings by scouring.
Accessories	Expansion joint, railing are damaged.	29 bridges	Insufficient maintenance
Anti-seismic measures	Insufficient countermeasures against bridge falling (reinforcement :substructure, enlargement: overlapped length of girders. width of bridge seat		
Countermeasure For live load	Insufficient load carrying capacity against HS20-44+25%		Bridges on Route 1 and 2 were designed with the H15-S12 of live load and the bridges on other routes were designed with HS20-44.

S.9 Selection of 10 Bridges for Rehabilitation, Reinforcement

Under collaboration between MOPT bridge engineers and the Study team, selection of prioritized bridges for rehabilitation were processed and finalized in accordance with the comprehensive deficiency evaluation of bridges whose criteria consists of a degree of deterioration observed, a weight determined by the functional importance as structural parts as well as a weight determined by the potential negative impact that those damages presenting may affect structural parts of bridges. In the Study, the Analytic Hierarchy Process (AHP), a decision support method was to be utilized for the evaluation of bridge deficiency.

10 bridges for rehabilitation, reinforcement shall be selected not only based on results of the evaluation of the bridge deficiency, but also other points of view, which it will be indeed a purpose of the Study, that outputs of the study are to be widely applicable and expandable for the bridge maintenance in Costa Rica.

S.10 Plan for Rehabilitation, Reinforcement and Improvement of 10 Selected Bridges

The plan for rehabilitation, reinforcement was formulated throughout an evaluation of results from both the detailed design (Visual Inspection, Concrete core sampling test, Schmidt hummer test, Phenolphthalein test, Detection of R-bar position, Measurement of steel plate thickness) and the structural analysis.

In this particular case of the Study, since it is required to completely re-check and secure both the load carrying capacity satisfying HS20-44+25% and quake-resistibility satisfying the local anti-seismic codes, a structural analysis with computed structural models were applied for verifying sectional forces or stresses at each members in order to determine a necessity as well as specific conditions to reinforce.

Bridge Loading Test was conducted mainly aiming at the technical transfer to MOPT engineers. Based on the results of the stress frequency measuring at the steel deck beam bridge, fatigue failure was evaluated to estimate the residual life.

S.11 Detailed Design for selected 10 bridges

Methods of the rehabilitation, the reinforcement for 10 bridges were summarized as follows.

Table 11.1 Superstructure ("O": Applicable method)

Member	Methods	R1			R2			R4		R32		R216
		2	3	7	12		16	17	19	20	26	29
		ST	ST	RI	SI	RI	RI	PB	SI	PB	SI	PI
Deck Slab	Slab thickness increasing (upper side)			O			O					
	FRP bonding				O	O			O		O	
	Replacement: PC deck	O	O									
Floor frame Main girder: Steel	Replacement: frames	O	O	N/A		N/A	N/A	N/A		N/A		N/A
	Steel plate thickness increasing		O	N/A		N/A	N/A	N/A	O	N/A		N/A
	Additional members	O		N/A		N/A	N/A	N/A		N/A		N/A
	Replacement: steel plate			N/A		N/A	N/A	N/A	O	N/A		N/A
	Out cable			N/A	O	N/A	N/A	N/A	O	N/A		N/A
Main girder: RC, PC	Girder height increasing	N/A	N/A	O	N/A				N/A		N/A	
	FRP bonding	N/A	N/A		N/A		O		N/A		N/A	O
	Steel plate bonding	N/A	N/A	O	N/A	O			N/A		N/A	
Accessories	Replacement: Expansion joint	O	O	O	O	O	O	O	O	O	O	O
	Bearing repair						O				O	
	Replacement: railing	O	O									
Pavement	Asphalt paving	O	O	O	O	O	O	O	O	O	O	○
	Waterproofing	O	O	O	O	O	O	O	O	O	O	○

Table 11.2 Substructure ("O": Applicable method)

Member	Methods	R1			R2		R4		R32		R216
		2	3	7	12	16	17	19	20	26	29
		ST	ST	RI	SI,RI	RI	PB	SI	PB	SI	PI
Substructure	Beam section increasing				O			O		O	O
	Concrete Jacketing	O	O	O		O					O
	Concrete protection						O		O		
Foundation	Footing widening	O	O	O	O	O	O	O		O	O
	Additional piles	N/A	N/A	N/A	N/A	O	N/A	O	N/A		N/A
Anti-Falling-down	Bridge seat widening, Displacement limitation system	O	O		O	O		O		O	O
	Connection system (chain)		O		O			O		O	
Protections	Slope protection (Masonry)	O			O	O					
	Riverbed protection (Gabion)	O	O		O	O				O	O

S.12 Preliminary Construction Planning and Cost Estimate

Work execution for the Project without entire traffic closure is crucial considering social and economic aspects because those bridges are located at highly important trunk roads in Costa Rica. It shall be a plan that construction works are basically to be executed on one side of the bridge in order to secure one-way traffic on the other side all the time. Consequently, the construction period is to be estimated 60 to 190 days.

Estimated cost for the Project counts 360,000 to 3,270,000 USD (42,088,000 to 382,300,000 JPY) including contingency which is equivalent to 5% of the total direct costs.

S.13 Economic Analysis

The aim of this economic analysis includes subjects such as: 1) consideration of the suitable economic analysis method for bridge rehabilitation & reinforcement, 2) trial this analysis against the 10 selected bridge, and 3) systemized this method to be extended to another bridge.

Based on the “with case” and “without case” for bridge rehabilitation & reinforcement, project costs & benefits are examined. The project benefits are evaluated as the reduction costs which are the costs in the case of “without case”.

Project costs, which are described in the chapter12, were converted as the economic cost to be employed. Operation & maintenance costs were calculated taking into account cots for the periodical and detailed inspections, replacement of the paving and reinforcement of members in accordance with the bridge type and material aging etc. Social costs were calculated based on “Detour Cost” & “Waiting Cost” due to traffic closure & restriction. Detour Cost is raised when the bridge falls down and there are detour route. Waiting Cost is raised when the traffic restriction for one-direction during the construction work etc..

“Future scenario”, which is a basis for the analysis, was determined for each bridge under the engineering judgment based upon results of the inspections and age of bridge.

The analysis results that there are 8 bridges whose EIRR exceeds to 20% and that the highest NPV (discount rate=12%) appears at Chirripo bridge (No.26) on the Route 32, which means that the rehabilitation and the reinforcement is to be quite effective.

S.14 Bridge Management System (BMS)

The study team researched the condition of the existing information systems for roads & bridges to grasp present issues, prior to formulation of the bridge management system.

The Bridge Management System (BMS) was established as a supporting tool for the technical judgment to be taken upon implementation of inspections, evaluation & analysis and maintenance of the bridge structural components. The functions of the system are as follows;

- Function for the registration and the renewal of the data
- Function for the administration of data such as evaluation of deficiency, prioritization of repair and cost estimation
- Function for the retrieval of data including bridge inventory and bridge inspection data and display for a location of a bridge.
- Function for output of bridge inventory

The System administrates all relevant data unified in the sole server.

S.15 Tools for the Bridge Maintenance Management

As supporting tools for the Bridge Maintenance, 1) the Inspection Manual, 2) the Operation Manual for Bridge Management System and 3) the Guideline for the Bridge Management were elaborated.

The inspection manual is prepared mainly for the bridge inspectors and bridge engineers, which comprises how to implement the inventory survey, the procedures of the routine inspection and the methods to evaluate the bridge deteriorations. The operation manual is prepared mainly for the system administrator and bridge engineers, which instructs the methods of operation and maintain Bridge Management System. The guideline is prepared mainly for the bridge engineers who engage in the bridge maintenance activities, and instructs the concept of the bridge maintenance, cause of the deterioration of the bridge, the method of the detailed inspection, the method of the loading test and the bridge repair methods.

S.16 Technical Support for the Environmental Examination

Within this study, the field investigation was carried out for 10 selected bridges while the information collection such as literature reviews and interviews with competent environmental agencies/or organizations such as SETENA were conducted. Based on those collected environmental information, the IEE of the proposed project was conducted. From the IEE, it is found that no significant potential environmental impacts are recognized since the proposed project is a rehabilitation/maintenance-oriented project. However, potential environmental impacts of following environmental factors such as the temporal water quality degradation, traffic jams, noise/vibration, the treatment of the construction waste, the set-up of the construction yards, infectious diseases such as dengue and malaria to the construction workers during the construction period would not be negligible. Several bridge sites may be

located in adjacent areas of the important ecological and/or cultural sites or inside of the national parks. Also, it is likely that several illegal squatters stay at two bridge sites.

Since the environmental licenses are to be required for implementation of the proposed bridge rehabilitation plans, suitable ways of the environmental license approach abiding by both Costa Rican EIA Law and JICA Guideline were discussed based on the potential negative impacts to be associated with this rehabilitation plan. Key directions and concepts for ToR development of environmental studies as well as the environmental management program were summarized.

It can be said that all selected 10 rehabilitation plans are categorized into "Category B1" by Costa Rican EIA Law while "Category B" by JICA Guideline.

During the Study, stakeholder meetings were held 4 times in order for relevant information to be disclosed to the public, which their questions & answers arisen were reported on the MOPT's web site.

S.17 Conclusion & Recommendation

Throughout the Study, "Capacity Development in Bridge Rehabilitation Planning, Maintenance and Management Based on 29 Bridges of National Highway Network" has commenced and efficaciously expanded on strengthening capability of the maintenance of bridge in Costa Rica. Along with a technical examination for the rehabilitation of 29 bridges inclusively the design for repair works of the 10 selected bridges, which represent structural features of totality, as well as multiple advocacy activities for the Asset Management, awareness and comprehension on the concept of Capacity Development have been extensively rewarded with positive results and efficacy.

Recommendations based on the Study are summarized as follows.

1) Implementation of Comprehensive Bridge Maintenance Program via Formulation of Full-scale Work Breakdown Structures & Operation Plans for 5 Integrated Modular Projects, which are to be finalized in the financial year 2007 and to be commenced from the year 2008 for 5 years rolling.

2) Smooth Continuous Operation of BMCG & 5 Working Groups on the following tasks.

- Individual Capacity Improvement of MOPT & CONAVI Officials
- Strengthen New Strategy for MOPT Bridges & Create Proposed Bridge Conservation Department for CONA
- Long-term Human Resources Development & Technical Information Exchanges
- Improvement of Regulations & Standards
- Promotion of Advocacy of Government Officials & Public Relations

3) Continuous Monitoring & Evaluation on Outcomes for Capacity Development Process

THE STUDY ON CAPACITY DEVELOPMENT IN BRIDGE REHABILITATION PLANNING, MAINTENANCE AND MANAGEMENT BASED ON 29 BRIDGES OF NATIONAL HIGHWAY NETWORK IN COSTA RICA

FINAL REPORT

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ABBREVIATIONS

AASHTO:	American Association of State Highway and Transportation Officials
AHP:	Analytic of Hierarchy Process
ASTM:	American Standard for Testing and Materials
BBS:	Budget Breakdown Structure
BCIE:	Banco Centroamericano de Integración Económica (Central American Bank for Economic Integration)
BID:	Banco Interamericano de Desarrollo (Interamerican Development Bank)
BMCG:	Bridge Management Consulting Group
BMS:	Bridge Management System
CABEI:	Central America Bank of Economic Integration
CAD:	Computer-Aided Design
CAFTA:	Central American Free Trade Agreement
CB:	Capacity Building
CBS:	Cost Breakdown Structure
CCTU:	Costa Rican Chamber of United Transporters
CD:	Capacity Development
CFIA:	Costa Rica Federation of Engineers and Architects
CGA:	Capacity Gap Assessment
CIC:	Civil Engineers' Association
CIDA:	Canadian International Development Agency
CNC:	Consejo Nacional de Concesiones (National Concession Counsel)
CONAVI:	Consejo Nacional de Vialidad (National Road Counsel)
CRC:	Costa Rica Colone
C/P:	Counter Part
EIA:	Environmental Impact Assessment
EIRR:	Economic Internal Rate of Return
FOB:	Free on Board
FRP:	Fiber Reinforced Plastic
FS:	Feasibility Study
FTAA:	Free Trade of the American Agreement
FY:	Financial Year
GDP:	Gross Domestic Product
GIS:	Geographic Information System
GPS:	Global Positioning System
GTZ:	Gesellschaft f r Technische Zusammenarbeit (The German Agency for Technical Co-operation)
HDM-III:	Highway Design and Maintenance Standard Model version III
HWL:	High Water Level
ICE:	Instituto Costarricense de Electricidad (Costa Rican Institute of Electricity)
IDB:	Inter-American Development Bank
IEE:	Initial Environmental Examination

JBIC:	Japan Bank for International Cooperation
JICA:	Japan International Cooperation Agency
JPY:	Japanese Yen
KfW:	Kreditanstalt fur Wiederaufbau
LAN:	Local Area Network
LANAMME:	Laboratorío Nacional de Materiales y Modelos Estructurales (National Laboratory of Materials and Structural Models)
LWL:	Low Water Level
MIDEPLAN:	Ministerio de Planificación Nacional y Política Ecónomica (Ministry of National Planning and Economic Politics)
MINAE:	Ministerio del Ambiente y Energía (Ministry of Environment and Energy)
M/M:	Minutes of Meeting
MOF:	Ministry of Finance
MOH:	Ministry of Health
MOPT:	Ministerio de Obras Publicas y Transportes (Ministry of Public Works and Transport)
MOPTT:	Ministry of Public Works, Transport and Telecommunications (Chile)
NPV:	Net Present Value
O&M:	Operation and Maintenance
OD:	Origin and Destination
OJT:	On-the-Job Training
PC:	Prestressed Concrete
PCM:	Project Cycle Management
PDM:	Project Design Matrix
PO:	Plan of Operation
PPP:	Plan Puebla Panamá
RAM:	Responsibility Assignment Matrix
RC:	Reinforced Concrete
RICAM:	International Mesoamerica Road Network
ROW:	Right of Way
SCF:	Standard Conversion Factor
SETENA:	Secretaría Técnica del Ambiente (Technical Secretary of the Environment)
SICA:	Sistema de la Integración Centroamericana (System of the Central American Integration)
SIECA:	Secretaría de Integración Económica Centroamericana (Economic Integration Secretary of Central American)
SIGVI:	Sistema Integrado de Gestión Vial (Integrated System of Administration Vial)
SINA:	Ministry of Environment and National System of Environmental Organizations
SINAC :	Sistema Nacional de Áreas de Conservación (The National System of Conservation Areas)
SOP:	Secretary of Publics Works (Mexico)
SPEM:	Sistema de Programacion y Ejecucion del Mantenimiento Vial (System of Programming and Execution of the Maintenance Vial)

STP:	Standard Penetration Test
SWRF:	Shadow Wage Rate Factor
TA:	Technical Assistance
TOR:	Terms of Reference
TPD:	Traffic per Day
TTC:	Time Travel Cost
UNDP:	United Nations Development Program
USD:	US Dollar
VOC:	Vehicle Operation Cost
WAN:	Wide Area Network
WBS:	Work Breakdown Structure
WS:	Workshop

Costa Rica Colones (¢): Unit of Costa Rica Currency: $US 1 approx. ¢ 516 as of August 2006

Chapter.1 Outline of the Study

1.1 Background of the Study

Costa Rica is approximately 51,100 km^2 in area with a population of 4,300,000 people. It is bordered by Nicaragua to the north, Panama to the south, the Caribbean Sea to the east, and the Pacific Ocean to the west.

Costa Rica is one of the member countries of "the System of Central American Integration (SICA)" and is expected to play an important role in developing and integrating the economy in region. In order to extend the economic integration, it is essential to support the improvement of the infrastructures in the transport sector. In particular, improvement of the road network is selectively listed in the prioritized subjects in the Puebla-Panama Plan (PPP) which is a region-wide economic-development program ratified in Mesoamerica. The PPP allows that overland transportation would be promoted because it is advantageous in Central America in terms of its cost effectiveness when compared with other transportation modes such as by-air or by-ship.

It is clearly stated in the National Development Plan (2002-2006) of Costa Rica that the "acceleration of the economic growth" is an integral component of the plan and that bridge construction and the rehabilitation of trunk roads are particularly key elements to be strategically prioritized in the construction and conservation of the road network.

The road network in Costa Rica has a total length of over 37,300 km and comprises international trunk roads running through the country, which geographically link Central America. Most of the 1,330 bridges on the national highway (7,775km) suffer from severe deterioration due to material aging. Insufficient and inadequate maintenance works have accelerated this damage and have led to the decline in bridge performance. The PPP's regional code requires a particular load carrying capacity for international trunk roads. This is not achieved satisfactorily to sustain the necessary capacity for land transportation as a main commercial route. In addition, due to the fact that the country is geologically situated right on the volcanic belt, it is critical for the bridge maintenance in Costa Rica to take into account disaster prevention measures which are aimed at protecting the road infrastructure from natural disasters such as eruptions and earthquakes. Accordingly, it is essential that an assistance program be rendered for improving the capacity of the bridge management, which comprises comprehensively inspection, the diagnosis of deterioration of existing bridges as well as the planning for reinforcement and rehabilitation of bridges.

Given the preceding, the Government of Costa Rica has requested the Government of Japan to execute a feasibility study for the implementation of a bridge management system, and to select 30 bridges as a part of the Feasibility Study. In response to the above request, it has been decided to conduct "The Study on Capacity Development in Bridge Rehabilitation Planning, Maintenance and Management" based on 29 bridges on National Highway Network in Costa Rica.

1.2 Objectives of the Study

The Study is to be conducted on the 29-targeted bridges on the trunk road network. These are Bridge Nos. 1 to 8 on National Highway Route 1, Bridge Nos. 9 to 16 on National Highway Route 2, Bridge Nos. 17 to 19 on National Highway Route 4, Bridge Nos. 21 to 28 on National Highway Route 32, and Bridge No. 29 on National Highway Route 218. The Study is to be focused on assistance for the capacity development for bridge reinforcement and rehabilitation as well as bridge management. The main objectives of the Study are stated as follows:

(1) To support the implementation of the capacity development program for a Bridge Management System for the individual, organizational and social/institutional levels.

(2) To conduct a diagnosis of the bridges and to evaluate their current condition.

(3) To formulate rehabilitation/reinforcement/improvement plans for 10 prioritized bridges.

(4) To produce design drawings of the rehabilitation/reinforcement/improvement for 10 prioritized bridges.

(5) To conduct preliminary cost estimation/construction planning and economic analysis.

(6) To establish the Bridge Management System (BMS) as a practical tool for the implementation of the bridge maintenance.

(7) To produce standard Manuals and Guidelines for bridge inspection as well as for bridge rehabilitation/reinforcement/improvement and maintenance.

(8) To support the relevant environmental assessments in accordance with the JICA Guideline for environmental and social considerations, which it is necessary to enforce prior to the implementation of any rehabilitation/reinforcement/improvement.

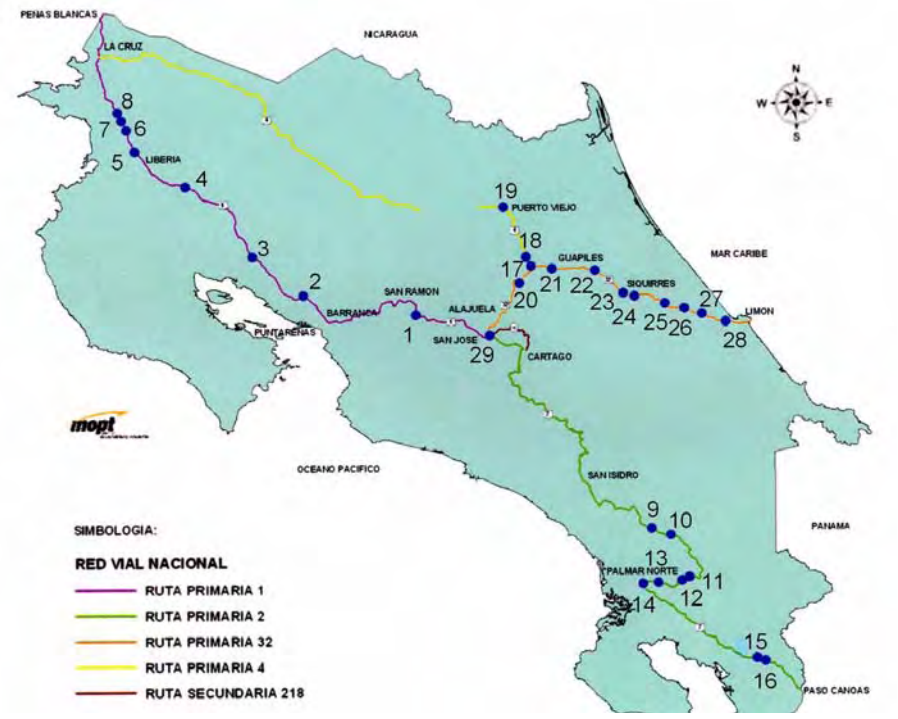


Figure.1.1. Location of the targeted bridges (29 bridges)

1.3 Components and Process of the Study

Figure 1.2 shows the comprehensive components of the study to embody the objectives mentioned earlier. The counterpart agency is the Planning Direction and the Bridge Design Department of the Ministry of Public Works and Transport (hereinafter described as "MOPT") as well as the Planning Direction of the National Council of Roads (hereinafter described as "CONAVI").

The Capacity Development (hereinafter described as "CD") for Costa Rica shall focus on the improvement of capacities on the "Individual"," Organizational" and "Institutional/Social" levels. In addition, the Study shall highlight assistance to the establishment of the Bridge Conservation Department in CONAVI, which are institutionally planned to.

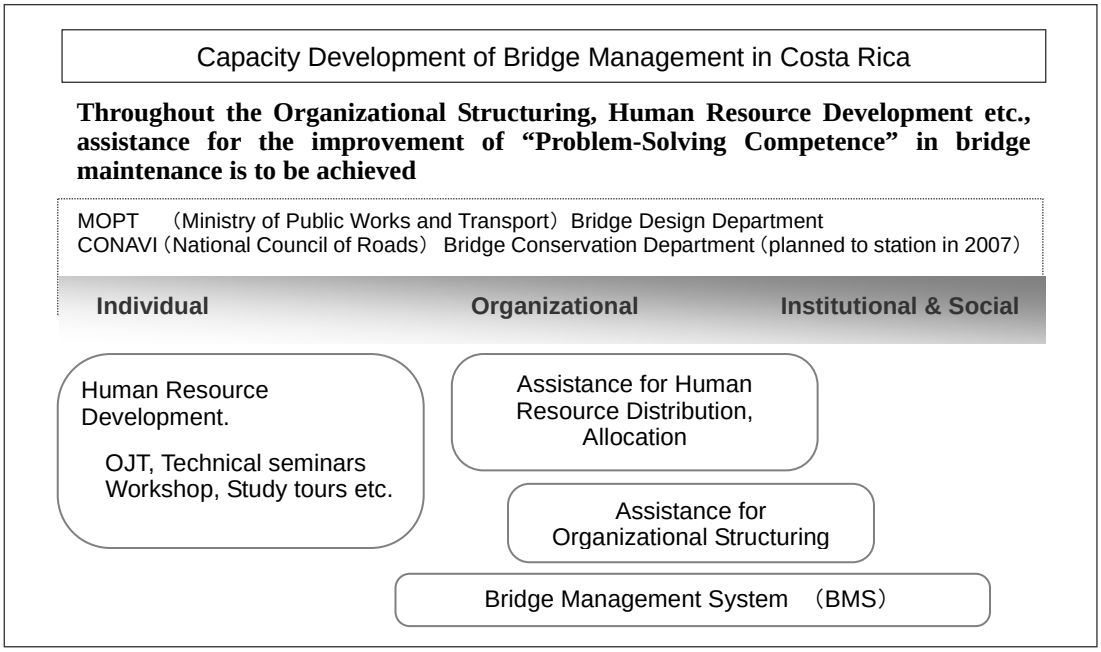


Figure.1.2. Objectives and Components of the Study

Figure S.1.3 shows a schematic of the study process. The upper section concerns the technical components of the Study and the lower section concerns the CD.

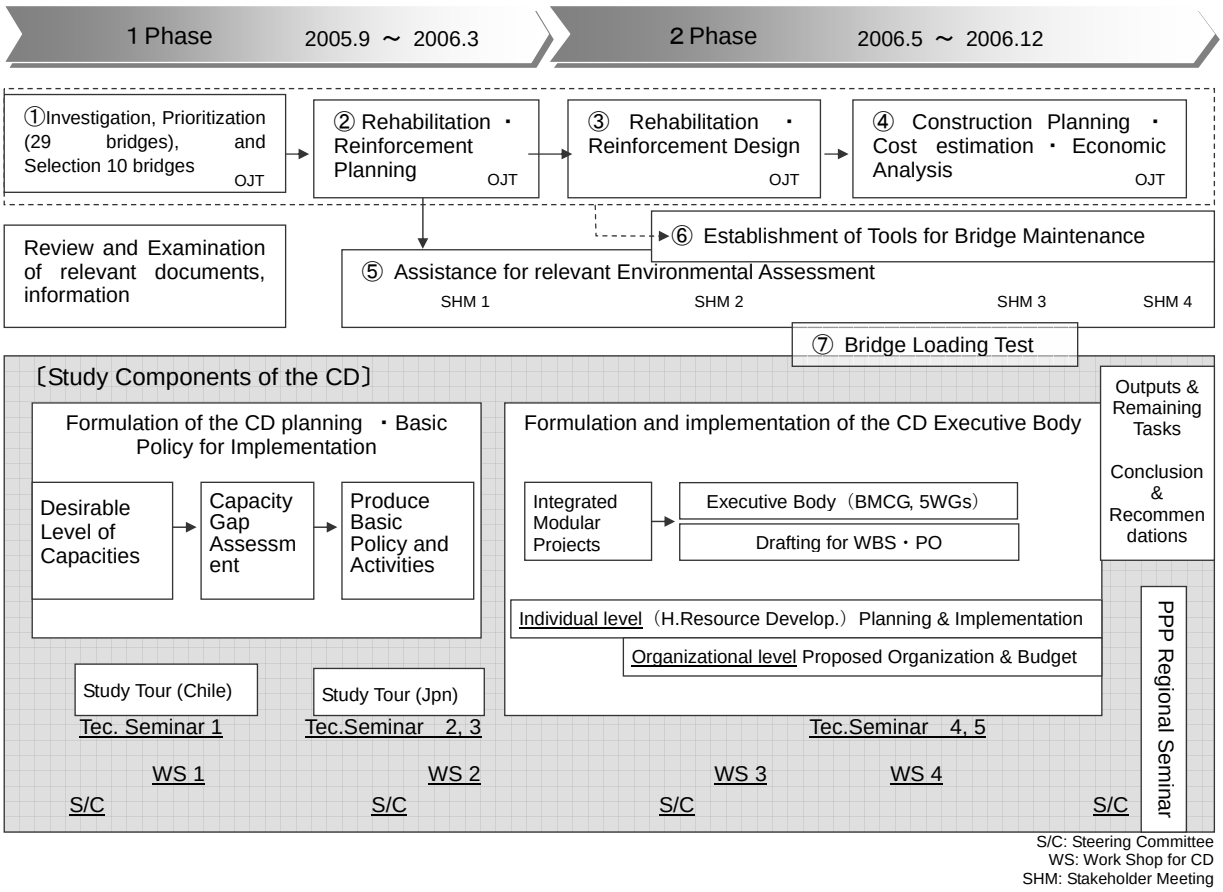


Figure.1.3. Schematic of the Components and Process of the Study

The technical components of the Study and its workflow are as follows:

1) Investigation of the current status of the 29 bridges; Diagnosis of any deterioration found; Prioritization and Selection of 10 prioritized bridges.

2) Formulation of the Bridge Rehabilitation/Reinforcement/Improvement Plan for the 10 selected bridges.

3) Elaboration of the Bridge Rehabilitation/Reinforcement/Improvement Design, Drawings and Quantity survey for the 10 selected bridges.

4) Formulation of the Preliminary construction planning, Cost estimation and Economic Analysis for the 10 selected bridges.

5) Assistance for the relevant environmental assessment based on the Rehabilitation/Reinforcement/Improvement Plan in 2) above, as well as the Construction planning for the 10 selected bridges.

In addition, the following will also be carried out:

6) Establishment of the Bridge Maintenance Tools (e.g. Bridge Management System (BMS), Inspection and Operation manuals for the BMS, Guidelines for bridge maintenance)

7) Implementation of Bridge Loading Tests

Managerial components concerning the CD are summarized as follows:

1) Capacity Gap Assessment

- Determination of the desirable future state of capacities on the "Individual", "Organizational" and " Institutional & Social " levels.
- Gap assessment of the capacity differentials between the current and desirable states.
- Problem-Objective analysis at the "Individual", "Organizational" and " Institutional & Social " levels by means of Project Cycle Management (PCM)

2) Formulation of the Basic Policy for Capacity Development

- Based on results from the problem analysis, 13 prototypes of modular projects are identified in total, comprising 4 projects on the "Individual", 3 projects on the "Organizational" and 6 projects on the " Institutional & Social " levels.
- 10 basic policies for the comprehensive bridge management are proposed. As the policy states, it is essential that the importance of a political commitment shall be recognized to secure a well-balanced allocation of the budget which enables the "Ad-hoc basis bridge maintenance" to be converted into " Preventive maintenance".

3) Implementation of Capacity Development

- The 13 proto-types of modular projects identified are integrated into 5 full-scale modular projects, taking into account the tasks screened-out at the "Individual", "Organizational" and " Institutional & Social " levels.
- As a main executive body for the implementation of the 5 full-scale modular projects, "Bridge Maintenance Consulting Group (BMCG)" which consists of representatives from various organizations such as MOPT, CONAVI, planning and financial authorities and academic institutions was established to form 5 working groups. The preliminary Work Breakdown Structures (WBS) and Plan of Operations (PO) of the 5 full-scale modular projects are to be finalized and embodied in the financial year 2007 in order for the objectives to be achieved within 5 years starting from the financial year 2008.
- The study team proposed both an organizational structure for MOPT, CONAVI and a budgetary arrangement for the bridge maintenance including the rehabilitation, reinforcement and improvement works. These are fundamental issues to be carefully linked with the activities of the BMCG.

- Individual capacity is to be implemented based on the ”Human Resource Development Plan”, which is incorporated into the integrated modular project-1 aimed at improvement of the technical competences at the individual level. Counterparts are trained on the basis of On-the Job training (OJT), and in addition 5 technical seminars will be held to disseminate technical know-how to Costa Rican engineers.

4) PPP Regional Seminar

- In order to realize further dissemination toward PPP countries, a PPP Regional Seminar was held in December 2006, which allowed an introduction to the outline of the study to be presented and extended the outputs/outcomes of the comprehensive CD on bridge management to neighboring countries.

This report is for conveying the entire activities and results described above and comprises the following chapters:

Chapter.2 Existing Situation In Costa Rica

2.1 National Condition

Geography: The land of Costa Rica is divided into a backbone of volcanoes and mountains. It is an extension of the Andes-Sierra Madre chain, which runs along the western side of Central America. Costa Rica is part of the Pacific "Rim of Fire" and has seven of the isthmus's 42 active volcanoes plus dozens of dormant or extinct cones. The Cordillera de Talamanca, the country's oldest and southernmost range, includes Mt. Chirripó, Costa Rica's highest mountain at 3,820 m.

River: The steep slope of the riverbed characterizes the rivers of Costa Rica. The starting point of the major rivers of Costa Rica with a length less than 200 km is located at 3,820 m to 1,600 m altitude. The steep slopes cause flooding and damage to the areas alongside rivers and to the bridges crossing over the rivers.

Climate: Costa Rica's climate is divided into two seasons, which are rainy and dry. The dry season runs from January through May, and the rainy season from May to November/December.

Temperature: The Annual Medium Temperatures of the Pacific Slope are higher than those in the Caribbean Slope. The isotherm of 27.5° covers all the lower basin of the Tempisque River and extends along the Pacific Coast towards Ciudad Cortes.

Rain Fall: The maximum precipitations are in the mountain areas. Maximums of 5,500mm and 6,500 mm are observed in the Caribbean Slope in the coastal sector between the Colorado River and the San Juan River, and also in the basin of the Banano River. The highest precipitation areas are located in the basin of Pejibaye River and the Grande de Orosi River, with over 7,000 mm per year.

Seismic: **Costa Rica is located in a region where several lithosphere plates interact.** The last major quake was on April 22, 1991. Centered on the Caribbean side, southeast of San Jose, it measured 7.4 on the Richter scale. The superior block moved about three meters towards the northeast in relation to the inferior block, causing a vertical rise of between 0.5m and 1.5 m along the Caribbean from Limon harbor to the Panama Border.

2.2 Socio-Economic Condition

Land Use: The total land area is 51,100 km^2, which is composed of 50,660 km^2 of land and 440 km^2 of water. The cropland is divided into 4.41% of "arable land" that is cultivated for crops like wheat, maize, and rice.

Population and Social Index: In 2004, the population of Costa Rica was 4,300,000 and the annual increase ratio is about 2% to 3 %. In two decades,

the population has increased approximately 1.7 times. According to the population by province, the population in San Jose province is 36% of the total population. The second largest population is in Alajuela province.

Economy and Industry: Costa Rica's basically stable economy depends on tourism, agriculture, and electronics exports. Poverty has been substantially reduced over the last 15 years, and a strong social safety net has been put into place. Foreign investors remain attracted by the country's political stability and high education levels, and tourism continues to bring in foreign exchange. Low prices for coffee and bananas have hurt the agricultural sector. GDP per capita is US $4,353 with a real growth rate in 2004 of 3.9%. These factors have had a steady increase for about one decade. The GDP composition by sector in 2004 is as follows; a) agriculture: 8.5%, b) industry: 29.7% and c) services: 61.8%. Tourism has an especially important role for the economy in Costa Rica. Indications are that tourism has increased almost 2 times in the last seven years. Harmonized with the increase in GDP, vehicle registration has increased continuously, and reached 228 vehicle/1000 people in 2004.

2.3 Road Network Configuration and Condition

Road Classification: In Costa Rica, National Roads are 7,775km long in a network of national trunk roads, and each road is classified into 3 categories. Rural roads are 29,498 km long. Total road network was 37,273 km long. MOPT is in charge of formulating basic policies and executing the construction of the national road network, with the maintenance being done by CONAVI. Maintenance and management of Rural Roads are officially done by each provincial government, but are actually done by MOPT because of budget constraints and the limited number of staff in local government.

Traffic Volume: The Planning Section of MOPT has been collecting Traffic Volumes in Costa Rica since 1987. According to the traffic volume data for national roads, for primary class roads, 13% of their length has more than 10,000 vehicles per day, 21% is in the range between 5,000 to 9,999 vehicles per day, and 56% is in the range between 1,000 to 4,999. On the secondary class roads, about 85% of their length has less than 5,000 vehicles per day and on the tertiary class, 42% of their length has less than 500 vehicles per day. Furthermore, the routes on which the 29 bridges are located have the following traffic volume characteristics. Traffic volumes more than 50km from San Jose:

- Route 1 : 13,000 TPD
- Route 2: 5,000 TPD
- Route 32: 10,000 TPD

Route 32 has more heavy goods vehicles than any other route. This is mainly due to goods being transported to Limon port, which is located the end point

of Route 32. In 2002, the total tonnage of goods for both import and export at Limon, was 7.16 million tonnes.

The 29 study bridges are located on roads that have 5,000-10,000 TPD except No.1 (60,000 TPD) and No.29 (45,000 TPD).

2.4 Road Maintenance

National roads: CONAVI is responsible for preparing the budget and making decisions for maintenance and rehabilitation. Primary inspection, data entry to the inventory database and priority planning for maintenance are all carried out by MOPT. MOPT submits " PROGAMACION" to CONAVI each year and this contains the program list for rehabilitation works including the estimated cost used by HDM-III.

Rural roads: MOPT and the local government are responsible for preparing the budget and for making decisions on maintenance and rehabilitation. The pavement management system is called "SPEM: Sistema de Programacion y Ejecucion del Mantenimiento Vital" which was set up by MOPT engineers supported by GTZ in the 1990's. However, the condition of some rural roads has yet not been inspected because of a lack of human resources and budget.

Chapter.3 Existing Condition of Bridges and Status of Bridge Maintenance

3.1 Outline of Bridges in Costa Rica

The total number of bridges on national highways in Costa Rica is 1,330. Most of these bridges suffer from damage due to a lack of maintenance and rehabilitation works. Some of bridges have been damaged by the natural disasters, such as floods and earthquakes as in Japan. Quantity of bridges is listed in the following table in accordance with the bridge type, road classification. Concrete bridge accounts for close to 82% of the whole bridges.

Table.3.1 Quantity per Bridge type and Road classification

	Class1		Class2		Class3		Total	
Steel Bridge	59	(4%)	62	(5%)	42	(3%)	163	(12%)
Concrete Bridge	419	(31%)	393	(30%)	283	(21%)	1,095	(82%)
Timber Bridge	2	(0.2%)	21	(2%)	49	(4%)	72	(6%)
Total	480	(36%)	476	(36%)	374	(28%)	1,330	(100%)

Typical Bridges in Costa Rica

3.2 Bridge Design Standards

The American Association of State Highway and Transportation Officials (AASHTO) is adopted for the bridge design standard for the bridges on the national highway roads in Costa Rica. The bridges constructed before 1950s, which are located on the route1 and 2, are design with a low live load condition such as HS15. The bridges constructed in 1960s are with HS20. The incremented 25 percent of HS20-44 is applied for the design live load of bridges on the national highway roads in Costa Rica, based on an agreement between the governments of Central America to permit the increment of the truck's load. It is necessary to urgently check the load capacities of all bridges on the national highway roads.

3.3 Bridge Maintenance

1) Organization for Construction and Maintenance of Bridges

The number of MOPT staff and workers is approximately 4,000. The Bridge Department under the Division of Public Works, has 18 staff and workers, and is responsible for providing technical assistance to the construction and maintenance of bridges. However, there are only 3 qualified professional engineers in the department who can offer technical services for bridge design.

Since CONAVI does not have any department in charge of the maintenance of bridges, it receives technical assistance from the Bridge Department of MOPT. In addition, each year CONAVI receives the priorities for the construction and rehabilitation of the national road network and bridges based on the recommendations of the Department of Planning of MOPT. However, due to the limitations of the budget, CONAVI is not able to complete all the recommended construction and rehabilitation programs.

2) Bridge Maintenance System in Costa Rica

The Bridge Management System (BMS) in MOPT was established under a project funded by France and it was modified by the Planning Department in MOPT in 1988. However, the BMS is used mostly for making the Bridge Inventory and only the inspection sheet and the evaluation method described in the BMS are applied for Routine Inspection of bridges on the national roads. The evaluation results are converted by the Planning Department of MOPT into a maintenance program, which lists the bridges in order of the degree of damage. This maintenance program is handed over to CONAVI as the plan for bridge repair and rehabilitation works.

Four inspectors from the Planning Department in MOPT have carried out the Routine Inspection of bridges on national roads as a part of the road's facilities when they inspect the roads. These inspectors are civil engineers and not bridge engineering specialists.

The Detailed Inspection of bridges is carried out by the Bridge Design Department in MOPT when they are requested from local governments or CONAVI to make a plan for repairing or reinforcing bridges. The detailed inspection is based on their original inspection method.

Chapter. 4 Capacity Gap Assessment

The major objective of the capacity gap assessment is to comprehensively evaluate the quantitative and qualitative gap between the ideal situation and the status quo in terms of the bridge maintenance for the purpose of identifying the bottleneck against the ideal bridge maintenance system. The ideal bridge maintenance system derives from a sort of preventive maintenance of bridges based on the concept of *"Asset Management"* which is an overall and strategic management system for social infrastructure to keep the maintenance service level satisfactory and to maximize the benefits of users under the limited budget. The gap was assessed through the interviews with various stakeholders. Stakeholders to be interviewed in the capacity gap assessment include a wide range of individuals and organizations related to inspection, BMS, planning and implementation of the bridge maintenance and rehabilitation, as shown below.

- MOPT, its related departments and regional offices
- CONAVI, its related departments and regional offices
- Other relevant government ministries and agencies such as MOH, MIDEPLAN, CNC, MINAE, SETENA and etc.
- University of Costa Rica and its related research institutes such as LANAMME
- Costa Rica Architect and Engineering Association
- Private sector such as contractors and design companies
- Users such as truckers, passengers and citizens

The full-scale capacity gap assessment was jointly conducted with counterpart officials of MOPT and CONAVI. The major objective of the full-scale capacity gap assessment is to evaluate the quantitative and qualitative gap between the ideal situation and the present situation in terms of the bridge maintenance, thereby identifying the bottleneck against the ideal bridge maintenance system.

The ideal bridge maintenance system derives from a sort of preventive maintenance of bridges based on the concept of *"Asset Management"* which is an overall and strategic management system for social infrastructure to keep the maintenance service level satisfactory and to maximize the benefits of users under the limited budget. In other words, *"Asset Management"* represents a holistic and systematic approach to asset preservation which ensures maximum service performance at minimum life-cycle costs.

The procedures for the capacity gap assessment include the following 6 steps.

- Designing capacity gap assessment score sheets
- Interviews and collection of data/information from relevant stakeholders
- Preliminary assessment of capacity gaps
- Full-scale assessment of capacity gaps
- PCM (Project Cycle Management) analysis including the problem analysis and the objective analysis to solve the bottleneck against the ideal bridge management
- Formulation of basic policies and action plans including the PDMs (Project Design

Matrix) of the required module projects for the ideal bridge management

The qualitative and quantitative degree of the gap between the required capacity and the present capacity at individual, organizational, institutional and social levels was comprehensively assessed by using 5-grade score sheets. Those 5-grade score sheets for the capacity gap assessment were designed so as to evaluate the degree of the gap.

Capacities at the individual level include relevant officials' i) knowledge and practical skills/experiences for inspection, diagnosis, operation of BMS, planning and implementation of repair and rehabilitation, and ii) management and responsiveness for preventive bridge maintenance.

4.1 Individual Level

The individual-level capacities refer to relevant officials' i) knowledge and practical skills/experiences for inspection, diagnosis, operation of BMS, planning and implementation of repair and rehabilitation, and ii) management and responsiveness for preventive bridge maintenance.

(a) Although the bridge department of MOPT has a few bridge engineers, they do not have sufficient knowledge and experiences in terms of bridge maintenance practices such as inspection, diagnosis, operation of BMS, planning and implementation of repair and rehabilitation of bridges.

(b) CONAVI does not have any qualified bridge engineer, although it employs contract-based local civil engineers for the bridge inspection activities.

(c) There are insufficient number of qualified professional inspectors in both MOPT and CONAVI, although the Planning Direction of MOPT is updating the existing bridge database.

(d) Officials of both planning and financial authorities are not well aware of significance of the preventive maintenance of bridges based on the concept of *"Asset Management"*.

(e) Although some researchers of affiliated research organizations of University of Costa Rica understand significance of the preventive maintenance of bridges, other officials of the public sector as well as staff of the private sector are not well aware of its importance.

(f) Although some foreign contractors have several trained bridge engineers, the level of engineers of domestic contractors does not reach to the required level.

4.2 Organizational Level

The organizational-level capacities refer to i) organizational performance (functions, number of qualified staff, decision-making mechanism, coordination abilities, incentive system, personnel management, etc.), ii) financial and outsourcing system (amount and allocation of budget for bridge maintenance and rehabilitation, and contracting system for bridge maintenance and rehabilitation), and iii) physical and intellectual assets for bridge maintenance and rehabilitation.

(a) There are no systematic and comprehensive bridge inspection systems in both MOPT and CONAVI, and the inspection of bridges is basically conducted only on ad-hoc basis.

(b) The budget for the maintenance of bridges is not sufficiently allocated for both MOPT and CONAVI, compared with the construction and maintenance of roads.

(c) The regional offices of MOPT and CONAVI do not have enough financial resources for the regular inspection activities.

(d) The standards for the diagnosis of damages of bridges as well as the inspection manuals are not sufficiently prepared, although the bridge department is updating the bridge data in the existing bridge database. In addition, there is lack of the required equipment for the bridge inspection activities.

(e) In the concession system for the maintenance of roads and bridges, CONAVI and CNC do not specify the detailed maintenance activities of bridges by concession companies.

(f) There is lack of opportunities for the training of bridge engineers and inspectors of MOPT and CONAVI.

4.3 Institutional and Social Level

Capacities at the institutional and social levels include i) existence of policies, laws, regulations and standards for preventive maintenance of bridges, and ii) social understanding of preventive maintenance of bridges and knowledge management. The full-scale assessment results by the 5-grade score sheets as well as the major findings at this level are shown below.

(a) There is no political commitment to the maintenance of bridges based on the concept of *"Asset Management"*.

(b) Although there are regulations for the payload capacities for trucks based on the international transportation framework such as PPP and SIECA, there are a lot of trucks and containers which are overloaded.

(c) Understanding of the concept of *"Asset Management"* as well as *"preventive maintenance"* is not enough among the society, since ordinary citizens are not so much interested in the maintenance of existing bridges.

(d) There are insufficient opportunities for the collaboration between the public sector and the private sector to develop the bridge maintenance and rehabilitation technologies.

Based on the interview results and the analysis of the 5-grade score assessment sheets, the full-scale problem analysis using PCM (Project Cycle Management) method was conducted. For example, the core problem of *"Inappropriate Bridge Maintenance"* is derived from i) insufficient bridge maintenance capacity, ii) weak organizational structure on bridge maintenance, iii) insufficient budget for bridge maintenance, iv) insufficient enforcement of laws, regulations and standards, and v) insufficient knowledge management on bridge maintenance. More detailed problem trees showing major causes of the core problem are illustrated as below in consultations with the counterparts using the full-scale PCM method.

Chapter. 5 Basic Policies For Capacity Development

In order to solve these problems, the program for the total management of the bridge maintenance and rehabilitation, which is composed of the cluster of 13 proto-type modular projects, is proposed. The program is composed of a set of modular projects to solve the problems identified, and the detailed contents of the modular projects have been specified through the process of the full-scale PCM analysis including a) problem analysis, b) objective analysis, and c) alternative analysis of the identified modular projects.

The alternative analysis derived following basic approaches such as i) bridge maintenance capacity improvement, ii) organizational structure improvement, iii) policy change for bridge maintenance, iv) Institutional enforcement improvement, and v) user advocacy as well as vi) knowledge management on bridge maintenance.

Table.5.1. Alternative Basic Approaches for Bridge Maintenance

Basic Approach	Prototype for Modular Project	Level
Maintenance Capacity Improvement Approach	1-a Individual Capacity Improvement Project for Bridge Inspection and Diagnosis	Individual
	1-b Individual Capacity Improvement Project for BMS Operation and Priority Selection of Bridge Maintenance	Individual
	1-c Individual Capacity Improvement Project for Planning and Implementation of Bridge Rehabilitation	Individual
	1-d Human Resources Development Project for Bridge Maintenance	Individual
Organizational Capacity Improvement Approach	2-a Organization Strengthening Project of Bridge Department of MOPT	Organizational
	2-b Organization Setting-up Project of Bridge Department of CONAVI	Organizational
	2-c Knowledge Management Promotion Project among Public, Private and Academic Sectors	Organizational
Policy Change Approach	3-a Asset Management Policy Introduction Project for Financial and Planning Authority	Institutional (Policy)
Institutional Enforcement Improvement Approach	3-b Enforcement Improvement Project for Procurement Procedures and Regulations	Institutional
	3-c Enforcement Improvement Project for Technical Regulations and Design Standards	Institutional
Users Advocacy Approach	3-d Bridge Users Advocacy and Campaign Project for Asset Management and Traffic Safety	Social
	3-e Tax Payers Advocacy and Campaign Project for Asset Management	Social
Overseas Technical Cooperation Approach	3-f Overseas Information Exchange Project for Bridge Maintenance	Social (International)

Based on the above alternative basic approaches to be identified, the following basic policies for the comprehensive bridge management are proposed.

(a) The basic approach for the bridge maintenance should be switched from *"ad-hoc basis maintenance"* to *"preventive maintenance"* which derives from the concept of *"asset management"* for bridges. Since the present budget for the maintenance of bridges remains minimum, the concept of the well-planned *"life cycle cost"* should be incorporated into the planning and budgetary arrangement of the maintenance of bridges. The strong political commitment to the optimum allocation of financial resources for the

bridge maintenance is critical in order to secure the required budget based on the concept of *"preventive maintenance"*.

(b) The maintenance of bridges should be managed not simply by the improvement of bridge maintenance technologies and training of individual engineers but by the comprehensive bridge maintenance improvement through the module projects in terms of individual, organizational, institutional and social levels of capacities.

(c) The ambiguous responsibilities, functions and missions of relevant departments of MOPT and CONAVI should be clarified, thereby strengthening the institutional capacities of those departments for both organizations. The functions of the bridge department of MOPT should be strengthened in the field of i) formulation of basic strategies, ii) allocation of budget, iii) operation of BMS, iv) prioritization of maintenance and repair of bridges, and v) planning of maintenance and repair of bridges. On the other hand, the bridge–related section of CONAVI should be created under the Direction of Road Conservation in cooperation with the Direction of Engineering and the Direction of Works. The core bridge management group, which consists of the representatives of relevant organizations, should be established as a transient institution to the newly created bridge-related section of CONAVI.

(d) The ad-hoc work flow for the bridge maintenance should be standardized with a proper manual for the bridge maintenance, thereby streamlining the functions of relevant departments of MOPT and CONAVI.

(e) A wide range of human resources development programmes in the field of bridge management should be designed taking into account that:

  i) the main target of the training programmes should be staff of the bridge maintenance core group;

  ii) training of road engineers, especially OJT (on-the-job training) in the field of the bridge maintenance should be promoted in order to make maximum use of the current human resources in MOPT and CONAVI; and

  iii) training of technical staff, contract-based technical staff of the Direction of Road Conservation of CONAVI, should be emphasized.

(f) A wide range of collaborations in the field of human resources development and technical information exchange among MOPT, CONAVI, research organizations and private companies should be promoted.

(g) Effective enforcement of laws, standards, regulations in the field of bridge maintenance, bridge designing, procurement *procedures* and traffic control should be significantly improved so as to upgrade capacities at the institutional level.

(h) The optimum budget for the maintenance of bridges should be achieved through:

  i) the most effective and allocation of the budget for the bridge maintenance within the realistic budgetary limit;

  ii) reasonable reallocation of the budget from new construction projects to maintenance works; and

  iii) reasonable reallocation of the budget from road maintenance works to bridge maintenance works.

(i) Advocacy for users and tax payers on the bridge maintenance as well as the technical cooperation with overseas countries such as PPP member countries should be

implemented for the purpose of socially and internationally extending the concept of "Preventive Maintenance" and "Asset Management".

(j) Sustainability of the bridge maintenance even after the completion of the Study is critical. In other words, "exit strategy" after the completion of the Study should be clarified in such ways as:

i) sustainable budget for the bridge maintenance in the longer term;

ii) visualized management of the identified module projects though the plan of operations; and

iii) monitoring on the identified module projects by using verifiable indicators.

Chapter. 6 Implementation of Capacity Development for Comprehensive Bridge Maintenance Program

Through a wide range of the capacity gap assessment activities for the improvement of the comprehensive bridge maintenance system, basic policies for the capacity development have been formulated, thereby identifying 13 proto-type modular projects at individual, organizational, institutional and social capacity levels. Thirteen proto-type modular projects identified in Chapter 5 are integrated into 5 full-scale modular projects, taking into account the similarity of each proto-type modular project. Consequently, the cluster of 5 integrated full-scale modular projects is regarded as the bridge maintenance program so as to comprehensively develop a wide range of capacities in the field of the bridge maintenance. The below table shows the list of the integrated modular projects together with the original 13 proto-type modular projects.

Table.6.1. List of 5 Integrated Modular Projects

Proto-type Modular Project No.	Contents of Integrated Modular Projects	Integrated Modular Project No.
Integrated Modular Project 1		
(MP-1: Individual Capacity Building Project for MOPT and COMAVI)		*Project Design Matrix (PDM-1)*
1-a	Individual Capacity Improvement Project for Inspection and Diagnosis	
1-b	Individual Capacity Improvement Project for BMS Operation, Priority Selection and Rehabilitation Planning of Bridges	
1-c	Individual Capacity Improvement Project for Implementation of Rehabilitation of Bridges	
Integrated Modular Project 2		
(MP-2: Institutional Building Project for MOPT and CONAVI)		*Project Design Matrix (PDM-2)*
2-a	Organization Strengthening Project for Direction of Bridges of MOPT	
2-b	Organization Strengthening Project for New Bridge-related Department of CONAVI	
Integrated Modular Project 3		
(MP-3: Long-term Human Resources Development and Technical Exchange Project)		*Project Design Matrix (PDM-3)*
1-d	Long-term Human Resources Development Project	
2-c	Public-Private-Academic Technical Exchange Project	
3-f	PPP Countries Technical Exchange Project	
Integrated Modular Project 4		
(MP-4: Regulation and Standards Improvement Project)		*Project Design Matrix (PDM-4)*
3-b	Technical Regulations and Design Standards Improvement Project	
3-c	Procurement Regulations and Procedures Improvement Project	
Integrated Modular Project 5		
(MP-5: Promotion of Public Relations and Advocacy Project)		*Project Design Matrix (PDM-5)*
3-a	Asset Management Advocacy Project for Financial and Planning Authorities	
3-d	Bridge Users Public Relations and Advocacy Project	
3-e	Tax Payers Public Relations and Advocacy Project	

As a main supporting body for the implementation of the capacity development to comprehensively improve the bridge maintenance activities of MOPT and CONAVI, “Bridge Maintenance Consulting Group (BMCG)” which consists of representatives from various organizations was established to form 5 working groups. The main functions of the working groups of the BMCG as well as the related modular projects are described as the below table.

Table.6.2. 5 Groups for BMCG and Related Modular Projects

WG No.	Working Group	Related Modular Projects
WG-1	Working Group for Individual Capacity Building	Modular Project 1
WG-2	Working Group for Institutional Building of MOPT and CONAVI	Modular Project 2
WG-3	Working Group for Long-term Human Resources Development	Modular Project 3
WG-4	Working Group for Improvement of Laws, Regulations and Standards	Modular Project 4
WG-5	Working Group for Promotion of Public Relations	Modular Project 5

The outline of each modular project is expressed in the form of PDM (Project Design Matrix) which is a four-by-four matrix to lay out a project design, and the PDMs for 5 integrated modular projects are formulated. Activities specified in each PDM are broken down into more manageable packages of work, which is called Work Breakdown Structure (WBS). The preliminary WBSs are drafted and the full-scale WBSs will be formulated in the course of a series of the BMCG meetings held in the financial year 2007.

A full-scale Plan of Operations (PO) is a detailed project implementation plan containing various project management factors including scope, time, human resource, quality, procurement and cost. The preliminary POs are drafted and the full-scale Pos will be formulated in consultation with each working group of the BMCG.

Proposal for Organizational Structure Needed for Optimum Bridge Maintenance

The ultimate goal of the institutional reform is to establish the regular and proper maintenance system of the nation-wide 1,350 bridges on the national highway network by streamlining the functions of MOPT and CONAVI as well as selecting the optimum organizational model. In order to achieve this ultimate goal, the ideal organizational structure to properly maintain the current number of bridges based on the following conditions.

(i) The ideal organizational level should be achieved within 5 years based on the step-by-step improvement of the current organizational structure.

(ii) The functions of the bridge maintenance practices are streamlined between MOPT and CONAVI.

(iii) The direction of bridges of MOPT will be responsible for the upstream of the bridge maintenance such as inspection and planning, while the proposed bridge construction department of CONAVI will be responsible for the downstream such as rehabilitation and repairs.

(iv) The scheduled inspection of 350 bridges on the primary and secondary level highway network will be conducted in every 5 years in the rotating manner.

(v) The detailed inspection as well as the rehabilitation and reinforcement of 50 bridges will be carried out in every 5 years.

(vi) The bridges which are seriously damaged and urgently rehabilitated will be treated

within 5 years.

As a primary entry point of the capacity gap assessment and the core member of the BMCG, the bridge design department of MOPT is subject to be promoted to the direction of bridges from the financial year 2007. Taking advantage of this strong momentum, the ideal organizational structure as well as the number of staff required for the proposed organization is estimated. A project-type organization which consists of 6 departments and regional offices headed by a director is proposed. The total number of the required staff and workers is calculated at 36 in the financial year 2008 and at 58 in the financial year 2012, respectively.

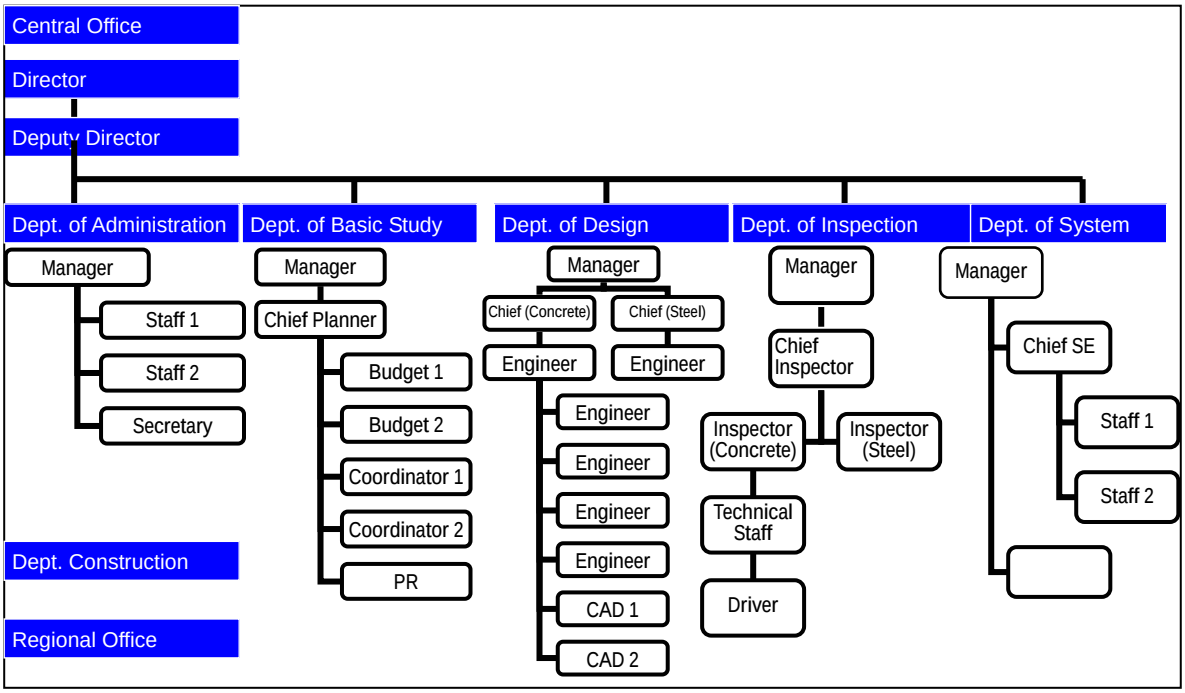


Figure.6.1. Proposed Organizational Structure of Direction of Bridges of MOPT

Juxtaposed with the direction of bridges of MOPT, the ideal organizational structure as well as the number of staff required for the proposed department of bridge construction of CONAVI together with its regional offices is estimated. The total number of the required staff should be increased to 14 in the financial year 2008 from 38 in the financial year 2012.

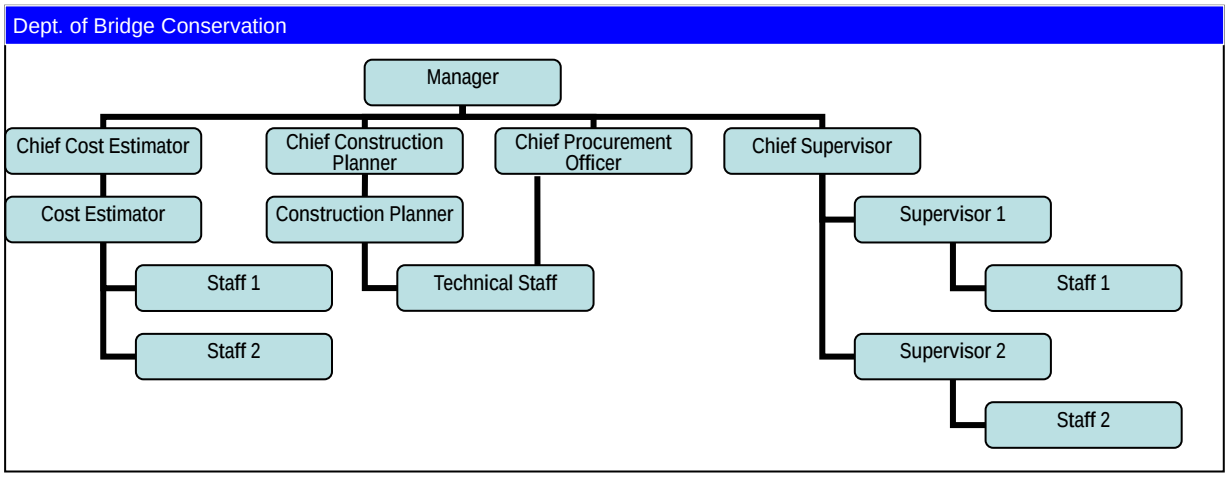


Figure.6.2. Proposed Organizational Structure of New Department of Bridge Conservation of CONAVI

According to this budget request for the financial year 2007, MOPT is allocating the budget for the total operating cost excluding construction costs at 277,690 Thousand Colones, which is only 75.1 percent of the total budget required for the basic organizational operation of the direction of bridges of MOPT.

Monitoring and Evaluation for Implementation of Capacity Development

Since capacity development is a continuous process of capacities at individual, organizational, institutional and social levels, the monitoring and evaluation of the process contributes to further improvement of the capacity development. A series of the capacity development activities such as several workshops at the individual level have been already included in the course of the Study. In this connection, the preliminary monitoring and evaluation activities have been conducted in an attempt to improve the activities after the termination of the Study.

The results of the evaluations at the early stage of the capacity development are rather satisfactory in terms of the individual capacity level as shown below. Since the inputs during the study period focus on the human resources development, especially trial inputs such as a comprehensive evaluation based on the human resources development activities, the monitoring and evaluation is mainly related to the individual capacity level.

(i) Human resources development activities through 4 workshops on capacity development as well as 4 technical seminars on bridge maintenance technologies are continuously held during the course of the study, and the majority of the participants fully understand the contents of the workshops and seminars.

(ii) The training of 4 officials through the mission to Chili as well as the training of 2 officials in Japan greatly contributes to the basis of the capacity development targeting the officials of MOPT and CONAVI which are entry points of the capacity gap assessment.

(iii) Through the activities of drafting the manuals and guidelines, the degree of the understanding by the MOPT and CONAVI officials are considerably satisfactory, although there still remain the requirements for the improvement of actual operational skills based on more practical on-the-job basis training opportunities.

(iv) Costa Rica is one of the PPP members and in charge of the technical commission in the field of the highway network. In order to further extend the outcome of the capacity development activities in the field of the bridge maintenance to other PPP member countries, the PPP regional seminar was held in December 2006 inviting all the PPP member countries. The seminar functioned as an opportunity for Costa Rica to strongly commit itself to the implementation of the proposed capacity development activities by MOPT and CONAVI, and also contributed to the capacity building of officials of MOPT and CONAVI by providing them with opportunities to make presentations in the seminar.

(v) The information disclosure by utilizing the web site of MOPT has been conducted in conjunction with i) the outline of the Study, ii) public relations in the field of the bridge maintenance, and iii) the summary of the questions and answers in a series of stakeholders at the timings of the initial environmental examination on the repairs and rehabilitations of 10 selected bridges. Furthermore, the advertisements

through various media channels on occasions of a series of steering committees as well as the PPP regional seminar have been promoting the understanding of the society on the necessity of financial resources for the nation-wide bridge maintenance.

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal: All the bridges on the national highway network will be sustainably maintained and repaired in the long run by the trained and qualified MOPT and CONAVI staff.	By the end of the financial year 2012, all the bridges on the national highway network will be rotationally maintained and repaired in 5 years (350 bridges per annum) by the trained and qualified MOPT and CONAVI staff.	Bridge Inventory Data on BMS	The training of the ample number of the qualified staff in the relevant expertise is regarded as one of priority areas of the bridge maintenance in Costa Rica.
Project Purpose: 1. All the bridges on the national highway network will be maintained and repaired by the ample number of the qualified staff of MOPT and CONAVI who have the following appropriate expertise. 1. Inspection of Bridges, 2. BMS Management, 3. Diagnosis and Priority Selection, 4. Repair Planning, 5. Repair Works	By the end of the financial year 2012, all the bridges on the national highway network will be maintained and repaired by the ample number of the qualified staff of MOPT and CONAVI who have the following appropriate expertise. 1. Inspection of Bridges, 2. BMS Management, 3. Diagnosis and Priority Selection, 4. Repair Planning, 5. Repair Works	Bridge Inspection Records and Bridge Repair Records	Through the full operations of the trained staff, maintenance and repair works of all the bridges will be rotationally implemented.
Outcome: 1. The ample number of the qualified staff of MOPT and CONAVI who have the following appropriate expertise will be trained. 1. Inspection of Bridges, 2. BMS Management, 3. Diagnosis and Priority Selection, 4. Repair Planning, 5. Repair Works	By the end of the financial year 2012, the required number of the qualified staff of MOPT and CONAVI will be trained in accordance with the plan of operations in the following expertise. 1. Inspection of Bridges, 2. BMS Management, 3. Diagnosis and Priority Selection, 4. Repair Planning, 5. Repair Works	Work Records and Progress Reports of the Working Group 1 (WG-1)	The trained staff will be actually assigned to MOPT and CONAVI, and will keep in full operations.
Activities: The details of activities are as per the attached Work Breakdown Structure (WBS) for MP-1	Input : The details of input are as per the attached plan of operations (PO) for the Modular Project 1 (MP-1).		The candidates for the qualified staff with the relevant expertise will participate in the training opportunities.
			Pre-Conditions : 1. The budget and staff for the working group 1 (WG-1) will be guaranteed starting from the financial year 2008 in order to cover the WBS under the MP-1

PDM（illustration）

PPP Regional Seminar（held in Dec, 2006）

Chapter. 7 Human Resource Development

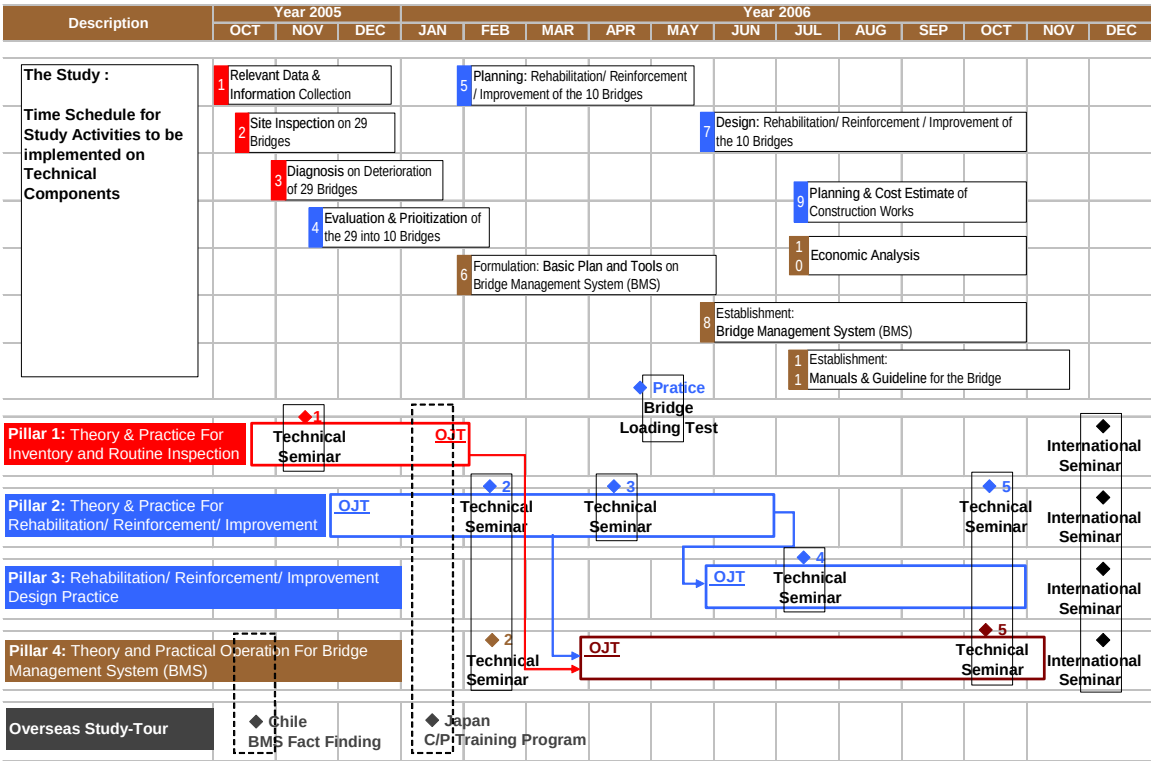
7.1 Basic Concept and Implementation Plan for Human Resource Development

Under the concept of Capacity Development (CD), Human Resource Development plays a role in the Capacity Development Program at the individual level. It is our intention that the CD Program incorporates those prior roles into the so-called modular projects and that they come into force during the process of the study. Technical training activities have been introduced and initiated aiming essentially at the counter-part technical staff at the beginning of the study, whereas the modular projects and their log-frames are examined to open up the implementation to wide-ranging target levels as a part of the CD program.

The training activities are all tried and tested and include both On-the-Job Training(OJT) and Technical Seminars aimed at enhancing Knowledge, Skill & Attitude. In addition, an Overseas Study Tour has been planned for the study, aimed at supplementing and amplifying the effectiveness of both the technical training and dissemination.

1) Technical Training program

The Technical Training program comprises 4 major technical pillars of bridge rehabilitation and maintenance, which are to be phased into the Study implementation schedule.



i) **Technical Pillar 1:** Inventory and Routine Inspection

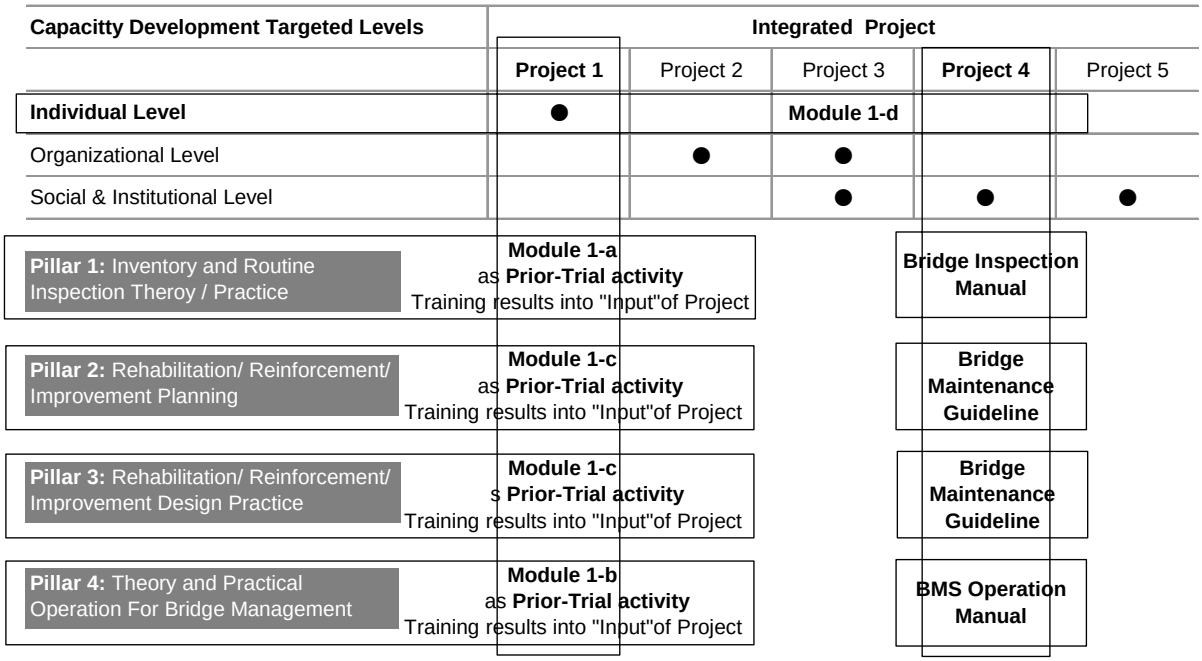
ii) **Technical Pillar 2:** Planning for Rehabilitation/ Reinforcement/ Improvement

iii) **Technical Pillar 3:** Rehabilitation/ Reinforcement/ Improvement Design practice

iv) **Technical Pillar 4:** Bridge Management System

2) Modular projects for individual competence improvement

As a part of the Program-Project-Management, four module projects at the individual level are to be incorporated into integrated projects, named Project 1 and Project 3. These will involve roll-play in Working Groups formulated under the direction of the Bridge Management Core Group. There are a total of 5 integrated projects, which include over 13 modules. The linkage and coherence between technical pillars of the training program and the 5 integrated projects of the Capacity Development program are briefly summarized in the following table.



7.2 Implemented Activities for Human Resource Development

Based on the implementation plan, a technical training program with 4 pillars has been duly carried out throughout the Study period. Details of the training activities implemented and their attainments are stated below.

1) Technical Pillar-1

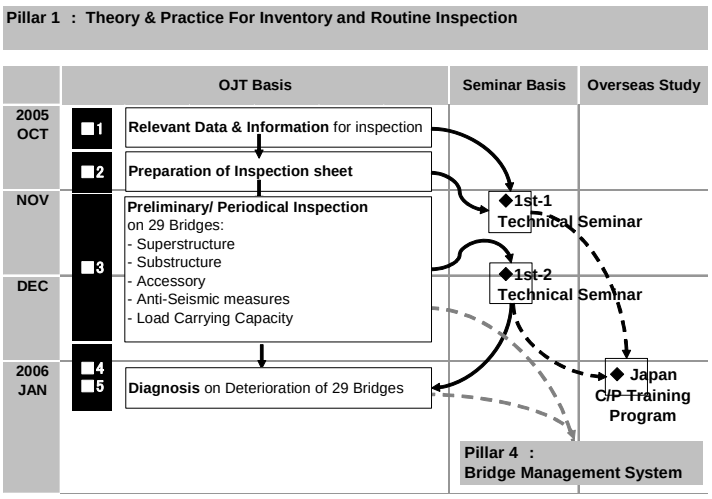
■**1** Relevant Data & Information for inspection

■**2** Preparation of Inspection sheet

■**3** Preliminary/ Periodical Inspection

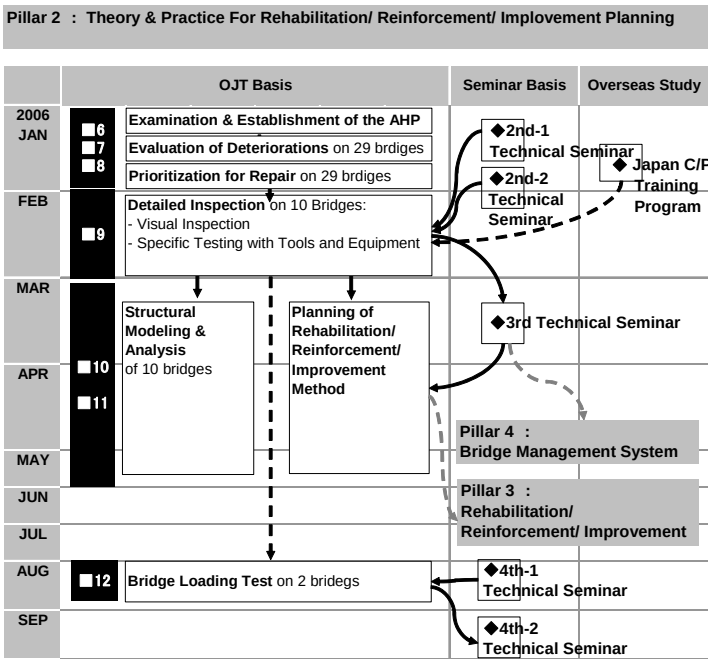
■**4** Diagnosis on Deterioration of 29 Bridges

■**5** Examination method with inspection results



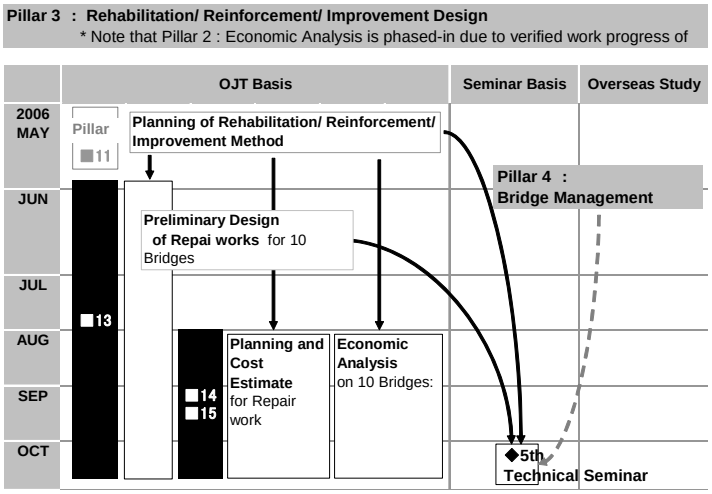
2) Technical Pillar-2

■6 Examination & Establishment of the AHP
■7 Evaluation of Deterioration
■8 Prioritization for Repair
■9 Detailed Inspection
■10 Structural Modeling & Analysis
■11 Planning of Rehabilitation/ Reinforcement/ Improvement Method
■12 Bridge Loading Test



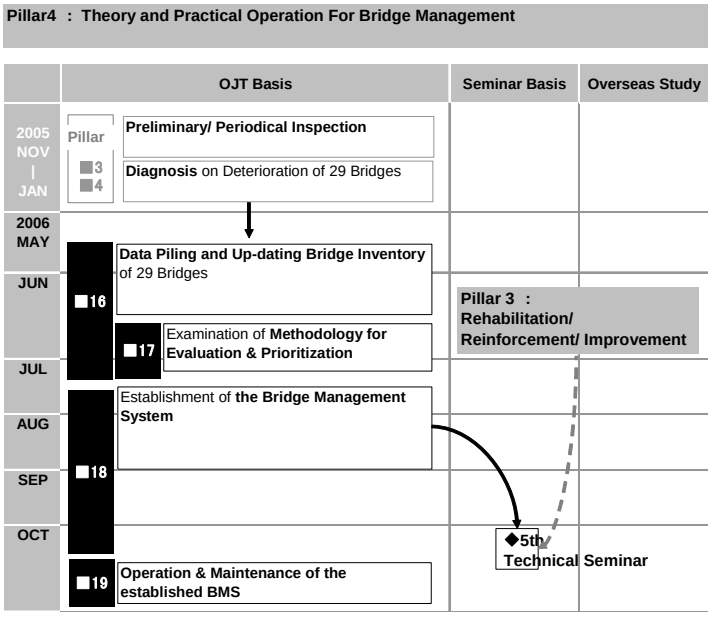
3) Technical Pillar-3

■13 Preliminary Design of Repair works for 10 Bridges
■14 Planning and Cost Estimate for Repair works for 10 Bridges
■15 Economic Analysis for 10 Bridges:



4) Technical Pillar-4

■16 Data compiling and Up-dating Bridge Inventory of 29 Bridges
■17 Examination of Methodology for Evaluation & Prioritization
■18 Establishment of the Bridge Management System
■19 Operation & Maintenance of the established BMS



5) Overseas Study Tour:

Fact-finding Study of Bridge Management System in Chile

A study similar to this one was implemented with Japanese aid from 1991 to 1993 in Chile. In order to take full advantage of the results of this previous study and to promote a common understanding for the direction and result of this Study, four study team members including the interpreter, five staff members including three bridge engineers from MOPT and CONAVI from Costa Rica, visited Chile to examine the current status of this study, its implementation framework, and how some issues have been dealt with etc.

JICA Counterpart Training Program in Japan

A JICA Counterpart training program has taken place as a part of the study, which assists in the practical learning about Japan's bridge maintenance. It is aimed at supplementing and amplifying the effectiveness of both the technical training and dissemination of technical know-how. The course program was to comprise a wide variety from concept comprehension of asset management, particularly bridge maintenance, to a specific case study of bridge rehabilitation/ reinforcement work as well as learning about the practical use of inspection instruments and undergoing site-visits. The programs were implemented throughout the training period through both lectures and "hands-on" practice. The engineers have duly been certified as having finished the entire program with undergoing cumulative and have benefited from the cumulative experiences.

6) Puebla-Panama Plan International Seminar

MOPT/CONAVI-JICA are all aware of the importance of the Puebla-Panama Plan (PPP) for the development of strategies that allow the transformation and updating of the eight countries included in the Plan. Through this initiative, that will contribute to the integration and sustainable development of the Mesoamerican Region, it has been considered appropriate to organize an International Seminar, which has as the main objective to disclose and search for a mechanism to assess the results of the Study that will contribute to the development of the capacities in the planning, rehabilitation, maintenance and management of bridges in the PPP countries. The Seminar is scheduled for December 11th, 2006 in San Jose, Costa Rica.

The 8 countries of PPP each despatched two personnel who are in charge of Road Infrastructure Services including specifically Maintenance and Planning. It was requested that one technical person with expertise in bridge engineering not limited to Bridge maintenance and an administrative person with expertise in the Planning should attend.

The Seminar focused on two main themes consisting of the CD program, which the counterpart personnel shall undertake in the future, and technical aspects of Bridge Maintenance. A session using largely presentations but incorporating a workshop was planned. All sessions are initially conducted by the Counterpart's Engineers and Personnel so that the Study team performs the role of technical advisors.